Republic of Kosovo
Ministry of Environment, Spatial Planning and Infrastructure

Republic of Kosovo
Capacity Development Project for Air Pollution Control
Project Completion Report

August 2021

Japan International Cooperation Agency (JICA)

SUURI-KEIKAKU CO., LTD.
JFE Techno-Research Corporation

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Ministry of Environment, Spatial Planning and Infrastructure

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Executive Summary

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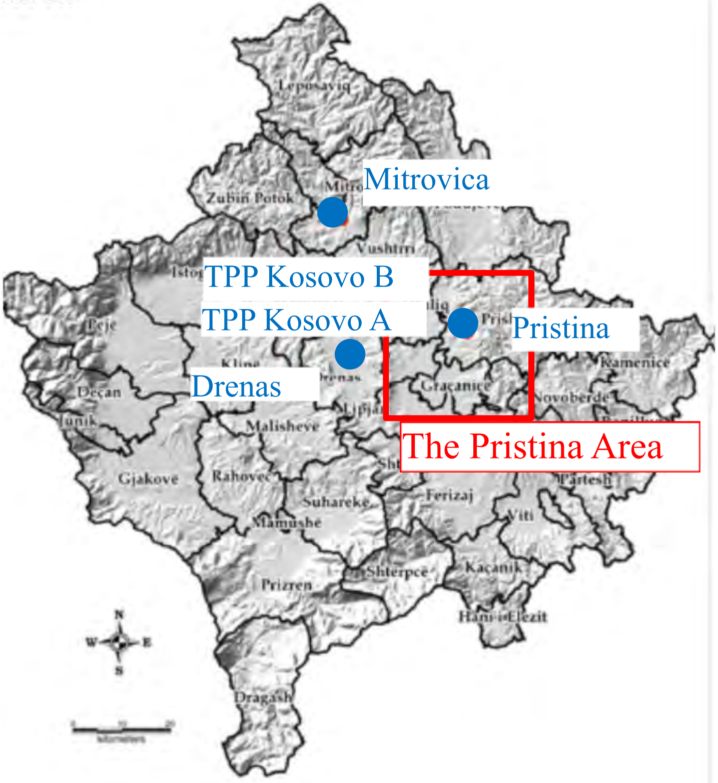
Location of the Project

Project Target Area



Executive Summary of Project Completion Report

1. Background of the Project

Republic of Kosovo (hereinafter referred to as "Kosovo") is highly dependent on low quality lignite produced indigenously and wood fuels as a major energy source for power generation, heating, etc. Because of this, air pollution in urban areas has become a serious environmental problem and its effect on human health is a major concern.

Kosovo is pursuing the goal of accession to the European Union (hereinafter referred to as "EU"). In this process, Kosovo concluded the Stabilization and Association Agreement (hereinafter referred to as "SAA") on October 27, 2015, and compliance with the EU environmental standards is needed in air quality management field. At the same time, Kosovo is one of the contracting parties of the Energy Community Treaty[1] (hereinafter referred to as "EnCT") regarding the formation of the energy market in Southeast Europe (signed on October 18, 2007, preceded by SAA), and is in the position where Kosovo must respond to the requirement by the EnC[1] on the compliance with the Emission Limit Values (hereinafter referred to as "ELVs") from Large Combustion Plants (hereinafter referred to as "LCP"). Therefore, Ministry of Environment, Spatial Planning and Infrastructure[2] (Former Ministry of Environment and Spatial Planning, hereinafter referred to as "MESPI/MESP") has been tackling for legislations, development and implementation of relevant plans for air quality management, and the compliance of emissions from LCPs in accordance with the EU Directives.

Kosovo is required to comply with the ambient air quality standards of the EU, but the situation is lacking behind in this aspect. Industries including LCPs, household heating and vehicle emission in Pristina and its vicinity are suspected to have a considerable impact on the ground level air quality in the Pristina area. However, no steps have been undertaken for these emissions to be assessed systematically and no concrete measures have been planned. Therefore, in order to study these issues, it is necessary to assess the air quality through accurate air quality data, to acquire the actual data from emission sources, and to plan concrete measures through the study of emission inventory preparation and air quality simulation.

On the other hand, Kosovo submitted the final National Emission Reduction Plan[3,4] (hereinafter referred to as "NERP") regarding the compliance with ELVs from LCPs requested by EnC in May 2018, and its implementation is needed. NERP requires for Dust, SO_2 and NO_X from LCPs to satisfy the ELVs of the EU Directive on LCP. In order to study emission reduction measures, it is required to know the property of exhaust gas from LCPs. However, neither business operators nor MESPI/MESP

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[1] EnCT is the treaty aiming at disseminating a sound and fair energy market in European Union (EU) to neighboring countries hoping for participation to EU including Southeast Europe. Energy Community (EnC) is playing a role to promote EnCT.

[2] At the staring time of the Project, it was the Ministry of Environmental and Spatial Planning (MESP), but in March, 2021, MESP was integrated with Ministry of Infrastructure (hereinafter referred to as "MESPI/MI") and has become Ministry of Environment, Spatial Planning and Infrastructure (MESPI/MESP).

[3] "DIRECTIVE 2001/80/EC" and "DIRECTIVE 2010/75/EU" stipulates ELVs. NERP is defined in "DECISION OF THE MINISTERIAL COUNCILOF THE ENERGY COMMUNITY" 24 October 2013, which explains migration method of ELVs for LCP from "DIRECTIVE 2001/80/EC" to "DIRECTIVE 2010/75/EU". The details are explained in "POLICY GUIDELINES on the Preparation of National Emission Reduction Plans PG 03/2014/19 Dec 2014".

[4] NERP is adapted by the Government with Decision No.12/49 date 29.05.2018.

had this capability, and MESPI/MESP strongly demanded this capacity development. In addition, MESPI/MESP requires this technology in order to audit a wide range of other stationary sources as part of the air environmental administrative measures. At the same time, capacity development for the study of emission reduction measures was required.

The objective of the “Capacity Development Project for Air Pollution Control in the Republic of Kosovo” (hereinafter referred to as “the Project”) is aiming at enhancing capacities of the MESPI/MESP, its relevant organizations and agencies for air pollution control measures, thereby contributing to planning and implementing more efficient air emission reduction measures for Public health protection and environmental management-related policy development in Kosovo. The Project especially enhances the ability to cope with the two issues that Kosovo faces (establishment of the foundation for air quality control and implementation of the NERP).

2. Description of the Project

Overall goal, project purpose, and expected outputs of the Project are as follows.

Overall goal

Kosovo side develops capacities for sound air pollution control and air quality management based on technical evidence.

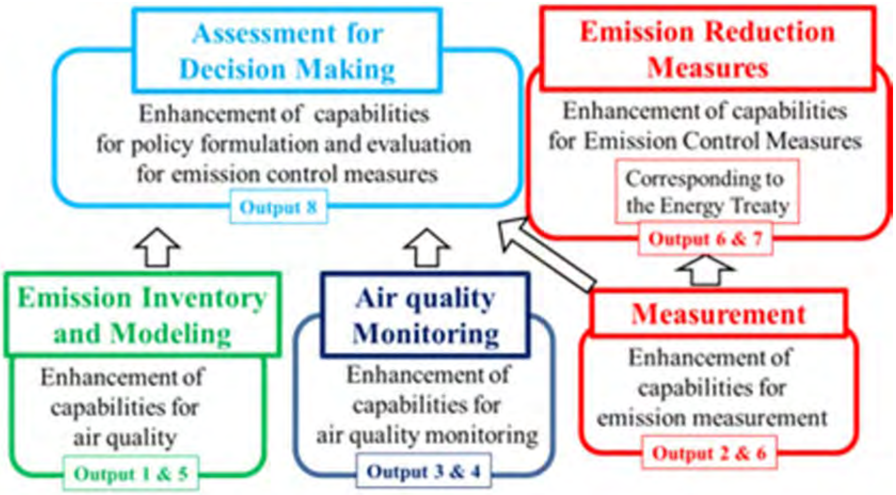
Project purpose

Kosovo side technical capabilities are developed to control emission sources in the Project target area.

Expected outputs

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.
Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.
Output 3: Air quality monitoring activities are sustained
Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.
Output 5: Capabilities for air quality simulation modeling are developed.
Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.
Output 7: Emission control measures are developed at LCPs.
Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

The following figure shows the structure of the Project activities regarding the expected outputs.



Structure of the Project regarding expected outputs

As shown in the figure, the achievement of outputs needs for C/Ps to learn and acquire technical elements such as emission inventory and modeling (Output 1 and 5), air pollution monitoring and laboratory analysis technology (Output 3 and 4), and exhaust gas measurement and emission reduction measures (Output 2, 6 and 7). Based on these outputs, Assessment for Decision making (Output 8) was carried out, which assists in the capacity development of the Kosovo side.

The Project aimed to establish the air quality management cycle shown in the figure below by carrying out activities in eight Outputs in the process of achieving the overall goal and Project purpose.

Air Quality Management Cycle

Achievement of each output will not only contribute to the establishment of the air quality management cycle but will also support the building of a mechanism for sustainable implementation of air pollution control measures. In addition, it will assist in the strengthening of the coping capacity for two issues which Kosovo is facing.

In Kosovo, the concern for air quality is rapidly increasing in recent years. In the winter season, the media is frequently referring to the air pollution problem in the Pristina Area, and the Kosovo government is in the situation that it cannot provide sufficient information on air quality to the public.

The cooperation with citizens is indispensable for the implementation of air pollution control measures, and therefore, the Project paid attention to provide timely information to the citizens based on the technical evidence through the activities such as securement of the sustainable air quality data, provision of the information of the emission condition from stationary sources, analysis of the air quality by emission inventory preparation and air quality simulation, etc.

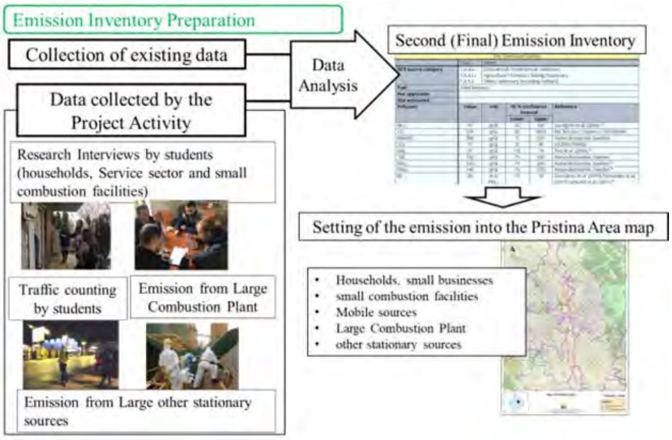
3. Project activities and achievements

The Project was implemented in three periods. The first period was from October 2017 to August 2018. The second period was from October 2018 to August 2019. The third period started from October 2019 and ended in June 2021 with the extension of the period due to the effect of Coronavirus 2019 (hereinafter referred to as "COVID-19").

Emission Inventory and Modeling (Output 1 and 5)

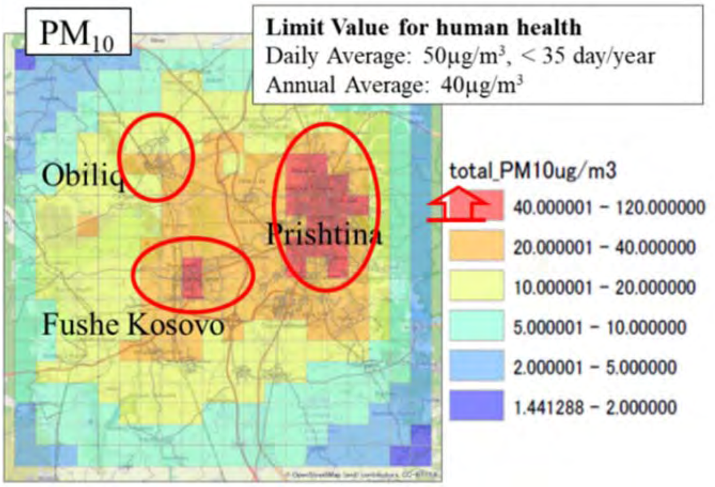
In order to improve air quality, it is efficient to take the following steps. The Steps are to assess the contribution of each emission source to air pollution, to plan measures, to prioritize and implement measures. For assessment of contribution and each measure, it is very effective to prepare emission inventory and carry out dispersion simulation model.

Emission inventory preparation needs various data. In the first period, the Project collected existing data as well as data of actual fuel consumption and traffic condition through field researches such as research interviews with households, businesses and small combustions, traffic volume counting, etc. in cooperation with students from the University of Prishtina. In the second period, collected data were analyzed and organized together with the emission data from LCPs, etc. In the third period, data was added through a further collection of existing data and research interviews by students, and they were reflected in the final emission inventory.



Emission Inventory preparation

The simulation was the technology introduced for the first time in Kosovo. Therefore, in the first period, the Project lectured on the overview, the purpose, method of utilization, etc., and collected geographical data, land use data, meteorological data, etc. through discussion with C/Ps. In the second period, based on the data from emission inventory, training for preparation, implementation and confirmation of the results of the simulation program was carried out. In the third period, based on the final emission inventory, the final simulation was implemented.



Simulation result of PM_{10}

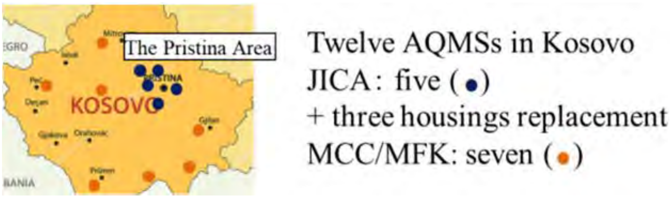
The simulation must be validated by comparing the results with the air quality data, but due to lack of the reliability of the past data, the comparison could not be done, which remained as a future issue. However, the results suggested that household heating may have a large contribution to PM_{10} pollution in urban areas.

Through these activities, C/P (mainly Department for Environmental Protection and Water / Division for Industrial Pollution Management (hereinafter referred to as “DEPW/DIPM”) and Kosovo Hydro-meteorological Institute (hereinafter referred to as “KHMI”) learned the process of emission inventory preparation and simulation implementation.

Air Quality Monitoring (Output 3)

Air quality data is the base for all studies such as understanding of air status, study on air control measures, etc. and therefore, the provision of accurate air quality data is indispensable.

JICA, in cooperation with the Millennium Challenge Corporation Millennium Foundation Kosovo (hereinafter referred to as “MCC/MFK”), rehabilitated analyzers in twelve Air Quality Monitoring Station (hereinafter referred to as “AQMS”) all over Kosovo. The following figure shows the sharing of the work. JICA rehabilitated analyzers in five AQMSs in the Pristina Area and upsized three out of five AQMS housings which improved the maintenance of analyzers.



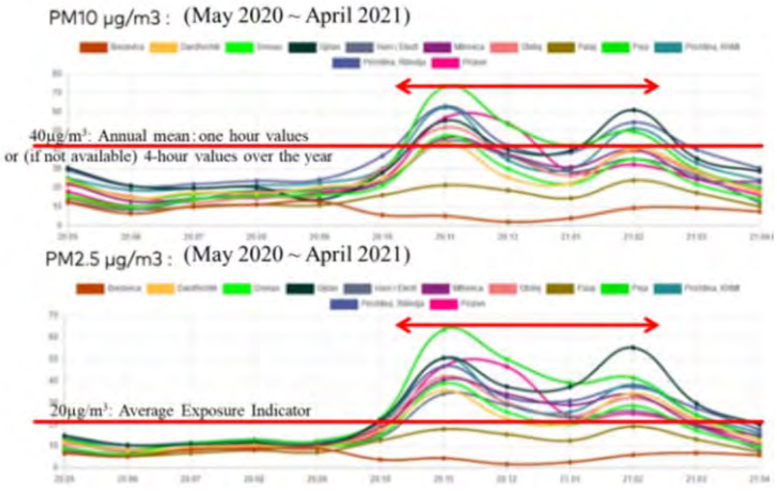
Sharing of the work on analyzer rehabilitation

As for the air quality data network, MCC/MFK constructed the network for all AQMSs, since the Kosovo side requested its own independent network. On the other hand, JICA installed the four air quality data displays in the city of Prishtina and one in Obiliq and strived to provide information and raise public awareness.

Air quality data displays

Rehabilitation of analyzers and establishment of the air quality data network was completed in November 2019, and the Kosovo side acquired the data collection system. The following figure shows the PM_{10} and $PM_{2.5}$ behavior after the completion of the work, and the figure says that in many cities the values of PM_{10} and $PM_{2.5}$ exceed the annual standard values.

JICA, as other activities, carried out training for Operation and Maintenance (hereinafter referred to as “O&M”) of analyzers, provision of O&M manuals and training for environmental emergency case measurement, and studied and proposed the optimum placement of AQMSs in Kosovo.



Behavior of PM_{10} and $PM_{2.5}$

<u>Laboratory Analysis and Heavy Metal Analysis in Particulate matter (</u><u>hereinafter referred to as</u> **<u>“PM”) (Output 4)</u>**

Around 2012, five analyzers were introduced to KHMI from the EU, but only the Atomic Absorption Spectrometer (hereinafter referred to as “AAS”) was under operation. In the Project, Ion Chromatograph (hereinafter referred to as “IC”) was re-functionalized for conducting analysis of exhaust gas by the Standard Reference Method[5] requested by the EU directive and the Inductively Coupled Plasma Mass Spectrometer (hereinafter referred to as “ICP-MS”) was adjusted to be able to analyze heavy metals in PM in the air.

EU directive requests analyses of SO_X, NO_X and Hg in exhaust gas from LCPs by Standard Reference Method. The Project conducted analyses by using IC for SO_X and NO_X, and AAS for Hg, and the analysis technologies were transferred. However, there remained issues that technologies are not sufficiently used and furthermore, the quality control system for analysis is not organized.

As for heavy metal monitoring in PM in the air, PMs were sampled in Drenas and Mitrovica and heavy metal contents in PMs were analyzed in Japan. As a result, in Drenas, nickel exceeded the Japanese guideline value, and in Mitrovica, Manganese and arsenic exceeded those guideline values too. Therefore, the Kosovo side decided to continue with the monitoring. However, these results were spot analyses, and therefore, it is necessary to conduct a final evaluation by calculating annual average values through several analyses a year. It is expected that the training by MCC/MFK will enable the KHMI staff to operate ICP-MS and analyze heavy metals.

Measurement and Emission Reduction Measures (Output 2, 6 and 7)

Exhaust gas measurement is the only mean to evaluate actual emission condition from stationary sources and to judge the compliance of emissions, and it is indispensable to regulate emissions. At the same time, in order to promote compliance with ELVs, it is essential to study emission reduction measure based on the exhaust gas measurement results.

Exhaust gas measurement succeeded from the Precedent Activities[6]. Through the Project period, the Project supported the exhaust gas measurement of SO_2, NO_X, and Dust by the Kosovo side through On-the-Job-Training (hereinafter referred to as “OJT”) at Thermal Power Plants (hereinafter referred to as “TPP”) Kosovo A, TPP Kosovo B, and other stationary sources. Through these activities, the Kosovo side acquired exhaust gas measurement technology.

Photo-2 Exhaust gas measurement

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[5] European Committee of Standardization (hereinafter referred to as “CEN”) stipulates standards in EU so called EN Standards. EN Standard stipulates analysis methods for exhaust gas, so called Standard Reference Method. EN standards are equivalent to Japanese Industrial Standard (hereinafter referred to as “JIS”) in Japan.

[6] “Expert for Air Pollution Control” (2015) and “Planning Survey for Capacity Development project for Air Pollution Control in Republic of Kosovo” (2016)

As for emission reduction measures for LCPs, only TPP Kosovo A has been studied as a request by the Kosovo side. In order to study the emission reduction measures, along with the exhaust gas measurement, detailed operation data of boilers was recorded, and lignite and fly ash were sampled and analyzed. Through these activities, the Project proposed the Dust reduction measures which are presumed to be the causes of the efficiency drop in Electrostatic Precipitator (hereinafter referred to as “ESP”) performance. The measures were the improvement of gas flow distribution inside the ESP, the introduction of the intermittent energization control and the reduction of exhaust gas flow rate. TPP Kosovo A accepted the proposal and decided to implement the measures. The ESP inlet modification for the improvement of gas flow distribution was applied to one of the ESP, at the same time the exhaust gas flow rate reduction was applied experimentally, and sufficient Dust reduction was confirmed. However, the introduction of the intermittent energization control is still pending due to the effect of COVID-19. In the near future, it is expected that the ELV for Dust will be met by applying the modification of the ESP inlet for all ESPs, introducing the intermittent energization control, and establishing the reduction of exhaust gas flow rate through the operation improvement. The improvement of gas flow distribution inside the ESP is a result of industry-academy-government cooperation, and it became one of the large outcomes of the Project. As for the reduction of SO_2 and NO_X, the Project proposed concrete emission reduction measures, but measures will be not realized due to the limitation on the investment since TPP Kosovo A is scheduled to stop.

In the second and third periods, for four other stationary sources, the Project studied the facility flows and fuel consumption conditions and conducted measurements. In three out of four sources, some pollutants were found to exceed ELVs, and emission reduction measures were proposed. From these facts, it is presumed that many other stationary sources do not comply with ELVs, and strengthening of the compliance with regulations is found to be a big future issue.

Assessment for Decision Making (Output 8)

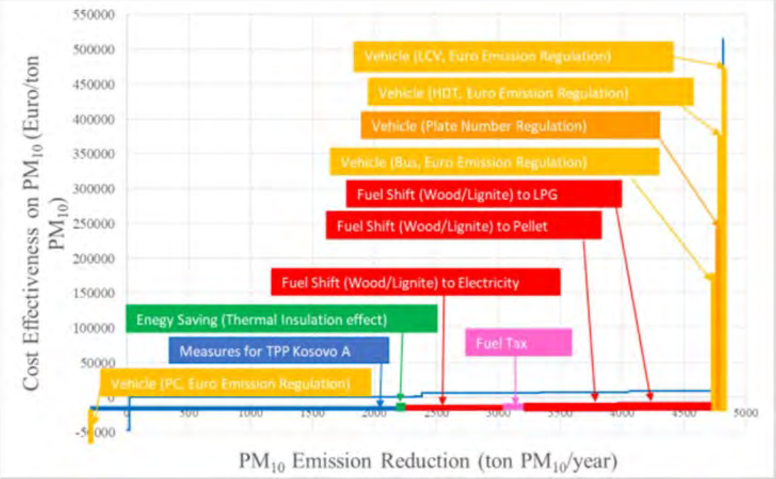
As for the evaluation of pollution control measures, the Project, based on the Strategy and Action Plan on Air Quality, and information from each output, concretized and evaluated the measures.

In the third period, based on the information from other outputs, the Project selected eight concrete measures shown in the Table below and evaluated cost, effect, etc. based on technical evidence. The results were summarized in the evaluation sheet.

	Measures			
Field	Fuel Shift	Energy preservation	Vehicles	LCPs
Case study	• From wood fuel/lignite to wood pellet • From wood fuel/lignite to wood Liquid Petroleum gas (LPG) • From wood fuel/lignite to electrical power • Fuel tax to industries	• Improvement of household thermal insulation	• Replacement of all vehicle to those meeting Euro-3 Emission Regulation and higher • Introduction of the restriction on vehicles entering the urban area of Pristina by the plate number classification	• TPP Kosovo A: Application of emission reduction measures proposed by the Project, TPP Kosovo B: emissions after the rehabilitation by EU

Studied air pollution control measures

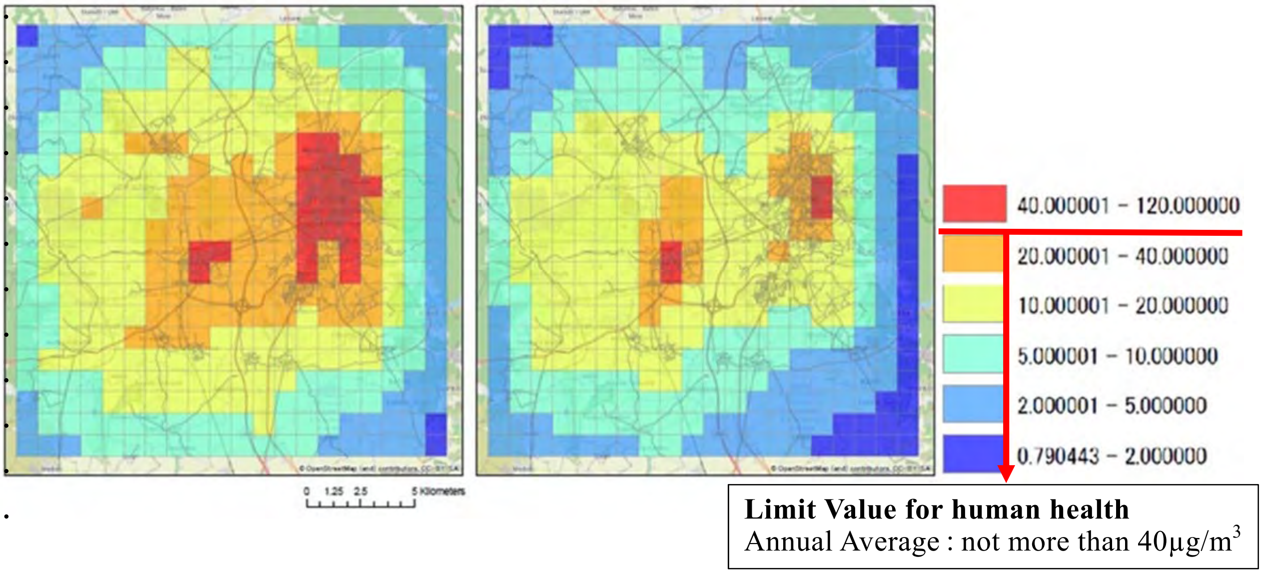
In the evaluation sheet, emission reduction amount, cost, etc. were evaluated for each measure. The following figure shows the relation between the reduction amount and necessary cost for PM_{10}.



Relation between emission reduction amount and necessary cost

A concrete example of before and after the studied measures is shown below by use of emission inventory and modeling technology, in which the following measures are applied.

- Fuel Shift (From Wood and Lignite to wood pellet)
- Energy saving (Improvement of thermal insulation effect for residential houses)
- Measures for transport (Introduction of Euro Emission Regulation for vehicles)
- Improvement of TPP Kosovo A and TPP Kosovo B



Limit Value for human health
Annual Average : not more than 40µg/m^3

Before the implementation of the measures After the implementation of the measures

Concentration map of PM_{10} with application of all the measures mentioned above

As shown in the figure, when all aforementioned measures are applied, the area which meets environmental standard expands to a considerable extent. However, not all areas in the center of the city of Pristina and Fushe Kosovo meet the environmental standard. The map suggests that more measures are required in order to meet the environmental standard in the Pristina area.

Through the activity, the Kosovo side (mainly DEPW/DIPM and KHMI) has learned the process of studying, planning and evaluating measures. It is expected that they will study measures by utilizing the method that they have learned, and apply them to Action Plans, etc.

Project Purpose and Overall Goal

As for the Project purpose, the Project targeted the Pristina Area and strengthened the technical capacity for air quality management of the Kosovo side in the three fields that are emission inventory and modeling, air quality monitoring and measurement and emission reduction measures. This enabled the activity of Assessment for Decision Making (the fourth field), and the capacity for proposal and evaluation of air pollution control measures was enhanced. Through these activities, the Project purpose is achieved.

As for the Overall Goal, the Project supported the Kosovo side for the establishment of the information collection system regarding air pollution as mentioned above and the proposal and evaluation of air pollution control measures. These activities contribute to the enhancement of coping capacity with the planning of viable air pollution control measures and the establishment of air quality management.

4. Issues remained, Recommendations and Requests

As mentioned above, the Project has gained the aforementioned achievements, and reached the original goal. However, the following issues remained although the Project should have dealt with them in its activities. At the same time, as the activities necessary for future sustainability and self-development, recommendations by JET and requests from the Kosovo side were indicated.

Emission Inventory and Modeling (Output 1 and 5)

Emission inventory and modeling are very useful tools for studying and evaluating air pollution control measures. In the Project, the technology of emission inventory and simulation was transferred, and the Kosovo side has acquired the capacity to conduct these activities.

However, the establishment of the institutional framework for emission inventory and simulation such as clarification of roles and responsibilities, etc. in order for these activities to be sustainable remain as an issue, and validation of simulation results remains as another issue too.

Furthermore, for emission inventory, the JET recommended the improvement of data quality, expansion of target pollutants, the establishment of cooperation with academia, etc., and for simulation, improvement of data collection for meteorological conditions, especially for high altitudes. On the other hand, the Kosovo side requested support for the preparation of the national emission inventory, drafting of local action plans by municipalities, etc.

Air Quality Monitoring (Output 3)

As for air quality monitoring, in November 2019, rehabilitation of analyzers and establishment of the data network for all AQMSs were completed, and the Kosovo side has become able to acquire accurate air quality data.

However, the securement of the maintenance system for analyzers, the establishment of the data management system for assurance of data, and the enhancement of analysis capability of air quality data remain as issues.

Furthermore, JET recommended the acquisition of air quality analysis technology at locations without AQMSs. On the other hand, the Kosovo side requested the rehabilitation of the mobile air quality station, the support for installation of new AQMSs, etc.

Laboratory Analysis and Heavy Metal Analysis in Particulate matter (PM) (Output 4)

In the Project, IC and ICP-MS were re-functionalized. Through IC operation, the Kosovo side has acquired analysis technology for LCPs by Standard Reference Method. As for ICP-MS, it was rehabilitated and it is available to analyze heavy metals in the air, and now its operation is waiting for the training by MCC/MFK. As for heavy metal monitoring in PM in the air, it was found that it is necessary to continue monitoring in Drenas and Mitrovica.

However, for laboratory analysis, the continuous use of IC and ICP-MS, and the establishment of laboratory management systems remain as issues, and for heavy metal monitoring, the continuation of monitoring activity remains as an issue too.

Furthermore, JET recommended the improvement of analysis technology through more frequent use of IC and ICP-MS, the establishment of a quality control management system for analyses, research for $PM_{2.5}$ emission source, etc. On the other hand, the Kosovo side requested re-functionalization of the Gas Chromatography Mass Spectrometer, but JET's opinion is that it is too early to carry this out.

Measurement and Emission Reduction Measures (Output 2, 6 and 7)

As for exhaust gas measurement, C/P learned series of works and became able to conduct measurements independently

As for emission reduction measures for LCPs, C/P have not only learned the process of studying improvements but also implemented the Dust reduction measures.

As for other stationary sources, the Project conducted measurements for four facilities and found the cases of exceedance of ELVs. For these cases, the emission reduction measures were proposed. For private facilities in Kosovo, it is presumed that measurement and reporting of exhaust gas have not sufficiently prevailed, and in addition, officials in the MESPI do not have sufficient capacity to understand the measurement results.

The issues remained are the dissemination of exhaust gas measurement and reporting by full use of measurement technology and the strengthening of instruction capacity through the enhancement of knowledge and capacity of the MESPI officials.

The issues of TPP Kosovo A are the application of the improvement of gas flow distribution inside the ESP, and the introduction of the intermittent energization control to all ESPs.

Furthermore, the JET proposed the evaluation of the performance of heating equipment using solid fuels by the use of exhaust gas measurement technology, the emission measurement from vehicles, etc.

Assessment for Decision Making (Output 8)

The Kosovo side (mainly DEPW/DIPM) evaluated eight concrete measures based on achievements from other outputs, by using examples learned in the training in Japan as references.

JET recommended preparing future scenarios, establishing a mechanism for information exchange and implementation structure of the measures, etc. for the development of the Action Plan in the future. On the other hand, the Kosovo side requested support for drafting the National Emission Ceilings (NEC), studying measures that target the whole of Kosovo, etc.

Issues remained, recommendations and requests were summarized as mentioned above. However, some activities cannot be carried out without reinforcement with staff. It is necessary to prioritize activities taking into consideration the reinforcement of staff.

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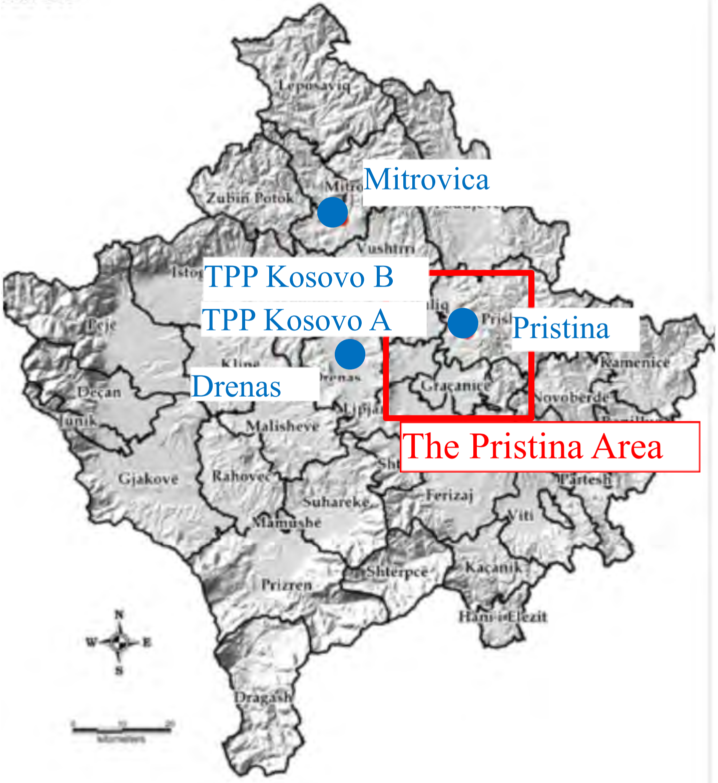

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Acronyms and Abbreviations

Abbreviation	Formal Nomenclature
AA	Accreditation Agency
AAS	Atomic Absorption Spectrometer
AFOLU	Agriculture, Forestry, and Other Land Use
AI	Administrative Instruction
AQI	Air Quality Index
AQMS	Air Quality Monitoring Station
CA	Capacity Assessment
CD	Capacity Development
CEMS	Continuous Emission Monitoring System
CEN	European Committee of Standardization
CFD	Computational fluid dynamics
CO	Carbon monoxide
COVID-19	Coronavirus Disease 2019
C/P	Counterpart
C/P-WG	Counterpart Working Group
DEPW (MESPI/MESP)	Department for Environmental Protection and Water
DEPW /DIPM (MESPI/MESP)	Division for Industrial Pollution Management
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ELVs	Emission Limit Values
EMEP/EEA Guidebook	EMEP/EEA (European Monitoring and Evaluation Programme /European Environment Agency) air pollutant emission inventory guidebook 2016
EnC	Energy Community
EnCT	Energy Community Treaty
ESP	Electrostatic Precipitator
EU	European Union
FS	Feasibility Study
GC-MS	Gas Chromatography Mass Spectrometry
GHG	Green House Gas
GIS	Geographic Information System
HDV	Heavy Duty Vehicle
IC	Ion Chromatograph
ICP-MS	Inductively Coupled Plasma Mass Spectrometer
IPCC	International Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control (Law No. 03/L-043)
IPPU	Industrial Process and Product Use
ISP (MESPI/MESP)	Institute for Spatial Planning
IT	Information Technology
JCC	Joint Coordinating Committee
JET	JICA Expert Team

JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standard
KCA (MESPI/MESP)	Kosovo Cadastral Agency
KEK	Kosovo Energy Corporation
KEPA (MESPI/MESP)	Kosovo Environmental Protection Agency
KHMI (MESPI/MESP)	Kosovo Hydro-meteorological Institute
TTP Kosovo A	Kosovo A Thermal Power Plant
TTP Kosovo B	Kosovo B Thermal Power Plant
Kosova e Re	New Thermal Power Plant
KSA	Kosovo Statistics Agency
LCP	Large Combustion Plant
LCV	Light Commercial Vehicle
LHV	Lower Heating Value
LPG	Liquid Petroleum Gas
MCC/MFK	Millennium Challenge Corporation/ Millennium Foundation Kosovo
MESPI	Ministry of Environment, Spatial Planning and Infrastructure
ME/MED	Ministry of Economy (Former Ministry of Economic Development)
MESPI/MESP	Ministry of Environment, Spatial Planning and Infrastructure (Former Ministry of Environment and Spatial Planning)
MESPI/MI	Ministry of Environment, Spatial Planning and Infrastructure (Former Ministry of Infrastructure)
MIAPA/MIA	Ministry of Internal Affairs and Public Administration
MIA/MPA	Ministry of Internal Affairs (Former Ministry of Public Administration)
M/M	Minutes of Meeting
MOU	Minutes of Understanding
MITE/MTI	Ministry of Industry, Trade and Entrepreneurship (Former Ministry of Trade and Industry)
NEC Directive	National Emission Ceilings Directive (DIRECTIVE (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants)
NERP	National Emission Reduction Plan
NMVOC	Non-methane volatile organic compounds
NO_X	Nitrogen oxides
NO_2	Nitrogen dioxide
O_3	Ozone
OJT	On the Job Training
O&M	Operation and Maintenance
PAH	Polycyclic Aromatic Hydrocarbon
PDM	Project Design Matrix
PM_{10}, $PM_{2.5}$,PM_1	Particulate Matter with a diameter of 10µm or less, 2.5µm or less and 1.0µm or less
PC	Passenger Car

PO	Plan of Operation
QA	Quality Assurance
QC	Quality Control
SAP	Stabilization and Association Process
SAA	Stabilization and Association Agreement
SIDA	Swedish International Development Cooperation Agency
SDGs	Sustainable Development Goals
R/D	Record of Discussion
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
TPP	Thermal Power Plant
TSP	Total suspended particulates
USEPA	United States Environmental Protection Agency
UP	University of Prishtina
VOC	Volatile Organic Compounds
VM	Volatile Matter
WBS	Work Breakdown Structure
WOM	Without Measures
WEM	With Existing Measures
WAM	With Additional Measures
WRF Model	Weather Research and Forecasting Model

1. Description of the Project

1.1 Background of the Project

Republic of Kosovo (hereinafter referred to as “Kosovo”) is highly depending on low quality lignite produced indigenously as a major energy source for power generation, heating, etc. Because of this, air pollution in urban areas has become a serious environmental problem, and its effect on human health is a major concern.

Kosovo is pursuing the goal of the accession to the European Union (hereinafter referred to as “EU”). In this process, Kosovo concluded the Stabilization and Association Agreement (hereinafter referred to as “SAA”) on October 27, 2015. At the same time, Kosovo is one of the contracting parties of the Energy Community Treaty[1] (hereinafter referred to as “EnCT”) regarding the formation of the energy market in the Southeast Europe (signed on October 18, 2007 preceded by the SAA), and is in the position where Kosovo must respond to the requirement by the EnC[1] on the compliance with Emission Limit Values (hereinafter referred to as “ELVs”) from Large Combustion Plant (hereinafter referred to as “LCP”). Therefore, the Ministry of Environment, Spatial Planning and Infrastructure[2] (Former Ministry of Environment and Spatial Planning, hereinafter referred to as “MESPI/MESP”) has been tackling for legislations, development of relevant plans and implementation of plans for air quality management and the compliance with emissions from LCPs in accordance with the EU Directives.

Kosovo is required to comply with the ambient air quality standards of the EU, and the situation is lacking behind in this aspect. Furthermore, industries including LCPs, household heating and vehicle emission in Pristina and its vicinity are also suspected to have a considerable impact on the ground level air quality in the Pristina area. However, no steps have been undertaken for these emissions to be assessed systematically and concrete measures have been planned. Therefore, in order to study these issues, it is necessary to acquire and assess the existing condition of air through accurate air quality data and to learn technologies for planning concrete measures such as emission inventory preparation and air quality simulation. According to the census of 2011[3], Pristina urban area is inhabited by approximately two hundred thousand people (It is alleged that the day time population is more than double of the original figure). However, these aspects up to now have not been assessed based on any sufficient technical grounds. The recent air quality monitoring results in 2012 to 2014 show relatively high ambient concentration levels of PM_{10} and $PM_{2.5}$ (Particulate Matter (hereinafter referred to as “PM”) in the air). The average annual values exceed the average annual limit value of 40µg/m^3 and 25µg/m^3 for PM_{10} and $PM_{2.5}$ respectively, in almost all Air Quality Monitoring Stations (hereinafter referred to as “AQMS”) in Kosovo.

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[1] EnCT is the treaty aiming at disseminating a sound and fair energy market in European Union (EU) to neighboring countries hoping for participation to EU including Southeast Europe. Energy Community (EnC) is playing a role to promote EnCT.

[2] At the staring time of the Project, it was the Ministry of Environmental and Spatial Planning (MESP), but in March, 2021, MESP was integrated with Ministry of Infrastructure (hereinafter referred to as “MESPI/MI”) and has become Ministry of Environment, Spatial Planning and Infrastructure (MESPI/MESP).

[3] It is estimated that the daytime population could be as much as around half million including workers commuting from other regions, which may account for the magnitude of air pollution.

Regarding the SO_2 concentration in 2014, at Obiliq and Palaj which are situated nearby TPP Kosovo A and TPP Kosovo B, the average annual values are close to 20µg/m^3 which is the average annual limit value in Kosovo. Regarding the NO_2 concentration, the average annual values are within the average annual limit value of 40µg/m^3 in all AQMSs[4].

Except for PM_{10} and $PM_{2.5}$, the air pollution intensity is in general considered moderate in Kosovo. However, there seems to be a problem regarding the quality and quantity of air quality data from a concern of AQMS placement and operation and maintenance (hereinafter referred to as "O&M") condition of analyzers (provision of abnormal data caused by troubles, lack of calibration, etc. in analyzers) in AQMSs. There are questionable issues of air pollution by heavy metals in PM in the air. One is by a company (non-ferrous industry) in Drenas and another by the past industrial activities in Mitrovica, although neither condition has been assessed, due to the lack of sufficient air quality data.

Therefore, it is important for the decision makers to strengthen the technical capabilities of the concerned authorities, to utilize technical knowledge and information on air control management, and make appropriate policy decision, as well as to provide citizens affected by air pollution with correct information on air quality.

On the other hand, Kosovo submitted in May 2018 the final National Emission Reduction Plan[5,6] (hereinafter referred to as "NERP") regarding the compliance with ELVs from LCPs requested by EnC, and its implementation is needed. NERP requires for Dust, SO_2 and NO_X from LCPs to satisfy the ELVs of the EU Directive on LCP. In order to study emission reduction measures, it is required to know the property of exhaust gas from LCPs. At the same time, along with the emission reduction in line with the NERP, acquisition of exhaust gas measurement technology was required. Neither business operators nor MESPI/MESP had this capability, and MESPI/MESP strongly demanded this capacity development. In addition, MESPI/MESP requires this technology in order to audit a wide range of other stationary sources as part of the air environmental administrative measures. At the same time, capacity development for the study of emission reduction measures was required.

The major energy source in Kosovo is the abundant low quality lignite. The power generation using lignite accounts for approximately 97 %[7] of the power generated in Kosovo. On the other hand, other energy sources such as oil and gas have to be imported, which will generate a considerable financial burden on the Kosovo economy. Alternative energy options are confined. Share of the renewable energy sources such as hydroelectric power, wind-generated power, photovoltaic power, etc. are still limited and are considered as only complementary energy sources to the electric power demand in Kosovo.

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[4] Source: Report-State of the Environment 2015, the Ministry of Environment and Spatial Planning, Kosovo Environmental Protection Agency

[5] "DIRECTIVE 2001/80/EC" and "DIRECTIVE 2010/75/EU" stipulates ELVs. NERP is defined in "DECISION OF THE MINISTERIAL COUNCILOF THE ENERGY COMMUNITY" 24 October 2013, which explains migration method of ELVs for LCP from "DIRECTIVE 2001/80/EC" to "DIRECTIVE 2010/75/EU". The details are explained in "POLICY GUIDELINES on the Preparation of National Emission Reduction Plans PG 03/2014/19 Dec 2014".

[6] NERP is adapted by the Government with Decision No.12/49 date 29.05.2018.

[7] Annual Energy Balance of Republic of Kosovo 2013

More than eight million tons of lignite is combusted annually in the Kosovo LCPs (Kosovo A Thermal Power Plant (hereinafter referred to as “TPP Kosovo A”) and Kosovo B Thermal Power Plant (hereinafter referred to as “TPP Kosovo B”). Although a series of emission reduction efforts have been implemented at TPP Kosovo A and TPP Kosovo B such as improvements of Electro-Static Precipitators (hereinafter referred to as “ESPs”), the hydraulic fly ash transportation system for Dust scattering reduction, etc. it is still necessary to reduce Dust, SO_2 and NO_X emission in order to satisfy the ELVs.

As mentioned above, it is significant to support in the fields of air pollution control in order for Kosovo to implement the NERP and establish the foundation for air quality management.

Under these circumstances, Kosovo requested a short-term individual expert dispatch in 2013 to support capacity development of MESPI/MESP in the process of preparation for a roadmap to develop a NERP, and in 2014, two senior officials of MESPI/MESP participated in the JICA training program on air quality management held at Tokyo International center. In April 2015, Japan International Cooperation Agency (hereinafter referred to as “JICA”) sent a contact mission to Kosovo, and MESPI/MESP and JICA agreed to send experts including support for exhaust gas measurement technology. JICA sent three experts as an expert dispatch “Expert for Air Pollution Control”, and through the Precedent Activity[8] three experts executed exhaust gas measurement technology transfer for TPP Kosovo A and TPP Kosovo B.

For these activities to go forward, Kosovo requested a full scale JICA technical cooperation project, and JICA conducted a detailed planning survey in October and November in 2016. On March 30, 2017, JICA and Kosovo signed the Record of Discussion (hereinafter referred to as “R/D”).

1.2 Description of the project

(1) Project objective

The objective of the Capacity Development Project for Air Pollution Control in the Republic of Kosovo (hereinafter referred to as “the Project”) is to improve capacities of MESPI/MESP and its relevant organizations and agencies for harmful air pollutants management, thereby contributing to planning and implementing of more efficient air emission reduction measures for Public health protection and environmental management-related policy development in Kosovo.

(2) Project Site / Target Area

The Pristina Area, Drenas and Mitrovica

The following map shows the target area. The Pristina Area includes LCPs, and is the target area for all activities. Drenas and Mitrovica are target areas for a part of activities (Monitoring of heavy metals in the air).

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[8] Precedent Activity includes “Expert for Air Pollution Control” (2015) and “Planning Survey for Capacity Development project for Air Pollution Control in Republic of Kosovo” (2016)

The Pristina Area
On-site stack gas measurement
Air quality monitoring station
Emergency air quality monitoring
Heavy metal content analysis in PM
Emission inventory
Simulation model
Drenas
Emergency air quality monitoring
Heavy metal content analysis in PM
On-site stack gas measurement
Mitrovica
Emergency air quality monitoring
Heavy metal content analysis in PM

Figure 1-1 Project Area

(3) The Beneficiary of the Project

Direct beneficiary: MESPI/MESP and its relevant organizations and agencies

Indirect beneficiary: citizens living in the Project site and its vicinity

(4) Schedule（Project period）

Original planned period: October, 2017 –September 2020 (3 years)

Revised period: October, 2017 –June 2021 (3 years and 9 months)

The period was revised due to the delay caused by COVID-19

(5) Overall goal, project purpose, and expected outputs

Overall goal, project purpose, and expected outputs of this project are as follows.

Overall goal

Kosovo side develops capacities for sound air pollution control and air quality management based on technical evidence.

Project purpose

Kosovo side technical capabilities are developed to control emission sources in the Project target area.

Expected outputs

Output 1: Capabilities to elaborate emission inventory (hereinafter referred to as “EI”) for LCPs and other sources are developed at Kosovo side.

Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

Output 3: Air quality monitoring activities are sustained

Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

Output 5: Capabilities for air quality simulation modeling are developed.
Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.
Output 7: Emission control measures are developed at LCPs.
Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

1.3 Project Design Matrix

The Project was implemented based on the R/D signed on March 30, 2017. The Project Design Matrix (hereinafter referred to as “PDM”) started based on the R/D agreed upon with the Kosovo side. The PDM was revised in the second Joint Coordinating Committee (hereinafter referred to as “JCC”) meeting held on July 9, 2018. The revision was to limit the study on emission reduction measures for LCPs only to TPP Kosovo A and to revise Objectively Verifiable Indicators in the PDM. Furthermore, in the third JCC meeting held on January 25, 2019, the PDM was revised again since the construction of air quality data network was left to MCC/MFK.

Furthermore, JICA and MESPI/MESP agreed on the extension of the Project period in July, 2020, due to the Coronavirus Disease 2019 (hereinafter referred to as “COVID-19”) pandemic, since Japanese nationals were not allowed to travel to Kosovo. During the extension period of the Project, various activities were added. Therefore, in the final JCC meeting held in June 2021, the PDM and the Plan of Operation (hereinafter referred to as “PO”) were revised

The final PDM is shown in Table 1-1 and the final PO is shown in Figure 2-1. The revising process is attached in ANNEX-1 “Joint Coordinating Committee meetings related documents”.

Table 1-1 Project Design Matrix (PDM) (Ver. 4.0)

Date: 2nd, November, 2017 (Ver. 1.0)
Date: 12th, July, 2018 (Ver. 2.0)
Date: 5th February, 2019 (Ver. 2.1)
Date: 4th August, 2020 (Ver. 3.0)
Date: 16th June, 2021 (Ver. 4.0)

Project Title: Capacity Development Project for Air Pollution Control
Duration of the Project: 3 years and 9 months (October 2017 to June 2021)
Project Target Group: Ministry of Environment, Spatial Planning and Infrastructure (MESPI) and Counterpart Working Group (C/P-WG)
Implementing Organization: MESPI and C/P-WG
Project Target Area: the Pristina Area, Drenas and Mitrovica

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal: Kosovo side develops capacities for sound air pollution control and air quality management based on technical evidence.	1. MESPI issues periodic/annual report on air quality including emission inventory, air quality assessment and emission measurement results. 2. Kosovo side's action plan is revised based on technical evidence.	1.“State of the Air” and “State of the Environment in Kosovo” reports 2. Kosovo side, after adoption of Action Plan for Air Quality, prepares report on “Implementation of the Action Plan for Air Quality”.	
Project Purpose: Kosovo side technical capabilities are developed to control emission sources in the Project target area.	1. Concrete emission reduction measures are initiated at the Large Combustion Plants (LCPs). 2. Air pollution control measures for other emission sources are elaborated. 3. Priority pollutants and emission sources including LCPs, other stationary sources and other emission sources are identified based on air quality monitoring, emission inventory and simulation modeling and revised twice during the Project for decision making.	1. “State of the Air” and “State of the Environment in Kosovo” reports 2. Action Plan for Air Quality 3. Progress Report	Kosovo side commitment for NERP in the context of Energy Community / EU Directives is sustained. Supports by Energy Community / EU and relevant donors for NERP are sustained. Relevant policies of MESPI on air quality management in accordance with EU

			Directives are sustained. Regulatory function of MESPI in air pollution control is maintained. Cooperation between MESPI and relevant agencies (MITE, MIAPA, KAS, KEK, etc.) is maintained. MESPI and related agencies are properly budgeted and staffed.
Outputs	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Output 1 : Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.	1.1 Emission inventory on LCPs and other sources for the current year[9] is revised at least twice.	1.1“State of the Air” and “State of the Environment in Kosovo” reports 1.2. Progress Report	More than 70% of C/P (Counterpart) and C/P-WG members assigned at the Project start will be maintained until the end of the Project
Output 2 : Capabilities for emission measurements are developed for LCPs and for other sources.	2.1 On-site stack gas measurements are conducted at least 26 times for NOx, SO2 and Dust (Kosovo A: 3 boilers×3 ducts, Kosovo B: 2 boilers ×2 ducts). 2.2 Standard Operating Procedures (SOPs) for on-site stack gas measurements for LCPs and other stationary sources are elaborated.	2.1 Progress Report 2.2 SOPs for on-site stack measurement (LCPs, other stationary sources)	
Output 3 : Air quality monitoring activities are sustained	3.1 Five air quality monitoring stations rehabilitated by the Project comply with 6,000 hours effective measurements a year (8,760 hours) in second and third year in the Project implementation. 3.2 Emergency air pollution monitoring drills are implemented at least three times	3.1“State of the Environment in Kosovo” and “State of the Air” reports 3.2 Progress Report	

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[9] The latest year for EI data

	utilizing portable samplers for SO2, NO2, PM2.5 and PM10 measurements. 3.3 Air quality monitoring reports are elaborated at least twice.		
Output 4 : Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.	4.1 Measurements for NOx, SO2 and Hg for LCPs as required by the EU Directive based on reference methods are conducted at least twice during the Project implementation. 4.2 The three SOPs for NOx, SO2 and Hg in stack gas for LCPs based on reference methods are elaborated. 4.3 Assessment of importance of heavy metal contents in ambient PM is conducted.	4.1 Progress Report 4.2 SOPs for reference method of LCPs (NOx, SO2, Hg)	
Output 5 : Capabilities for air quality simulation modeling are developed.	5.1 Dispersion simulation model for the current year is elaborated. 5.2 Based on the current emission inventory, simulation model is implemented at least twice.	5.1"State of the Environment in Kosovo" and "State of the Air" reports 5.2 Progress Report	
Output 6 : Decision making by Kosovo side is improved based on technical evidence for air pollution control.	6.1 Recommendations for air pollution control are made at least once toward Kosovo side's relevant policy making processes. 6.2 Publication and newsletter on air pollution control are disseminated at least four times.	6.1 Decision on review of the Action Plan for Air Quality (Analysis of implementation of the Action plan based on the recommendation) 6.2 Progress Report 6.3 Newsletter etc.	
Output 7 : Emission control measures are developed at LCPs.	7.1 Diagnosis on NOx, SO2 and Dust emissions for LCPs are conducted. Three Pollution control measures for each pollutant are elaborated for Kosovo A TPP.	7.1 Progress Report	
Output 8 : Capabilities for evaluating air pollution control measures of Kosovo side are developed.	8.1 Pollution control measures discussed in Kosovo sides strategy on air quality and action plan are evaluated at least once.	8.1"State of the Environment in Kosovo" and "State of the Air" reports 8.2 Progress Report	

Activities	Input of the Project		Important Assumptions
	Japanese Side	Kosovo Side	
1-1 Kosovo side with JICA Experts designates a responsible section and establishes necessary coordination with relevant agencies. 1-2 Based on analyzing existing information, Kosovo side with JICA Experts decides framework for emission source inventory in the Pristina Area. 1-3 MESPI with JICA Experts makes a plan and conduct a survey for emission inventory on LCPs. 1-4 MESPI with JICA Experts makes a plan and conduct a survey for emission inventory on other stationary sources. 1-5 Kosovo side with JICA Experts develops a methodology for emission inventory on other sources such as automobile and small combustion facilities, and elaborates preliminary emission inventory. 1-6 Based on activities (1-1 to 1-5) on emission sources, MESPI with JICA Experts elaborates an integrated emission inventory. 1-7 MESPI with JICA Experts independently prepares the emission inventory, implements the quality control and quality assurance of the emission inventory and prepares the improvement plan.	1. Dispatched Japanese Experts (1) Project Leader/ On-site stack gas measurement 1/Air pollution control measures 1 (2) Project Sub-Leader/Stationary Emission Inventory/ Disclosure and Publication of information and public awareness (3) Air quality monitoring 1 (4) Pollution control measures for power plants (boiler) (5) On-site stack gas measurement 2/ Air quality monitoring 3 (6) On-site stack gas measurement 3 (7) Pollution control measures for power plants (ESP-1) (8) Pollution control measures for power plants (ESP-2) (9) Air quality monitoring 2 (10) Mobile Emission Inventory/ Air pollution control measures 2 (11) Simulation model (12) Air quality protection policy 2. Provision of necessary equipment 3. Holding of local seminars and provision of seminar documents	1. Counterpart and Counterpart Working Group Member (1) Assignment of C/P and C/P-WG staff (2) JCC Chairman (3) Project Director (4) Project Manager 2. Provision of necessary office space and a project office at MESPI /DEPW and KHMI 3. Provision of laboratory and laboratory instruments such as microbalance, draft chamber, desiccator, oven, atomic absorption spectrophotometer, Ion Chromatography etc. 4. Provision of secured storage space for procured equipment 5. Provision of place for display on air quality monitoring 6. Provision of necessary supports for on-stack measurement for LCPs and other stationary sources 7. Acquisition of permissions needed and authorization 8. Local costs (1) Counterpart and counterpart working	During the Project implementation, adequate number of C/P and C/P-WG members with appropriate technical background is appointed. Kosovo side will take necessary measures including both privileges and tax exemptions in the Project implementation. Kosovo side will take necessary measures to obtain relevant permissions and authorizations in the Project implementation. Kosovo side will take necessary safety measures to conduct on-site stack gas measurements and field works.
2-1 MESPI and relevant agencies with JICA experts acquire theoretical knowledge of on-site stack gas measurement for LCP through seminars and workshops in Kosovo and Japan.			

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2-2 MESPI and relevant agencies with JICA experts execute on-the-job-training of on-site stack gas measurement by introducing necessary instruments including standard gases. 2-3 MESPI and relevant agencies with JICA experts develop experts of on-site stack gas measurement in Kosovo. 2-4 MESPI and relevant agencies with JICA experts establish an institutional framework for implementation of on-site stack gas measurement in Kosovo. 2-5 MESPI with JICA experts conducts on-site stack gas measurement for LCP and other stationary emission sources, and confirms compliance with ELVs (Emission Limit Values)	4. Training course implementation in Japan 5. Car rental costs of Japanese experts	group members for salaries and transportation expenses (2) Project administrative expenses (3) Seminar participants expenses for personnel travel 9. Transportation for on-site stack gas measurements equipment by Kosovo side outside of the Project activities	Pre-conditions
3.1 MESPI with JICA Experts assesses air quality monitoring stations (AQMS) in Kosovo and summarizes status of analyzers and equipment. 3.2 MESPI with JICA Experts prepares a plan of operation and maintenance, and a renewal plan for AQMS in Kosovo. 3.3 MESPI with JICA Experts rehabilitate AQMS in the Pristina Area based on the plans (3-2). 3.4 MESPI with JICA Experts prepares manuals for operation and maintenance for AQMS in the Pristina Area. 3.5 MESPI with JICA Experts calibrates analyzers in AQMS in the Pristina Area based on the operation/maintenance manuals. 3.6 MESPI with JICA Experts prepares a guideline for network design of AQMS in Kosovo. 3.7 MESPI with JICA Experts confirms			

Networking among AQMS in the Pristina Area. 3.8 MESPI with JICA Experts prepares SOP for ambient NO2, SO2, PM10, and PM2.5 measurement by a portable sampler for emergency needs. 3.9 MESPI with JICA Experts implements measurements of ambient NO2, SO2, PM10, and PM2.5 based on SOP (1 hour average), for emergency needs. 3.10 MESPI with JICA Experts utilizes results of AQMS for an annual air quality report as well as for public awareness. 3.11 JICA Experts give lectures on data management system for air quality data.			
4-1 MESPI with JICA experts studies sampling and measurement methodologies for the LCPs. 4-2 MESPI with JICA experts makes Ion Chromatograph available for analysis. 4-3 MESPI with JICA experts conducts analyses by reference methods for LCPs by using Ion Chromatograph method for SO2 and NOx and atomic absorption method for Hg. 4-4 MESPI with JICA experts elaborates SOPs for sampling and analyses for LCPs' stack gas. 4-5 MESPI with JICA experts studies sampling and measurement methods for other stationary emission sources. 4-6 MESPI with JICA experts elaborates SOPs for sampling and measurement methods for other stationary emission sources. 4-7 MESPI with JICA Experts conducts Particulate Matter (PM) sampling by			

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Hi-volume air samplers at least for 2 sampling points. 4-8 JICA Experts analyze heavy metal contents (Mn, Ni, As, Cd, Pb and Zn) in PM in laboratory in Japan 4-9 MESPI with JICA Experts assesses importance and urgency of heavy metal pollution in air. 4-10 JICA experts make diagnosis on ICP-MS in KHMI laboratory for operation.			
5-1 MESPI and relevant agencies with JICA Experts designate responsible section for simulation model and establish necessary coordination with relevant agencies. 5-2 MESPI and relevant agencies with JICA Experts collect existing data such as air quality monitoring data, meteorological data, geographical information etc. 5-3 MESPI with JICA Experts analyzes and validates meteorological data for applying a dispersion simulation model. 5-4 MESPI with JICA Experts analyzes and validates air quality monitoring data. 5-5 MESPI with JICA Experts elaborates dispersion simulation model for the target year. 5-6 MESPI with JICA Experts analyzes structure of air pollution. 5-7 MESPI with JICA experts acquire theoretical knowledge of simulation model and practice simulation modeling through seminars and workshops. 5-8 MESPI with JICA experts prepares for the establishment of simulation implementation system. 5-9 MESPI with JICA experts analyzes the air quality condition in the Pristina area.			

6-1 Kosovo side with JICA experts reviews emission reduction measures for LCPs relating with NERP (National Emission Reduction Plan) from technical point of view. 6-2 Kosovo side with JICA experts reviews and evaluates emission reduction measures for other stationary sources from the technical point of view. 6-3 Kosovo side with JICA experts discusses relevant policy improvements based on activities 6-1 and 6-2. 6-4 Kosovo side with JICA experts disseminates relevant knowledge and information on air pollution control generated by the Project to the public through newsletter and web site etc.			
7-1 Kosovo side with JICA experts analyzes the behavior of exhaust stack gas from LCPs including SO2. 7-2 JICA experts provide a seminar and a workshop to discuss emission reduction measures for LCPs and other stationary sources including fundamental theories of emission control. 7-3 Kosovo side with JICA experts implements diagnosis of LCPs' operations and elaborates operational improvements for emission reduction. 7-4 MESPI with JICA experts carry out additional exhaust gas measurement at TPP Kosovo A.			

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8-1 Kosovo side with JICA experts evaluates technical, economic and social viability of pollution control measures for important emission sources. 8-2 MESPI and relevant agencies with JICA experts evaluates emission reduction effects of pollution control measures for important emission sources. 8-3 MESPI with JICA Experts evaluates effects on air quality improvements by pollution control measures with dispersion simulation model. 8-4 MESPI with JICA experts summarizes the future administrative issues taking into consideration the new draft air pollution law in Kosovo, and confirms administrative procedures and issues for revision of the Action Plan.			

Note: “XX with JICA experts” means “XX with the assistance of JICA experts”

1.4 Implementation policy for the Project

1.4.1 Basic Policy of the Project implementation

The Project aims at enhancement of the capability of MESPI/MESP and relevant organizations and agencies to cope with harmful air pollutants and contribute to the plan and implementation of more effective air pollution control measures for human health and deployment of relevant air quality management policies.

The Project intends to form air quality management cycle in Kosovo shown in Figure 1-2 in the process to achieve the Overall Goal and Project Purpose described in the PDM, through the implementation of the project activities corresponding to eight outputs, which support the establishment of the air quality management.

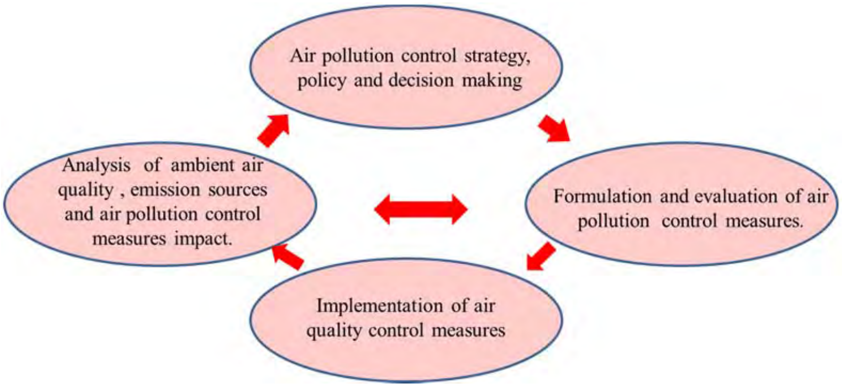

Figure 1-2 Air quality management cycle[10]

Project summary is shown in Figure 1-3. Rows of the figure indicate the target aspects such as Emission Sources (LCP, other stationary sources, and other sources), Ambient Air Quality/Exposure to Population, and Institutional Coordination/Education. Columns of the figure indicate each item of Air quality management cycle. The figure also shows the coverage range of each output corresponding to Air Quality Management cycle.

Achievement of each output will establish Air Quality Management Cycle, which leads to the establishment of a sustainable development structure for air pollution control. At the same time, this structure can assist the enhancement of the coping capacity for two issues (NERP implementation and establishment of the foundation for air quality control) which Kosovo is now dealing with.

The achievement of these outputs requires learning and acquiring of technical elements on the exhaust gas measurement and emission reduction measures (Output 2 and 7), air pollution monitoring and air pollutant analysis (Output 3 and 4), and the preparation of the emission inventory and the implementation of the dispersion simulation model based on this Emission inventory (Output 1 and 5). Based on these outputs, the implementation of the Decision making and Evaluation (Output 6 and 8) such as improved policies etc., will assists in establishing the air quality management cycle.

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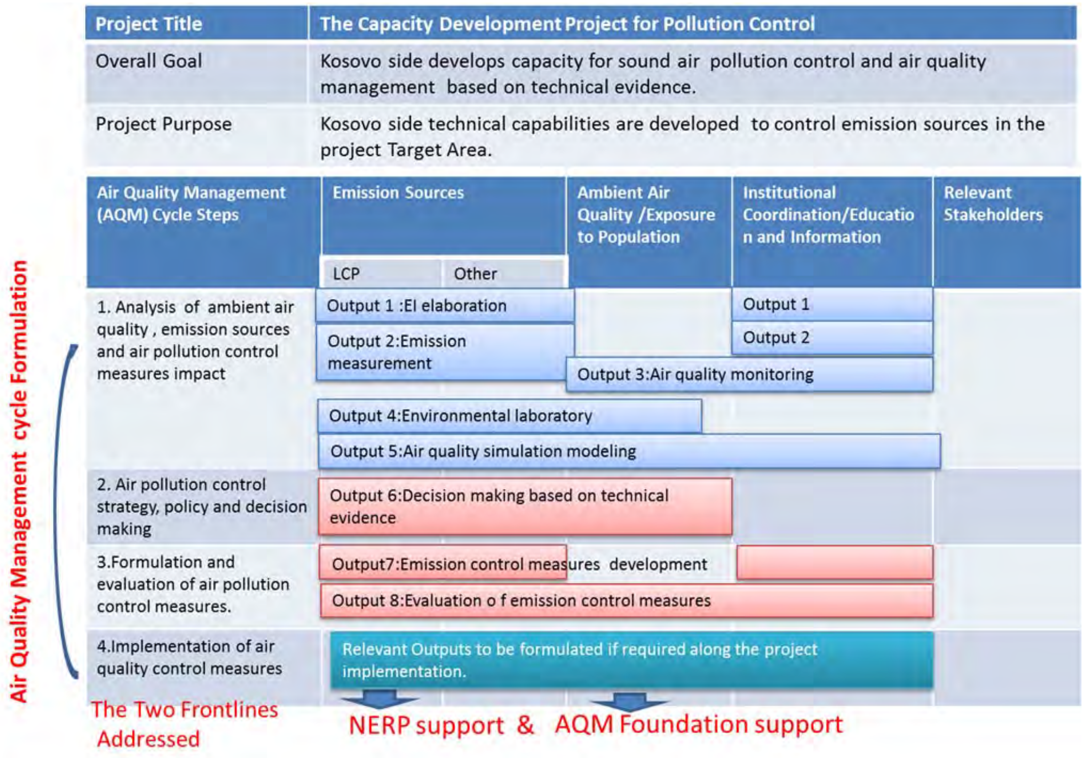
[10] Republic of Kosovo: Detailed planning Capacity development project for Air Pollution Control in Republic of Kosovo



Project Title	The Capacity Development Project for Pollution Control
Overall Goal	Kosovo side develops capacity for sound air pollution control and air quality management based on technical evidence.
Project Purpose	Kosovo side technical capabilities are developed to control emission sources in the project Target Area.

Figure 1-3 Project Summary[10]

1.4.2 Points to consider for the Project implementation

(1) Emphasis on Capacity Development (hereinafter referred to as "C/D")

The Project conducted activities centering on the C/D of Counterpart (hereinafter referred to as "C/P") and Counterpart Working Groups (hereinafter referred to as "C/P-WG").

In the Project activities, technology transfer is the pillar of every field. Therefore, emphasis was placed on the sustainable implementation of transferred technology. The Project tried for C/P and C/P-WG to deepen their understandings on transferred technology through On-the–Job-Training (hereinafter referred to as "OJT"), lectures, workshops, seminars, etc. Although Manuals and Standard Operating Procedure (hereinafter referred to as "SOP") were provided, the Project placed the importance on the transfer of technical experience and know-how in detailed manner. The Project, through repetition of OJT, etc. aimed at fostering the development of human resources who will make full use of the transferred technology. It is expected for these human resources to enhance relevant organization and at the same time, to construct the base for establishment of institutions and system for the use and dissemination of transferred technology.

In the Project, activities were carried out separately in four fields. In order to promote information sharing, the Project held a regular meeting approximately once every two weeks mainly during JICA Expert Team (hereinafter referred to as "JET") stay in Kosovo, and this supported the information sharing among C/P-WG and JET. Meanwhile, JET also shared the information with the University of Prishtina (hereinafter referred to as "UP") through lectures, since the Project collaborated with the UP in the field of emission inventory preparation, etc.

(2) Implementation of Capacity Assessment

In order to evaluate the trend of capacity development of the Kosovo side during the Project, JET carried out Capacity Assessment (hereinafter referred to as "CA") of the C/P and C/P-WG in each period.

The purpose of the CA is to assess the capacity of the Kosovo side from the viewpoints of individual level, organization level and social level related to the Overall Goal and the Project Purpose. In addition, it also assessed the capacity development for the formation of self-sustained and constructive air quality management cycle mentioned before. At the same time, JET assessed the human resources (the member of the staff), budget, institutional resources such as competence and cooperative relationship with other relevant organizations/agencies, equipment, etc.

(3) Coordination with other donors

In the second JCC meeting, Japanese side proposed the cooperation mechanism with other donors related the Project. Japanese side announced the intent of positive collaboration with other donors, and the JCC approved the proposal. The Project exchanged the information in a positive way, and intended to achieve more efficient outcomes. The followings are the outcomes achieved in collaboration with other donors.

i) Rehabilitation of analyzers in AQMS (MCC/MFK)
ii) Establishment of air quality data network (MCC/MFK)
iii) Re-functionalization and training of Inductively Coupled Plasma Mass Spectrometer (hereinafter referred to as "ICP-MS") (MCC/MFK)

JET also exchanged information and opinions with other donors such as the World Bank (hereinafter referred to as "WB"), Deitsche Gesellschaft fur Internationale Zusammennarbeit (hereinafter referred to as "GIZ") GmbH and Swedish Environmental Protection Agency (hereinafter referred to as "SEPA").

In parallel, JET participated in the donor coordination meetings regarding the air quality in Kosovo that were held on December 21, 2020 and January 30, 2020, and exchanged the information. The participants were the United Nations Development Programme, The Grand Duchy of Luxembourg, Ministry of Health - National Institute of Public Health, Health Associations, Ministry of Economy & Environment, Kosovo Hydro meteorological Institute, European Commission, the World Bank, European Bank for Reconstruction and Development, United Nations Children's Fund, World Health Organization, Millennium Challenge Cooperation/Millennium Foundation Kosovo, Japan International Cooperation Agency, Swedish International Development Cooperation Agency, GIZ.

1.4.3 Policy for each field of the Project

According to the aforementioned backgrounds, issues and objectives, basic policies for the implementation of the Project were set as follows.

Activities for the outputs in the Project are basically divided into three fields, and leads to the fourth field as shown in Figure 1-4. The first field is an issue regarding the assessment of the effect of each emission source to the ambient air (hereinafter referred to as “Emission Inventory and Modeling”), the second field is an issue regarding air quality monitoring system by AQMS and ambient air quality analysis (hereinafter referred to as “Air Quality Monitoring”), and the third field is an issue regarding exhaust gas measurement and emission reduction measures (hereinafter referred to as “Measurement and Emission Reduction Measures”). With the achievement of these three fields, plans and projections of air pollution control measures, air pollution control policies, etc. become viable as “Assessment for Decision Making”.

In this document, large stationary emission sources such as thermal power plants are called “LCPs”, other stationary emission sources such as industrial facilities are called “other stationary sources”, and mobile emission sources such as vehicles and stationary sources such as heating in households and private and public businesses are called “other sources”.

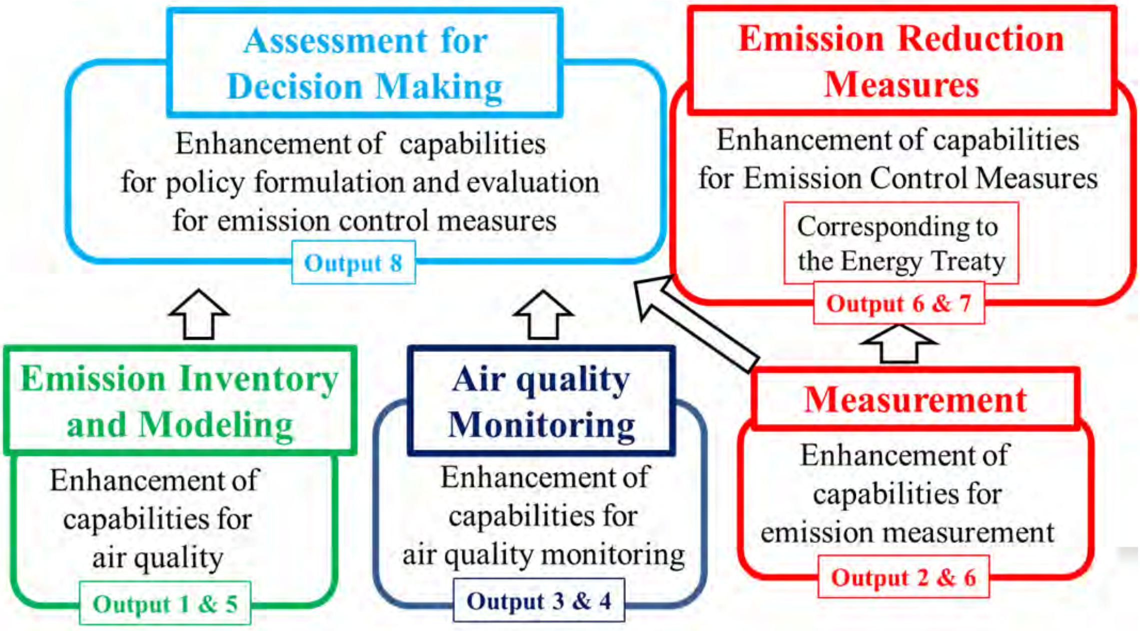


Figure 1-4 Structure of the Project

Overview of policies and outcomes for each field is described as follows.

(1) Policy for Emission Inventory and Modeling field and outline of the outcomes

Rehabilitation of analyzers in AQMSs and acquisition of ambient air quality measurement technology enables the grasping of the ambient air condition, but in order to improve the air quality, it is important to plan and implement air pollution control measures with a high priority. In order to realize this, it is efficient to take the following steps. Steps are to assess contribution of each emission source to air pollution, to plan measures for high emission sources, to evaluate the effect of each measure and to give each measure its priority order. For assessment of contribution and evaluation of each measure, it is very effective to prepare emission inventory and apply dispersion simulation model.

The Project placed importance on emission inventory preparation and simulation implementation by the Kosovo side through OJT, lectures, workshops, seminars, etc. C/Ps with assistance of JET tried to establish the institutional framework for emission inventory preparation and dispersion simulation implementation in Kosovo.

At the Final stage, the Project, as a trial, implemented air pollution simulation as an analysis of the structure of air pollution in the Pristina Area, and tried to evaluate the effect and estimate contribution of each emission source. However, because of the low reliability of past air quality data, the Project could not validate the simulation results. This remains a future issue.

This is the first experience for the Kosovo side to learn emission inventory preparation and dispersion simulation modeling and therefore, the Project supported to draw up manuals in order to maintain a sustainability of conducting emission inventory preparation and dispersion simulation, taking the experience of the second Japanese Training into consideration.

In the Project, C/P-WG consisting of organizations/agencies related to this field was organized, and at the same time, established the collaboration relationship with the UP. The Implementation structure agreed upon in R/D was basic one, but the Project reviewed organizations/agencies and individuals as necessary.

Emission inventory and air dispersion simulation are very effective tools for understanding air quality condition, and it is important to continue with these activities.

(2) Policy for Air Quality Monitoring field and outline of the outcomes

Air quality data is the base for all studies such as understandings of air status, study on air control measures, etc. and therefore, the provision of accurate air quality data is indispensable. The Project supported to inspect and rehabilitate analyzers providing air quality data in AQMSs. In parallel, the Project assisted the capacity enhancement in operating analyzers in the KHMI laboratory.

In Kosovo, where twelve AQMSs are located, air quality data was not sufficiently reliable because of lack of analyzer maintenance and data was not collected rapidly well because of the inadequacy of the data collection system. Furthermore, there was no system for assessing the reliability of air quality data. It is hard to say that the Kosovo side has the ability to evaluate air quality condition, and it is necessary to improve reliability of air quality data.

On the other hand, MCC/MFK has supported the air quality improvement, planned rehabilitation of analyzers in AQMS, installation of meteorological instruments, establishment of air quality data network, air quality data disclosure to the public, etc. MESPI/MESP, JET and MCC/MFK discussed the role sharing and agreed upon it in the early second period. The details are described in 2.1 (1).

As a result, the Project carried out rehabilitation of analyzers in five AQMSs in the Prishtina area in order to improve data reliability, and at the same time, upsized the housing for three out of five AQMSs for improvement of maintenance process. Furthermore, in order to sustain data accuracy, the Project conducted the introduction of analyzer calibration instrument, preparation of the O&M manual and training for analyzer O&M. As for air quality data network, both sides agreed for MCC/MFK to establish all data network in Kosovo, and JICA, instead, expanded the original plan of installing one display in the city of Pristina to installing a larger number of displays in the Pristina Area.

Through the collaboration with MCC/MFK, the ability of air quality data collection in Kosovo has drastically improved. However, there are still issues remaining with the data management system such as the system for checking data abnormality from analyzers and validating the final data is not established yet, and understanding of the air quality condition based on the collected data is not sufficient.

In parallel, JET studied optimum placement of AQMSs in Kosovo in order to understand the accurate air quality state in Kosovo. JET also trained C/P the drill for emergent air quality measurement in the case of emergency such as environmental accidents.

As for capability enhancement of analysis in the KHMI laboratory, JET supported the exhaust gas analysis by Standard Reference Method[11]. Standard Reference Method is the method that the EU directive requests for analysis of SO_2 and NO_X in exhaust gas from LCPs. As for analysis of SO_2 and NO_X, JET selected the method of Ion Chromatograph (hereinafter referred to as “IC”), and supported the analysis through the training on gas sampling and re-functionalization of the IC. At the same time, since EU directive also requests analysis of Hg in exhaust gas from coal fired LCPs, JET supported sampling and pretreatment for Hg analysis, and analysis by Atomic Absorption Spectrometer (hereinafter referred to as ”AAS”).

As another issue, there is a concern of heavy metal in PM in the air. C/Ps together with JET sampled the PM in Drenas and Mitrovica, and these samples were analyzed in Japan. Both results showed that some components exceeded the guideline values of Japan, and the necessity of the heavy metal monitoring was confirmed. At the same time, JET supported the re-functionalization of the ICP-MS in order to analyze heavy metals in the future.

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[11] European Committee of Standardization (hereinafter referred to as “CEN”) stipulates standards in EU so called EN Standard. EN Standard stipulates analysis methods for exhaust gas, so called Standard Reference Method. EN standards are equivalent to Japanese Industrial Standard (hereinafter referred to as “JIS”) in Japan.

However, KHMI has issues such as lack of proper environment and system for analysis work, insufficient human resources, etc. From now on, it is important to establish the quality control system to guarantee the analysis results, and make the laboratory keep doing analysis sustainably.

(3) Policy for Measurement and Emission Reduction Measures field and outline of the outcomes

TPP Kosovo A and TPP Kosovo B, which are main targets of the NERP, are recognized as a large emission sources in Kosovo. Energy strategy in Kosovo[12] revised in 2017 says as follows.

The construction process of the new TPP (hereinafter referred to as "TPP Kosova e Re”) will continue, following the environmental criteria set in the EU Directive. The target for its commissioning is set at the beginning of 2023 at the latest. To prevent endangering the security of electricity supply, TPP Kosovo A will operate until its replacement by TPP Kosova e Re. TPP Kosovo B will continue to carry the main burden of security for electricity supply. The process of rehabilitation of TPP Kosovo B will take place in two phases:

a. The first phase will include interventions in environmental components for Dust and NO_X reduction.
b. The second phase includes the complete rehabilitation such as recovery of power generation capacity, etc. including SO_2 reduction measures that begins after the start of the operation of TPP “Kosova e Re”.

At present, TPP Kosovo A and TPP Kosovo B have covered 97% of power demand in Kosovo, and Kosovo cannot help relying on the power from both TPPs.

The final NERP Kosovo submitted to EnC in May, 2018 says that TPP Kosovo B will continue its operation through the rehabilitation supported by EU, but TPP Kosovo A will stop its operation till 2023 when the TPP Kosova e Re starts operation.

In the above mentioned situation, TPP Kosovo B rehabilitation by EU which includes environmental measures, life extension measures and improvement performance was determined in the first period of the Project, and TPP Kosova e Re was determined to be constructed. However, “Counter Global” who is the investor for TPP Kosova e Re announced the withdrawal from the investment in March, 2020, and the plan for TPP Kosova e Re is now pending. It is necessary to follow how the Kosovo side will deal with this issue, including the review of the NERP.

The Project conducted the exhaust gas measurement for TPP Kosovo A and TPP Kosovo B in the first period. The Project grasped the existing emission condition from both TPPs and these data were used for the emission inventory from LCPs. However, emission

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[12] ENERGY STRATEGY OF THE REPUBLIC OF KOSOVO 2017-2026

reduction measures were only studied for TPP Kosovo A, responding to the request from the Kosovo side not to study the TPP Kosovo B due to the relation with EU.

The Project collected exhaust gas measurement results, operation data analysis data of lignite and fly ash, etc. and studied emission reduction measures. As a result, in the first period, Dust reduction measures were proposed. TPP Kosovo A accepted the implementation of the measures, and part of the measures was applied in the second period. TPP Kosovo A and JET confirmed the effectiveness of the measure through exhaust gas measurement.

As for other stationary sources, JET conducted the exhaust gas measurement for four other stationary sources after measurement at LCPs. Measurement results indicated that some of the measured components exceeded ELVs. Along with exhaust gas measurement, JET inspected and studied process flow of factories and fuel use condition. JET proposed emission reduction measures for each factory based on these studies.

ELVs for other stationary sources are described in Administrative Instruction[13] (hereinafter referred to as "AI"). At present, MESPI/MESP has tried to apply stricter ELVs for other stationary sources through drafting a new AI including ELVs[14] for LCPs requested by the EU Directive. In this manner MESPI/MESP is taking legislative measures. As for LCPs, measures are taken in line with the NERP. However, as for other stationary sources, it is clear that the law enforcement is not sufficient even at this moment. There is an issue that Reporting of emissions from facilities is not thoroughly carried out, and instruction from MESPI/MESP is not at the sufficient level. This issue seems to be caused by the lack of technical knowledge and capacity of competent authority (MESPI/MESP). At the same time, this leads to the situation where no private companies/agencies for measurement can be fostered. It is one of the biggest issues for the future.

(4) Policy for Assessment for Decision Making and outline of the outcomes

In Kosovo, for the purpose of air quality improvement, "Action plan for Air Quality[15]" (hereinafter referred to as "Action Plan") is developed based on "Strategy on Air Quality[16]". Present Action plan mentions emission control measures for heating equipment, LCPs and industrial facilities, vehicles, etc. However, these measures are not concretely proposed, they are not planned based on the technical evidences, etc. Therefore, measures were not sufficient in concreteness, and did not evaluate the impact of each measure

The Project, based on the information obtained from each output, supported the proposal of concrete measures and the evaluation not only of their impact but also of the necessary costs. The purpose of the activity is not only to propose measures but also for the Kosovo

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[13] ADMINISTRATIVE INSTRUCTION, No. / 2007 "ON THE RULES AND STANDARS OF THE DISCHARGES ON AIR BY THE STATIONARY SOURCES OF POLLUTION"

[14] DIRECTIVE 2010/75/EU

[15] "Action Plan" has the time span of three years, and is developed based on the "Strategy on Air Quality".

[16] "Strategy on Air Quality" has the time span of ten years. The present strategy is for 2013 ~ 2022.

side to learn steps on how to make a policy based on the technical evidences from now onwards.

As for LCPs and industrial facilities, JET proposed that it is important for facilities to conduct exhaust gas measurement and report the results and to study emission reduction measures based on the measurement results in a proper way, due to the difference in processes and fuel use of each facility. In order to realize this, both business operators and MESPI/MESP need to strengthen the technical capacity to inspect exhaust gas measurement results and study emission reduction measures.

As for the study of measures, the Project, based on other outputs, took a process of listing concrete measures, selecting feasible measures and estimating the impact and cost of selected measures. Especially for estimation of the impact and cost, emission inventory and simulation developed in the Project were utilized. In the future, it is expected that policies are drafted sustainably based on the technical evidence.

1.5 Activity implementation schedule

The Project consists of four fields as mentioned above.

1.5.1 Activity Plan and schedule

Activity plan is shown in Figure 1-5 and Activity schedule is shown Figure 1-6 at the starting time of the Project.

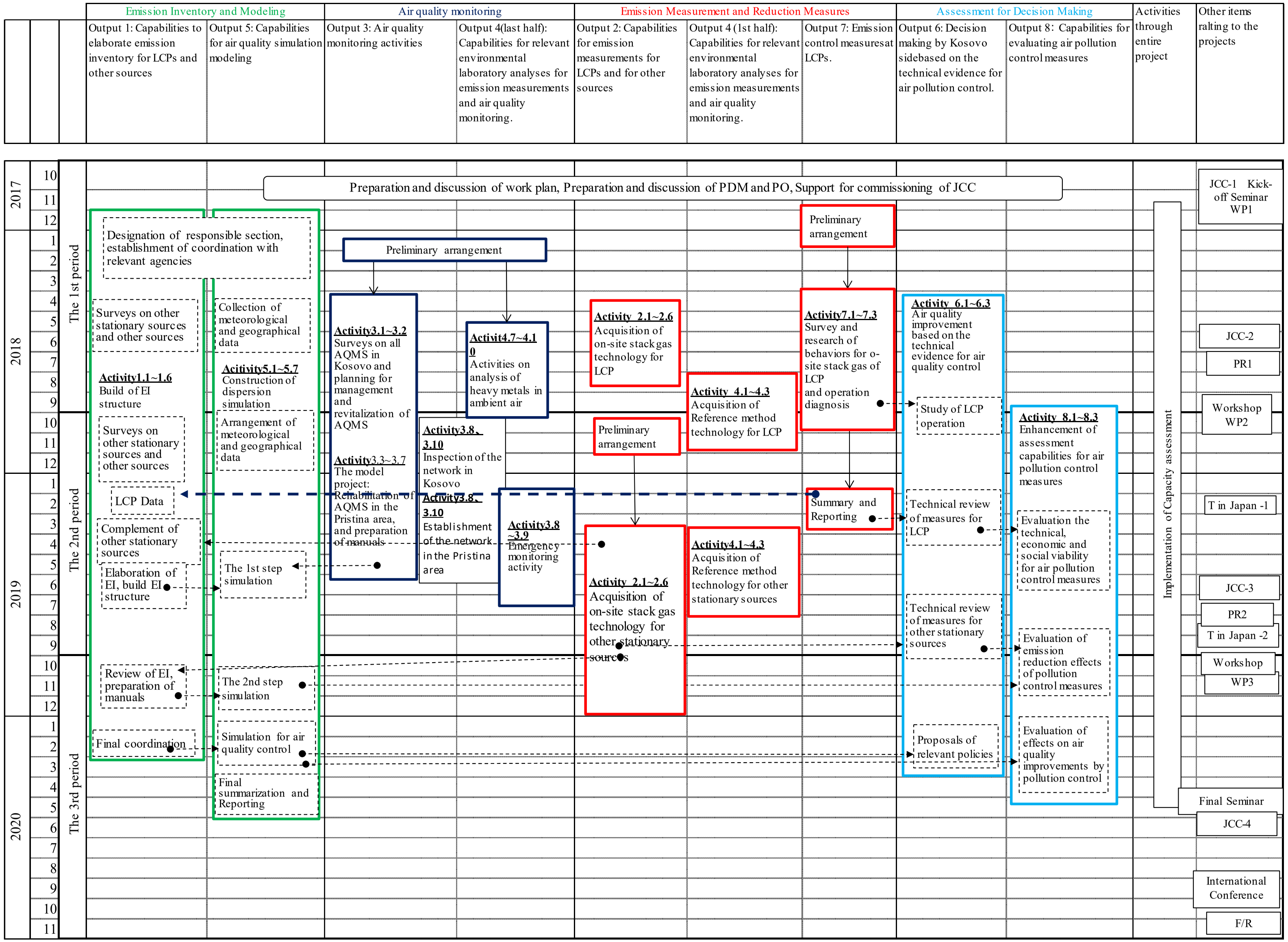
Main activities in the field of Air Quality Monitoring were scheduled to finish by the end of the second period, since air quality data became the base for validating the air quality simulation.

Main activities in the field of the Measurement and Emission Reduction Measures were also scheduled to finish by the end of the second period, considering the situation where emission reduction measures for TPP Kosovo A and TPP Kosovo B had to be studied and applied as early as possible in order to meet the NERP.

Some activities in the field of Air Quality Monitoring and the Measurement and Emission Reduction Measures are also allocated to the third period in order to follow the outcome.

Activities in the field of Assessment for Decision Making were mainly scheduled for the second and the third period, since the activities needed outcomes from other outputs.

The actual schedule in the third period was extended for approximately 9 months due to the effect of the COVID-19. Therefore, during the extension period, the Project carried out the additional activities for the enhancement of the capacity of C/P.



PR: Progress Report, WP: Work plan, T in Japan : Training in Japan, F/R: Final Report

Figure 1-5 Activity plan for each field

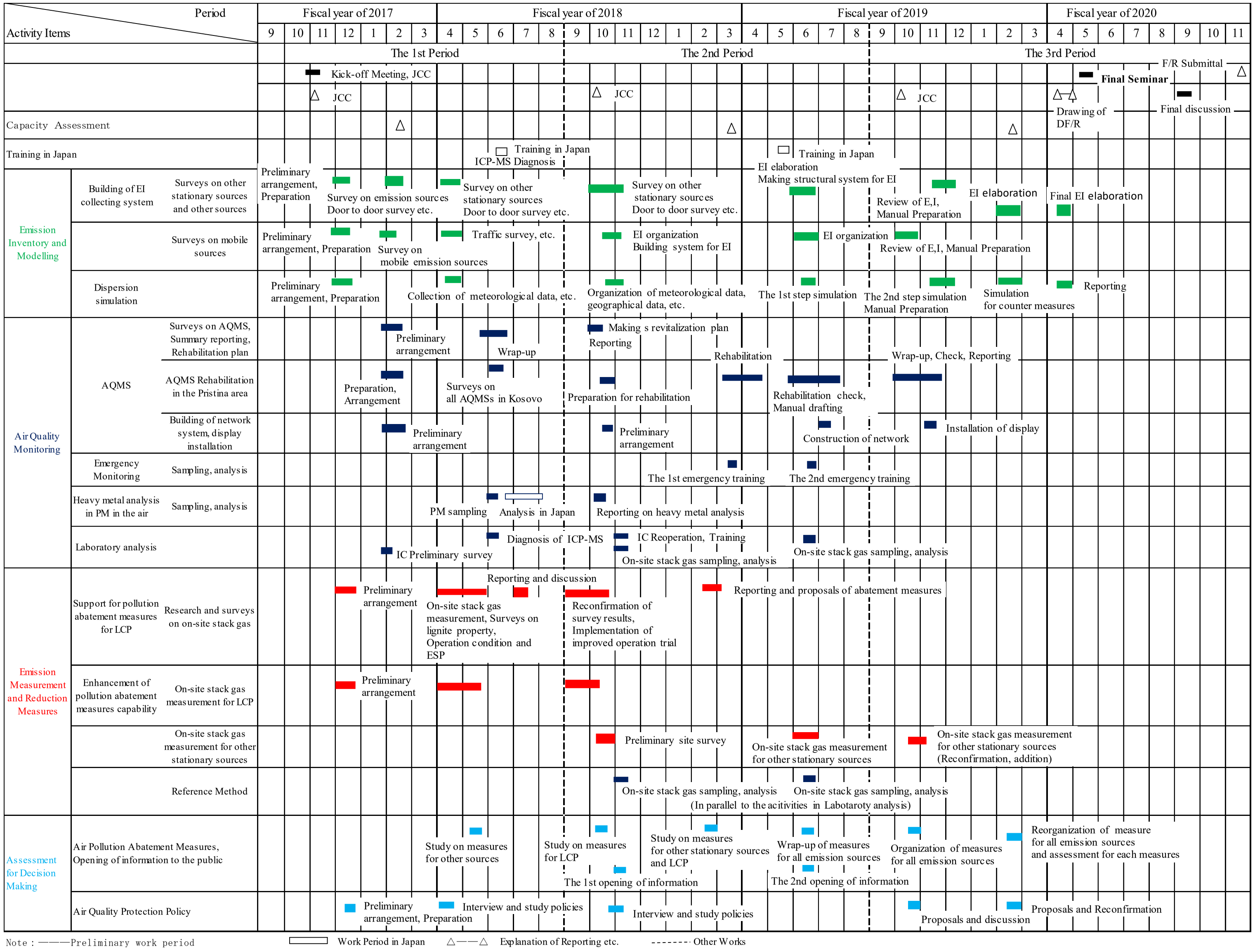


Figure 1-6 Activity schedule

1.5.2 Activity items

In the PDM shown in Table 1-1, forty eight (48) activities were planned. In the third period, the Project period was extended from one year to one year and nine months, and six activities were added.

The Project is divided into three periods and activities in each output are carried out as follows

【First Period】

(1) Works in regards to the Project management

1) To draft and consult a work plan
2) To draft, review and consult the PDM and PO, and support for establishment of JCC and holding a JCC meeting
3) Holding a Project kick-off seminar
5) Implementing of capacity assessment

(2) Activity for each output

・ Activity for Output 1

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

Activity 1.1 ~ 1.4

・ Activity for Output 2

Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

Activity 2.1 ~ 2.3, 2.5

・ Activity for Output 3

Output 3: Air quality monitoring activities are sustained

Activity 3.1 ~ 3.2, 3.6

・ Activity for Output 4

Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

Activity 4.5, 4.7 ~ 4.10

1) Activity for Output 5

Output 5: Capabilities for air quality simulation modeling are developed.

Activity 5.1 ~ 5.2, 5.7

・ Activity for Output 6

Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.

No activities

・ Activity for Output 7

Output 7: Emission control measures are developed at LCPs.

Activity 7.1 ~ 7.2

- Activity for Output 8

  Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

  No activities

【Second Period】

(1) Works in regards to the Project management

1) To draft and consult a work plan
2) To draft, review and consult the PDM and PO, and support for holding a JCC meeting
4) Implementation of trainings in Japan
5) Implementing of capacity assessment

(2) Activity for each output

- Activity for Output 1

  Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

  Activity 1.3 ~ 1.6

- Activity for Output 2

  Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

  Activity 2.1 ~ 2.5

- Activity for Output 3

  Output 3: Air quality monitoring activities are sustained

  Activity 3.3 ~ 3.10

- Activity for Output 4

  Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

  Activity 4.1 ~ 4.6, 4.9, 4.10

- Activity for Output 5

  Output 5: Capabilities for air quality simulation modeling are developed.

  Activity 5.2 ~ 5.5, 5.7

- Activity for Output 6

  Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.

  Activity 6.1 ~ 6.4

- Activity for Output 7

  Output 7: Emission control measures are developed at LCPs.

  Activity 7.1 ~ 7.3

- Activity for Output 8

  Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

  Activity 8.1 ~ 8.2

【Third Period】

(1) Works in regards to the Project management

1) To draft and consult a work plan
2) To draft, review and consult the PDM and PO, and holding a JCC meeting
5) Implementing of capacity assessment
6) Implementing the regional conference

(2) Activity for each output

- Activity for Output 1

  Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

  Activity 1.4 ~ 1.6

  In addition, "Emission Inventory Preparation for the year 2018 & review of manual", "Quality Control (hereinafter referred to as "QC") and Quality Assurance (hereinafter referred to as "QA") activities for emission inventory preparation" and "Study on improvement plans for emission inventory preparation" are carried out.

- Activity for Output 2

  Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

  Activity 2.2 ~ 2.5

- Activity for Output 3

  Output 3: Air quality monitoring activities are sustained

  Activity 3.4 ~ 3.10

  In addition, "Seminar for air quality data management" is carried out.

- Activity for Output 4

  Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

  Activity 4.3 ~ 4.6

- Activity for Output 5

  Output 5: Capabilities for air quality simulation modeling are developed.

  Activity 5.4 ~ 5.7

  In addition, "Analysis of air quality during lockdown in Kosovo", "Lectures on the analysis result of air quality during lockdown", "Support for analysis and evaluation for air quality data during one year" and "Discussion on establishment of simulation implementation framework" are carried out.

- Activity for Output 6

  Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.

  Activity 6.2 ~ 6.4
- Activity for Output 7

  Output 7: Emission control measures are developed at LCPs.

  Activity 7.2

  In addition, "Exhaust gas measurement at TPP Kosovo A" is carried out.
- Activity for Output 8

  Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

  Activity 8.1 ~ 8.3

  In addition, "Study on additional air control pollution measures", "Simulation Calculation of additional air control pollution measures", "Discussion for Administrative procedure for the Action Plan and issues" and "Study on evaluation of enforcement of laws in Kosovo" are carried out.

In the third period, the Project period was extended, and additional activities aiming at the enhancement of capacities of C/Ps are carried out. These activities are described above, and additional activities are wrapped up in the following table.

The content of the activities	
Output 1	・MESPI/MESP with the assistance of JICA Experts independently carries out the preparation of the emission inventory, implementation of quality control and quality assurance of the emission inventory, and drafting of the improvement plan.
Output 3	・JICA Experts give lectures on data management system on air quality data.
Output 5	・MESPI/MESP with the assistance of JICA Experts analyzes the air quality status in the Pristina area. ・MESPI/MESP with the assistance of JICA Experts prepares for the establishment of simulation implementation system.
Output 7	・MESPI/MESP with the assistance of JICA experts carries out additional exhaust gas measurement at TPP Kosovo A.
Output 8	・MESPI/MESP with the assistance of JICA experts summarizes the future administrative issues taking into consideration the new draft air pollution law in Kosovo, and confirms the administrative procedures and issues for revision of the Action Plan.
Concrete activities	
First stage additional activities (added in August	- Workshops and summarization of the results on Emission Inventory, Air pollution control measures and Simulation (Output 1 and 5) - Seminar on air quality data management (Output 3) - Analysis of air quality during the lockdown in Kosovo (Output 5)

2020)	- Lectures on the analysis result of air quality during the lockdown (Output 5)
Second stage additional activities (added in October 2020)	- Emission Inventory Preparation for the year 2018 & review of the manual (Output 1) - Quality Control and Quality Assurance activities on emission inventory preparation (Output 1) - Study on improvement plans for emission inventory preparation (Output 1) - Support for analysis and evaluation of air quality data during one year (Output 5) - Discussion on the establishment of simulation implementation framework (Output 5) - Support for the study on additional air pollution control measures (Output 8) - Simulation Calculation of additional air pollution control measures (Output 8) - Study on evaluation of the enforcement of laws in Kosovo (Output 8) - Discussion on the Administrative procedure for the Action Plan and summarization of issues (Output 8) - Exhaust gas measurement at TPP Kosovo A (Output 7)

1.6 Supplemental explanation for the Project activities (the rules of law in EU)[17]

In order to be a member state of EU, every state must obey the rules of law, so called “Acquis communautaire”.

Acquis communautaire are the rules of law which cover all treaties, EU legislation (Regulations, Directives, etc.), international agreements, standards, court verdicts, fundamental rights provisions and horizontal principles in the treaties such as equality and non-discrimination.

All member states and their citizens must obey the Acquis and all candidate countries must accept the full Acquis to become a member of the European Union.

The EU's 'acquis' is the body of common rights and obligations that are binding on all EU countries, as EU Members. It is constantly evolving and comprises:

- the content, principles and political objectives of the Treaties;
- legislation adopted in application of the treaties and the case law of the Court of Justice of the EU;
- declarations and resolutions adopted by the EU;
- measures relating to the common foreign and security policy and measures relating to justice and home affairs;
- International agreements concluded by the EU and those concluded by the EU countries between themselves in the field of the EU's activities.

In the items mentioned above, EU legislation is divided into primary and secondary. The treaties (primary legislation) are the basis or ground rules for all EU action. Secondary legislation, which

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[17] https://europa.eu/european-union/law_en

includes regulations, directives and decisions, are derived from the principles and objectives set out in the treaties

The System of EU legal instruments is as follows

	Addressees	Effects
Regulations	All Member states, natural and legal persons	Directly applicable and binding in their entirety
Directives	All or specific Member states	Binding with respect to the intended results. Directly applicable only under particular circumstances
Decision I	Directed at addressees - All or specific Member States - Specific natural or legal persons	Directly applicable and binding in their entirety
Decision II	Not directed at specific addressees	Binding in their entirety
Recommendations	All or specific Member States, other EU bodies, individuals	Not binding
Opinions	All or specific Member States, other EU bodies. Not specified	Not binding

In the Project Activity, there are many activities related to the EU Directives. The explanation of the EU Directives is as follows.

A "directive" is a legislative act that sets out a goal that all EU countries must achieve. However, it is up to the individual countries to devise their own laws on how to reach these goals. One example is “the EU consumer rights directive”, which strengthens rights for consumers across the EU, for example by eliminating hidden charges and costs on the internet and extending the period under which consumers can withdraw from a sales contract.

Furthermore, the activity closely related to Kosovo is “Stabilization and Association Process” (hereinafter referred to as “SAP”).

SAP is the European Union's policy towards the Western Balkans, established with the aim of eventual EU membership. Western Balkan countries are involved in a progressive partnership with a view of stabilizing the region and establishing a free-trade area. The SAP sets out common political and economic goals although progress evaluation is based on countries' own merits.

The SAP was launched in June 1999 and strengthened at the Thessaloniki Summit in June 2003 taking over elements of the accession process. It rests on:

- Contractual relationships (bilateral Stabilization and Association Agreement (hereinafter referred to as “SAA”))
- Trade relations (autonomous trade measures);
- Financial assistance (the Instrument for Pre-accession Assistance (hereinafter referred to as “IPA”))

- Regional cooperation and good neighborly relations

The government of Kosovo signed the SAA on October 27, 2015 and now is a ”Potential Candidate” for the EU accession. Therefore, Kosovo needed to accept the EU regulations, and impose various EU directives to the domestic laws as well as enforce them.

EU directives related to the fields of the Project are as follows.

- DIRECTIVE 2008/50/EC on ambient air quality and cleaner air for Europe

  The directive stipulates the air quality standards, etc., and requests air quality monitoring and compliance with the standards, which is the most fundamental directive for air quality. The contents are reflected in the draft air protection law.
- DIRECTIVE 2010/75/EU on industrial emissions (integrated pollution prevention and control)

  This is the directive on emissions from LCPs and waste treatment plants, which is the fundamental directive for the NERP. The contents are reflected in the draft air protection law and the AI under the law that is now being drafted.
- DIRECTIVE (EU) 2015/2193 on the limitation of emissions of certain pollutants into the air from medium combustion plants

  This is the directive on emissions for smaller combustion plants than the LCPs (1MW=<thermal input<50MW). The contents are reflected in the AI under the air quality pollution law that is now being drafted.
- DIRECTIVE 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products

  This is the directive on eco-products, and at the same time, it stipulates the ELVs for the products. This directive has not been transposed in the domestic laws in Kosovo.
- DIRECTIVE (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants

  This is the directive that obligates the member states to plan and implement the reduction of national emissions of certain atmospheric pollutants. However, this directive has not been transposed in the domestic laws in Kosovo. This directive is titled the National Emission Ceilings Directive (hereinafter referred to as “NEC Directive”).

Some of these directives are not planned to be transposed into the laws in Kosovo, and there still exist barriers in enforcement even if they are transposed in the laws.

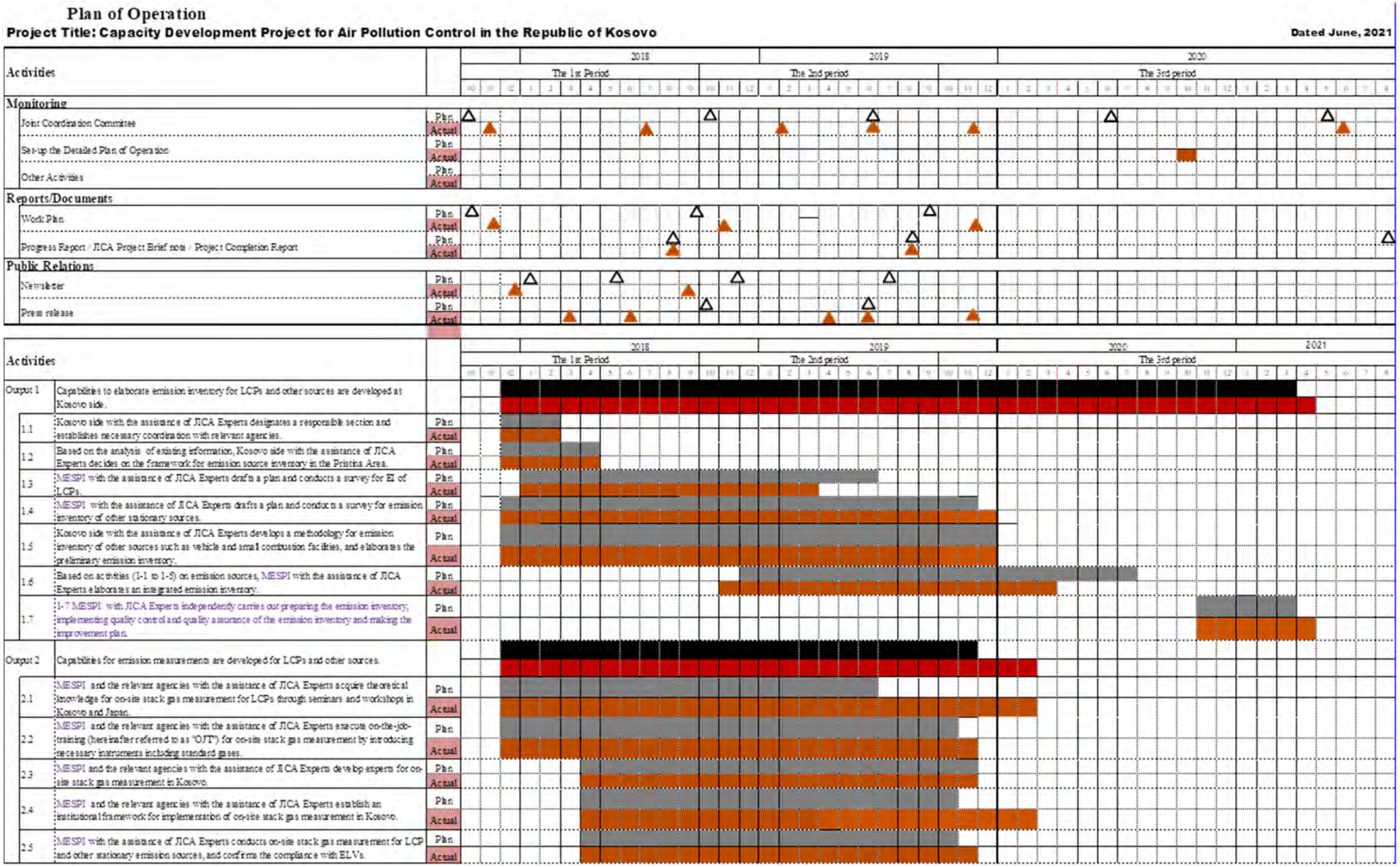
In addition to the directives mentioned above, there are regulations, etc. related to the Paris agreement.

2. Project Management

2.1 Activity performance

The PO of the Project is the version that the Project planned at the starting time of the Project. However, due to the effect of the COVID-19 pandemic, the Project period was extended for nine months. The revised Plan and actual record of the activities, including the additional activities during the extension period are shown in Figure 2-1. Original PO is in “ANNEX-1 Joint Committee Meeting related documents”

There are discrepancies between the original plan and the actual record. They are mainly caused by the readjustment and/or addition of the works, and therefore, a review of PO was carried out not for the original parts of the plan, but only for the additional parts.



Plan of Operation

Project Title: Capacity Development Project for Air Pollution Control in the Republic of Kosovo

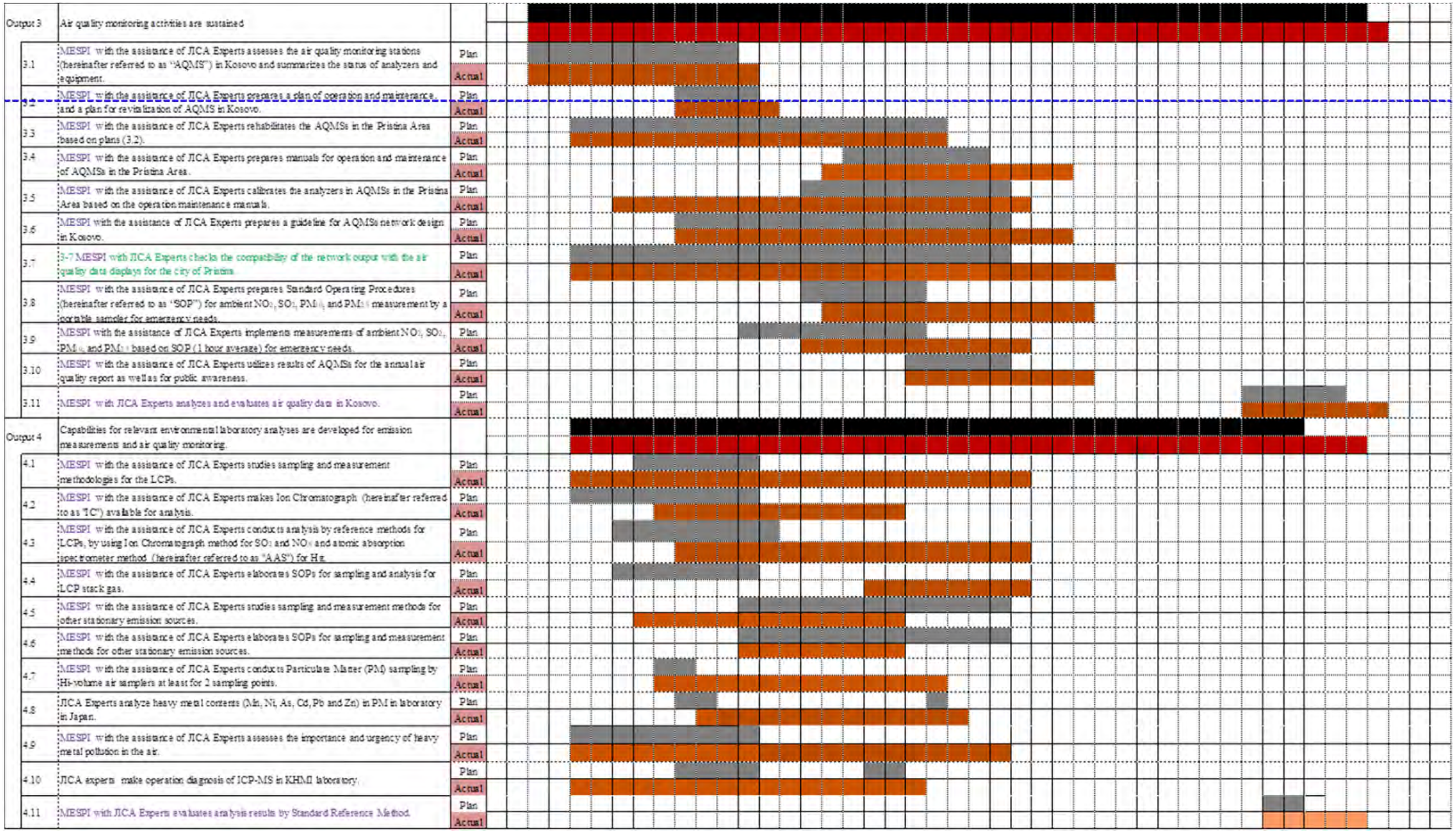
Dated June, 2021

Activities		
Monitoring		
Joint Coordination Committee		Plan Actual
Set-up the Detailed Plan of Operation		Plan Actual
Other Activities		Plan Actual
Reports/Documents		
Work Plan		Plan Actual
Progress Report / JICA Project Brief note / Project Completion Report		Plan Actual
Public Relations		
Newsletter		Plan Actual
Press release		Plan Actual

Activities		
Output 1	Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.	
1.1	Kosovo side with the assistance of JICA Experts designates a responsible section and establishes necessary coordination with relevant agencies.	Plan Actual
1.2	Based on the analysis of existing information, Kosovo side with the assistance of JICA Experts decides on the framework for emission source inventory in the Pristina Area.	Plan Actual
1.3	MESPI with the assistance of JICA Experts drafts a plan and conducts a survey for EI of LCPs.	Plan Actual
1.4	MESPI with the assistance of JICA Experts drafts a plan and conducts a survey for emission inventory of other stationary sources.	Plan Actual
1.5	Kosovo side with the assistance of JICA Experts develops a methodology for emission inventory of other sources such as vehicle and small combustion facilities, and elaborates the preliminary emission inventory.	Plan Actual
1.6	Based on activities (1-1 to 1-5) on emission sources, MESPI with the assistance of JICA Experts elaborates an integrated emission inventory.	Plan Actual
1.7	1-7 MESPI with JICA Experts independently carries out preparing the emission inventory, implementing quality control and quality assurance of the emission inventory and making the improvement plan.	Plan Actual
Output 2	Capabilities for emission measurements are developed for LCPs and other sources.	
2.1	MESPI and the relevant agencies with the assistance of JICA Experts acquire theoretical knowledge for on-site stack gas measurement for LCPs through seminars and workshops in Kosovo and Japan.	Plan Actual
2.2	MESPI and the relevant agencies with the assistance of JICA Experts execute on-the-job-training (hereinafter referred to as "OJT") for on-site stack gas measurement by introducing necessary instruments including standard gases.	Plan Actual
2.3	MESPI and the relevant agencies with the assistance of JICA Experts develop experts for on-site stack gas measurement in Kosovo.	Plan Actual
2.4	MESPI and the relevant agencies with the assistance of JICA Experts establish an institutional framework for implementation of on-site stack gas measurement in Kosovo.	Plan Actual
2.5	MESPI with the assistance of JICA Experts conducts on-site stack gas measurement for LCP and other stationary emission sources, and confirms the compliance with ELVs.	Plan Actual

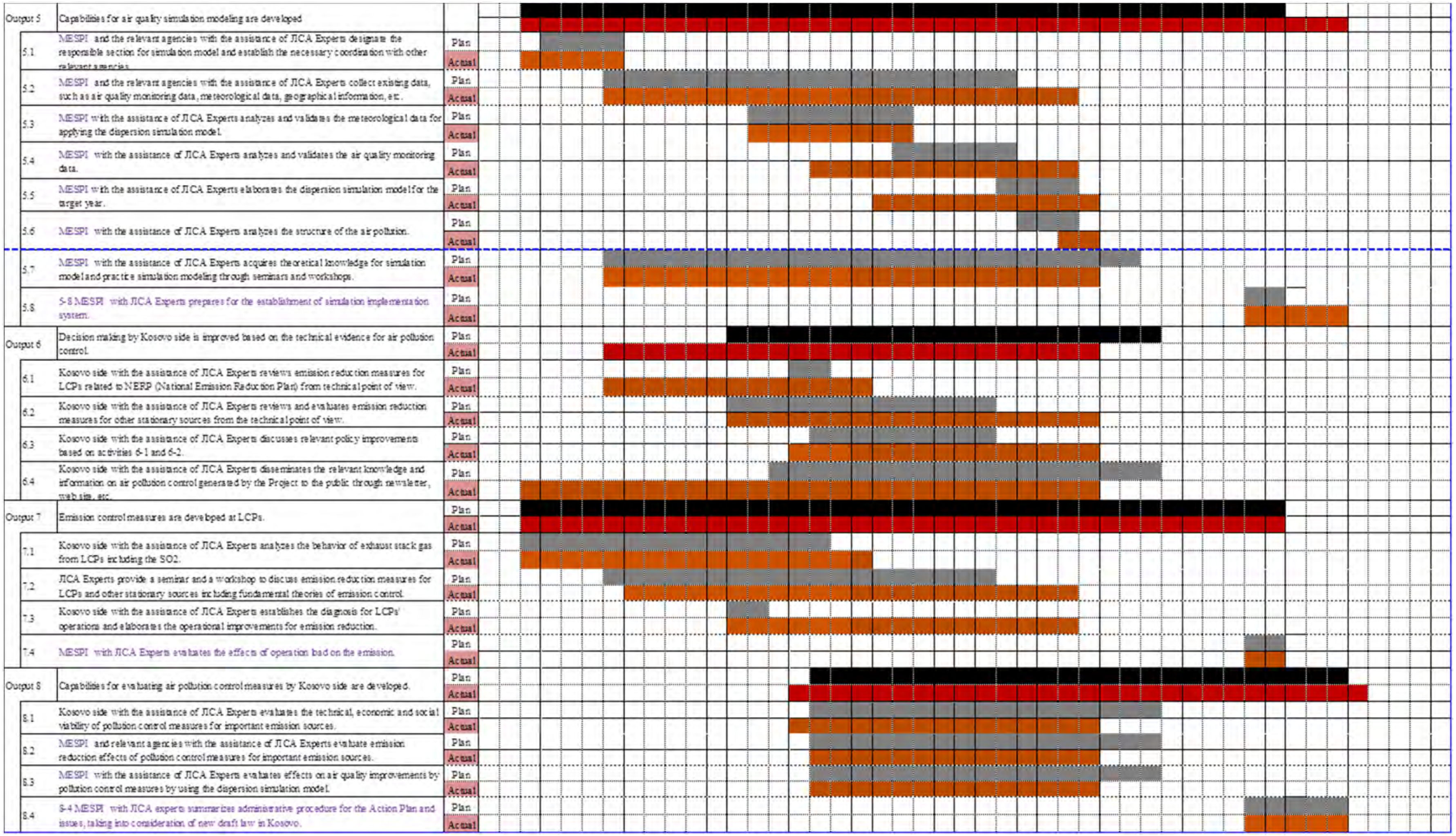
Figure 2-1 Activity plan and actual record

(1/3)



Output 3	Air quality monitoring activities are sustained	
3.1	MESPI with the assistance of JICA Experts assesses the air quality monitoring stations (hereinafter referred to as "AQMS") in Kosovo and summarizes the status of analyzers and equipment.	Plan Actual
3.2	MESPI with the assistance of JICA Experts prepares a plan of operation and maintenance and a plan for revitalization of AQMS in Kosovo.	Plan Actual
3.3	MESPI with the assistance of JICA Experts rehabilitates the AQMSs in the Pristina Area based on plans (3.2).	Plan Actual
3.4	MESPI with the assistance of JICA Experts prepares manuals for operation and maintenance of AQMSs in the Pristina Area.	Plan Actual
3.5	MESPI with the assistance of JICA Experts calibrates the analyzers in AQMSs in the Pristina Area based on the operation maintenance manuals.	Plan Actual
3.6	MESPI with the assistance of JICA Experts prepares a guideline for AQMSs network design in Kosovo.	Plan Actual
3.7	3-7 MESPI with JICA Experts checks the compatibility of the network output with the air quality data displays for the city of Pristina.	Plan Actual
3.8	MESPI with the assistance of JICA Experts prepares Standard Operating Procedures (hereinafter referred to as "SOP") for ambient NO_2, SO_2, PM_{10} and $PM_{2.5}$ measurement by a portable sampler for emergency needs.	Plan Actual
3.9	MESPI with the assistance of JICA Experts implements measurements of ambient NO_2, SO_2, PM_{10} and $PM_{2.5}$ based on SOP (1 hour average) for emergency needs.	Plan Actual
3.10	MESPI with the assistance of JICA Experts utilizes results of AQMSs for the annual air quality report as well as for public awareness.	Plan Actual
3.11	MESPI with JICA Experts analyzes and evaluates air quality data in Kosovo.	Plan Actual
Output 4	Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.	
4.1	MESPI with the assistance of JICA Experts studies sampling and measurement methodologies for the LCPs.	Plan Actual
4.2	MESPI with the assistance of JICA Experts makes Ion Chromatograph (hereinafter referred to as "IC") available for analysis.	Plan Actual
4.3	MESPI with the assistance of JICA Experts conducts analysis by reference methods for LCPs, by using Ion Chromatograph method for SO_2 and NO_x and atomic absorption spectrometer method (hereinafter referred to as "AAS") for Hg.	Plan Actual
4.4	MESPI with the assistance of JICA Experts elaborates SOPs for sampling and analysis for LCP stack gas.	Plan Actual
4.5	MESPI with the assistance of JICA Experts studies sampling and measurement methods for other stationary emission sources.	Plan Actual
4.6	MESPI with the assistance of JICA Experts elaborates SOPs for sampling and measurement methods for other stationary emission sources.	Plan Actual
4.7	MESPI with the assistance of JICA Experts conducts Particulate Matter (PM) sampling by Hi-volume air samplers at least for 2 sampling points.	Plan Actual
4.8	JICA Experts analyze heavy metal contents (Mn, Ni, As, Cd, Pb and Zn) in PM in laboratory in Japan.	Plan Actual
4.9	MESPI with the assistance of JICA Experts assesses the importance and urgency of heavy metal pollution in the air.	Plan Actual
4.10	JICA experts make operation diagnosis of ICP-MS in KHMI laboratory.	Plan Actual
4.11	MESPI with JICA Experts evaluates analysis results by Standard Reference Method.	Plan Actual

Figure 2-1 Activity plan and actual record (2/3)



Output 5	Capabilities for air quality simulation modeling are developed	
5.1	MESPI and the relevant agencies with the assistance of JICA Experts designate the responsible section for simulation model and establish the necessary coordination with other relevant agencies.	Plan Actual
5.2	MESPI and the relevant agencies with the assistance of JICA Experts collect existing data, such as air quality monitoring data, meteorological data, geographical information, etc.	Plan Actual
5.3	MESPI with the assistance of JICA Experts analyzes and validates the meteorological data for applying the dispersion simulation model.	Plan Actual
5.4	MESPI with the assistance of JICA Experts analyzes and validates the air quality monitoring data.	Plan Actual
5.5	MESPI with the assistance of JICA Experts elaborates the dispersion simulation model for the target year.	Plan Actual
5.6	MESPI with the assistance of JICA Experts analyzes the structure of the air pollution.	Plan Actual
5.7	MESPI with the assistance of JICA Experts acquires theoretical knowledge for simulation model and practice simulation modeling through seminars and workshops.	Plan Actual
5.8	5-8 MESPI with JICA Experts prepares for the establishment of simulation implementation system.	Plan Actual
Output 6	Decision making by Kosovo side is improved based on the technical evidence for air pollution control.	Plan Actual
6.1	Kosovo side with the assistance of JICA Experts reviews emission reduction measures for LCPs related to NERP (National Emission Reduction Plan) from technical point of view.	Plan Actual
6.2	Kosovo side with the assistance of JICA Experts reviews and evaluates emission reduction measures for other stationary sources from the technical point of view.	Plan Actual
6.3	Kosovo side with the assistance of JICA Experts discusses relevant policy improvements based on activities 6-1 and 6-2.	Plan Actual
6.4	Kosovo side with the assistance of JICA Experts disseminates the relevant knowledge and information on air pollution control generated by the Project to the public through newsletter, web site, etc.	Plan Actual
Output 7	Emission control measures are developed at LCPs.	Plan Actual
7.1	Kosovo side with the assistance of JICA Experts analyzes the behavior of exhaust stack gas from LCPs including the SO2.	Plan Actual
7.2	JICA Experts provide a seminar and a workshop to discuss emission reduction measures for LCPs and other stationary sources including fundamental theories of emission control.	Plan Actual
7.3	Kosovo side with the assistance of JICA Experts establishes the diagnosis for LCPs' operations and elaborates the operational improvements for emission reduction.	Plan Actual
7.4	MESPI with JICA Experts evaluates the effects of operation bad on the emission.	Plan Actual
Output 8	Capabilities for evaluating air pollution control measures by Kosovo side are developed.	Plan Actual
8.1	Kosovo side with the assistance of JICA Experts evaluates the technical, economic and social viability of pollution control measures for important emission sources.	Plan Actual
8.2	MESPI and relevant agencies with the assistance of JICA Experts evaluate emission reduction effects of pollution control measures for important emission sources.	Plan Actual
8.3	MESPI with the assistance of JICA Experts evaluates effects on air quality improvements by pollution control measures by using the dispersion simulation model.	Plan Actual
8.4	8-4 MESPI with JICA experts summarizes administrative procedure for the Action Plan and issues, taking into consideration of new draft law in Kosovo.	Plan Actual

Figure 2-1 Activity plan and actual record
(3/3)

The main readjustment and/or addition of the works are shown below. Details are explained for each activity.

1. Output 3: Air quality monitoring activities are sustained
   - When the Project started, MCC/MFK also planned rehabilitation of analyzers in AQMSs and establishment of air quality data network. JICA planned rehabilitation of analyzers and establishment of air quality data network for five AQMSs in the Pristina Area. In early stage of the second period (October 2018), as a result of the meeting between JET and MCC/MFK with MESPI/MESP, JET was going to rehabilitate analyzers in five AQMSs in the Pristina Area as planned, but as for establishment of air quality data network, MCC/MFK was going to install data network for all AQMSs since Kosovo side requested an integrated and independent data network in Kosovo. JICA left the establishment of all data network to MCC/MFK. Instead, JET changed the plan of air quality data display installation from installing one indoor display in the city of Pristina to installing outdoor displays in the Pristina Area for five locations. The change of the PDM due to this change of the plan was approved in the third JCC meeting.

     Table 2-1 shows the role sharing between JICA and MCC/MFK

Table 2-1 Role sharing between JICA and MCC/MFK
(In the table below, MESPI /MESP is described as MESPI)

Technical Area	MCC/MFK	JICA
3-3 MESPI with assistance of JICA Experts rehabilitate AQMS in the Pristina Area.	・MCC/MFK rehabilitates analyzers in AQMSs in Kosovo, except five AQMSs in the Pristina Area. ・MCC/MFK rehabilitates all meteorological instruments for AQMSs all over Kosovo.	・JICA rehabilitates analyzers in five AQMS in the Pristina Area ・JICA replaces three AQMS housings out of five AQMSs in the Pristina Area.
3-4 MESPI with assistance of JICA Experts prepares manuals for O&M for AQMSs in the Pristina Area.	MCC/MFK prepares manuals for O&M for AQMSs except five AQMSs in the Pristina Area	JICA prepares manuals for O&M for five AQMSs in the Pristina Area.
3-5 MESPI with assistance of JICA Experts calibrates analyzers in AQMS in the Pristina Area based on the	MCC/MFK calibrates analyzers in AQMSs except five AQMSs in the Pristina Area.	JICA calibrates analyzers in five AQMSs in the Pristina Area

O&M manuals.		
3-7 MESPI with assistance of JICA Experts establishes Networking among AQMS in the Pristina Area.	MCC/MFK establishes Networking among all AQMSs	Activity canceled because of the establishment of integrated data network by MCC/MFK
3-10 MESPI with assistance of JICA Experts utilizes results of AQMS for an annual air quality report as well as for public awareness.	MCC/MFK establishes the air quality data publication system through internet.	JICA installs air quality data displays in the Pristina Area

2. Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.
   - In the last half of the first period, JET sampled PM in the air in Drenas and Mitrovica, brought them to Japan and analyzed heavy metals in the PM. Analysis result for Mitrovica had the components exceeding Japanese guideline value, but analysis result for Drenas had no problems. However, at the timing of sampling in Drenas in the first period, the factory which is presumed to be the biggest emission source was not under operation. C/P requested for analysis to be repeated. In the second period, JET sampled the PM in Drenas again, brought them to Japan and analyzed them. Analysis result showed the components exceeding Japanese guideline value same as the case in Mitrovica. This work needed one year extension because of the waiting period for re-operation of the factory.

     Kosovo side and Japanese side acknowledged the necessity of monitoring heavy metals in PM in the air for both Drenas and Mitrovica. However, in order to analyze heavy metals, the operation of ICP-MS was required. Original plan for ICP-MS was the confirmation of operation possibility. JET checked and repaired the ICP-MS, and the ICP-MS became operational. However, C/P requested to make ICP-MS be able to analyze heavy metals, and therefore, JET operated and adjusted the ICP-MS. The ICP-MS was ready for analyzing heavy metals. MCC/MFK is going to conduct training on operation of the ICP-MS, and then analysis by ICP-MS will become available.

3. Output 7: Emission control measures are developed at LCPs.
   - The Project originally planned to study emission reduction measures for TPP Kosovo A and TPP Kosovo B which are the LCPs targeted by the NERP. However, EU conducted the Feasibility study on rehabilitation of TPP Kosovo B[18], and decided to assist the

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[18] The European Union IPA 2013 Programme For Kosovo*: “ Feasibility Study for Environmental and other measures on Kosovo B Thermal Power Plant,　Feasibility Study Final Version 19 May 2017”

rehabilitation technically and financially. Since EU decided to support the rehabilitation of TPP Kosovo B, KEK requested for MESPI/MESP not to study emission reduction measures for TPP Kosovo B. The Project accepted the request, and decided to study measures only for TPP Kosovo A. On the other hand, KEK and the Project agreed on conducting exhaust gas measurement for TPP Kosovo B as planned, since the Project had to know the existing emission condition in relation to Output 2.

The change was approved in the third JCC meeting. Table 2-2 shows the changes in the activities for Kosovo A TPP and Kosovo B TPP

Table 2-2 Changes in the activities for Kosovo A TPP and Kosovo B TPP
(In the table below, MESPI /MESP is described as MESPI)

Technical Area	Kosovo A TPP	Kosovo B TPP	Reference
Information of Emission measurement data (Dust, SO_2, NO_X) and operation data for Emission inventory preparation for LCPs On-site stack gas measurement (Dust, SO_2, NO_X) for the compliance with Emission Limit Values by MESPI	To be executed	To be executed	Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side Activity 1-1 MESPI with JICA Experts makes a plan and conduct a survey for emission inventory on LCPs. In this activity, following operation data are required. ・ Fuel (lignite) consumption of each unit ・ Net Power output of each unit ・ Temperature of exhaust stack gas ・ Supply of heat to district heating (temperature and pressure of extracted steam and its amount from each unit) ・ Height and Diameter at the top of the stack Output 2: Capabilities for emission measurements are developed for LCPs. Activity 2-2 MESPI and relevant agencies with the assistance of JICA experts execute OJT on exhaust gas measurement by introducing necessary instruments including standard gases. 2-5 MESPI with the assistance of JICA experts conducts on-site stack gas measurement for LCP, and confirms compliance with ELVs (Emission Limit Values)
Emission measurement (SO_2, NO_X, Hg) by Standard Reference Method in line with EU Directive (2010/75/EU)	To be executed	To be executed	Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring. Activity 4.1 MESPI with the assistance of JICA experts studies sampling and measurement methodologies for the

by MESPI			LCPs. 4.3 MESPI with the assistance of JICA experts conducts analyses by reference methods for LCPs by using Ion Chromatograph method for SO_2 and NOx and atomic absorption method for Hg. 4.4 MESPI with the assistance of JICA experts elaborates SOPs for sampling and analyses for LCPs' stack gas
Review and discussion on Emission reduction measures for LCPs	To be executed	Not executed	Output 6: Decision making by Kosovo side is improved based on technical evidence for air pollution control. Activity 6.1 Kosovo side with the assistance of JICA experts reviews emission reduction measures for LCPs relating to NERP (National Emission Reduction Plan) from technical point of view. 6.3 Kosovo side with the assistance of JICA experts discusses relevant policy improvements based on activities 6-1 and 6-2.
Study on Emission reduction measures for LCPs ・ Analysis of the behavior of exhaust gas from LCPs including SO_2 ・ Diagnosis of LCPs' operations and elaboration of operational improvements for emission reduction.	To be executed	Not executed	Output 7: Emission control measures are developed at LCPs. Activity 7.1 Kosovo side with the assistance of JICA experts analyzes the behavior of exhaust stack gas from LCPs including SO2. 7.2 JICA experts provide a seminar and a workshop to discuss emission reduction measures for LCPs including fundamental theories of emission control. 7.3 Kosovo side with the assistance of JICA experts implements diagnosis of LCPs' operations and elaborates operational improvements for emission reduction. In this activity, following activities and data are required. Operation diagnosis ・ Continuous measurement of NO_X and SO_2 ・ Analysis of lignite and fly ash ・ Detailed operation record (fuel, boiler and turbine operation data, etc.) Research on Electrostatic precipitator 6.2 Dust measurement 6.3 Measurement of velocity distribution inside ESP, and Flow analysis inside ESP by Computer Fluid Dynamics (hereinafter referred to as “CFD”) 6.4 Study on improvement plan for ESP by CFD

4. Others
   - Some Balkan countries are suffering from air pollution. Especially in Bosnia and Herzegovina and Republic of North Macedonia, it has become a serious problem. Although it was not originally planned, the Project will hold a regional conference for the Balkan area, and not only introduce the activities of the Project, but also share information on the issues regarding air quality in each participating country.

2.2 Project Implementation Structure

For implementing ambient air protection administration and planning ambient air pollution control measures, in addition to the environmental administration authority, it is necessary to establish a close and collaborative relationship with various sectors such as energy, traffic, infrastructure, etc., because emission sources and pollution control measures spread to a wide range of sectors. Therefore in addition to MESPI/MESP which requested this project, the Project studied the collaboration and role allocations with other relevant organizations and agencies, and constructed the C/P-WG to support the establishment of the Project scheme. C/P-WG, where MESPI/MESP is a main C/P, also consists of ME/MED which is higher competent agency of KEK, and, with respect to development of Emission inventory elaboration, MITE/MTI, MESPI/MI, MIAPA/MIA, the municipality of Pristina, KSA, etc. The following figure shows implementation framework of the Project.

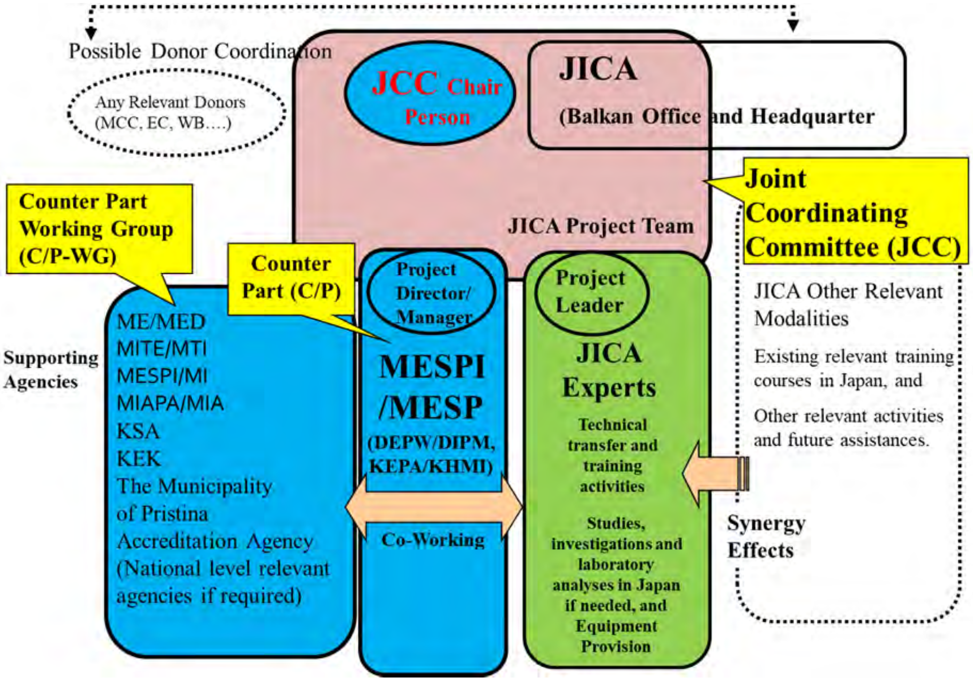

Figure 2-2 Project Implementation Framework

Acronyms of each organization or agency are as follows.

MESPI/MESP	Ministry of Environment, Spatial Planning and Infrastructure (Former Ministry of Environment and Spatial Planning)

DEPW (MESPI/MESP)	Department for Environmental Protection and Water
DEPW/DIPM (MESPI/MESP)	Division for Industrial Pollution Management
KEPA (MESPI/MESP)	Kosovo Environmental Protection Agency
KHMI (MESPI/MESP)	Kosovo Hydro-Meteorological Institute
ME/MED	Ministry of Economy (Former Ministry of Economic Development)
KEK	Kosovo Energy Corporation
MITE/MTI	Ministry of Industry, Trade and Entrepreneurship (Former Ministry of Trade and Industry)
MESPI/MI	Ministry of Environment, Spatial Planning and Infrastructure (Former Ministry of Infrastructure)
MIAPA/MIA	Ministry of Internal Affairs and Public Administration (Former Ministry of Internal Affairs)
KSA	Kosovo Statistics Agency
AA	Accreditation Agency

The Figure 2-3 shows the diagram of Japanese side structure.

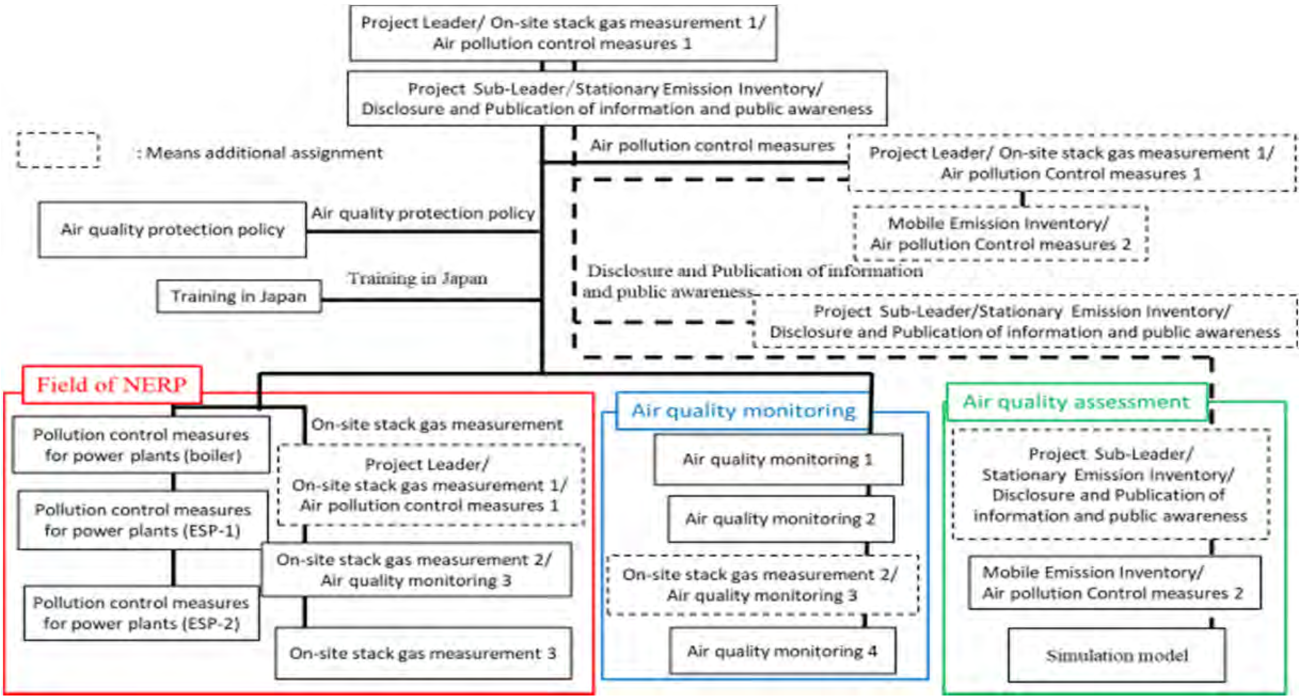

Figure 2-3 Diagram of JICA Expert Team (JET) Structure

2.3 Japanese side input

2.3.1 Dispatch record of JICA experts

Thirteen Japanese experts were assigned to visit Kosovo from October of 2017 to March of 2020. Experts supported the activities by C/P and C/P-WG of the Project. However, JET could not travel to Kosovo due to the COVID-19 Pandemic, and the Project has continued activities through virtual meetings. .

Table 2-3 shows the expert assignment result.

Table 2-3 Expert assignment results
(1/2)

First Period: Oct-06, 2017 ~ Sep-28, 2018
Second Period: Oct-12, 2018 ~ Sep-30, 2019
Third Period: Sep-27, 2019 ~ Jun-30, 2021

No	Field of expertise	Name (Firm)	Rank	Period	Dispatch period			Man Months		
					From	To	Man･Day	First Period	Second Period	Third Period
1	Chief Adviser to On-site stack gas measurement 1/ Air pollution control measures 1	Masuto SHIMIZU Suuri-Keikaku Co.,Ltd.	2	First Period	Oct-18, 2017	Nov-9, 2017	23	5.03		
					Nov-29, 2017	Dec-22, 2017	24			
					Jan-24, 2018	Feb-20, 2018	28			
					Apr-4, 2018	Jun-5, 2018	63			
					Jul-4, 2018	Jul-16, 2018	13			
				Second Period	Oct-18, 2018	Nov-27, 2018	41		4.77	
					Jan-9, 2019	Feb-8, 2019	31			
					Mar-19, 2019	Apr-30, 2019	43			
					Jun-4, 2019	Jul-1, 2019	28			
				Third Period	Oct-19, 2019	Dec-4, 2019	47			2.53
					Jan-28, 2020	Feb-25, 2020	29			
				Sub total			370	12.33		
2	Deputy Chief Adviser to Stationary Emission Inventory/ Disclosure and Publication of information and public awareness	Fumihiko KUWAHARA Suuri-Keikaku Co.,Ltd.	3	First Period	Nov-29, 2017	Dec-22, 2017	24	3.07		
					Jan-24, 2018	Mar-2, 2018	38			
					Apr-4, 2018	May-3, 2018	30			
				Second Period	Oct-18, 2018	Nov-1, 2018	15		3.33	
					Jan-16, 2019	Feb-8, 2019	24			
					Apr-2, 2019	Apr-26, 2019	25			
					May-29, 2019	Jul-3, 2019	36			
				Third Period	Oct-19, 2019	Dec-7, 2019	50			3.20
					Jan-21, 2020	Mar-6, 2020	46			
				Sub total			288	9.60		
3	Air quality monitoring 1	Keiichi TAKAHASHI engaged by Suuri-Keikaku Co.,Ltd. Nippon Koei Co., Ltd.	2	First Period	Jan-24, 2018	Feb-21, 2018	29	1.97		
					May-23, 2018	Jun-21, 2018	30			
				Second Period	Oct-18, 2018	Nov-9, 2018	23		4.13	
					Jan-9, 2019	Feb-2, 2019	25			
					Apr-3, 2019	Jun-17, 2019	76			
				Third Period	Nov-11, 2018	Nov-30, 2018	20			0.67
				Sub total			203	6.77		
4	Pollution control measures for power plants (boiler)	Yasufumi NAKAJIMA engaged by JFE Techno-Research Corporation Thermal Power Engineering Institute	2	First Period	Nov-29, 2017	Dec-22, 2017	24	3.17		
					Apr-4, 2018	Jun-1, 2018	59			
					Jul-4, 2018	Jul-15, 2018	12			
				Second Period	Oct-19, 2018	Nov-12, 2018	25		2.10	
					Mar-20, 2019	Apr-26, 2019	38			
				Third Period						0.00
				Sub total			158	5.27		
5	On-site stack gas measurement 2/ Air quality monitoring 3	Tadayoshi USUI JFE Techno-Research Corporation	3	First Period	Jan-24, 2018	Feb-21, 2018	29	3.63		
					Apr-4, 2018	Jun-22, 2018	80			
				Second Period	Oct-31, 2018	Nov-26, 2018	27		3.20	
					Mar-19, 2019	Apr-12, 2019	25			
					Apr-23, 2019	Jun-5, 2019	44			
				Third Period	Oct-31, 2018	Dec-10, 2018	41			1.37
				Sub total			246	8.20		
6	On-site stack gas measurement 3	Natsuji SAWAKI Suuri-Keikaku Co.,Ltd.	4	First Period	May-30, 2018	Jun-18, 2018	20	0.67		
				Second Period	Apr-23, 2019	May-21, 2019	29		0.97	
				Third Period	Oct-31, 2018	Nov-15, 2018	16			0.53
				Sub total			65	2.17		
7	Pollution control measures for power plants (ESP-1)	Kazutaka TOMIMATSU engaged by JFE Techno-Research Corporation Japan Coal Energy Center	3	First Period	Nov-29, 2017	Dec-17, 2017	19	1.67		
					Apr-11, 2018	May-11, 2018	31			
				Second Period	Oct-19, 2018	Nov-5, 2018	18		1.50	
					Mar-20, 2019	Apr-15, 2019	27			
				Sub total			95	3.17		
8	Pollution control measures for power plants (ESP-2)	Takehito SOUMA engaged by JFE Techno-Research Corporation Japan Coal Energy Center	4	First Period	Apr-11, 2018	Apr-26, 2018	16	0.53		
				Sub total			16	0.53		

Table 2-3 Expert assignment results
(2/2)

9	Air quality monitoring 2	Ryo HASEGAWA JFE Techno-Research Corporation	4	First Period	Jan-24, 2018	Feb-10, 2018	18	1.30		
					May-28, 2018	Jun-17, 2018	21			
				Second Period	Nov-7, 2018	Nov-26, 2018	20		1.73	
					Apr-23, 2019	May-24, 2019	32			
				Third Period	Nov-18, 2018	Dec-10, 2018	23			0.77
				Sub total			114	3.80		
10	Air quality monitoring 4	Hiroyuki MAEDA Suuri-Keikaku Co.,Ltd.	3	Second Period	May-30, 2019	Jun-18, 2019	20		0.67	
				Sub total			20	0.67		
11	Mobile Emission Inventory/ Air pollution control measures 2	Toru TABATA Suuri-Keikaku Co.,Ltd.	3	First Period	Oct-23, 2017	Nov-9, 2017	18	1.27		
					Feb-7, 2018	Feb-26, 2018	20			
				Second Period	Feb-5, 2019	Feb-27, 2019	23		0.77	
				Third Period*1)	Jan-21, 2020	Feb-8, 2020	18			0.60
				Sub total			79	2.64		
12	Simulation model	Ei EDO SUURI-KEIKAKU CO.,LTD	3	First Period	Oct-18, 2017	Nov-9, 2017	23	2.53		
					Dec-4, 2017	Dec-22, 2017	19			
					Apr-23, 2018	May-26, 2018	34			
				Second Period	Oct-29, 2018	Dec-5, 2018	38		3.70	
					Feb-5, 2019	Feb-27, 2019	23			
					May-15, 2019	Jul-3, 2019	50			
				Third Period	Oct-20, 2019	Nov-25, 2019	37			2.53
					Jan-28, 2020	Mar-6, 2020	39			
				Sub total			263	8.76		
13	Air quality protection policy	Katunori SASAKI engaged by Suuri-Keikaku Co.,Ltd. Sasaki environamtanl technology Office Inc.	3	First Period	Apr-11, 2018	Apr-25, 2018	15	0.50		
		Kyoichi KAMEYAMA engaged by Suuri-Keikaku Co.,Ltd. Human Resources Innovation Inc.		Second Period	Jan-16, 2019	Feb-2, 2019	18		0.60	
				Third Period	Nov-11, 2019	Nov-27, 2019	17			1.13
					Feb-3, 2020	Feb-19, 2020	17			
				Sub total			67	2.23		
				Total				66.14		

*1) on Jan-26, 2020, one day was spent for the work for hthe Teheran Project.

2.3.2 Counterpart training record in Japan

As one of the activities of the Project, the Project selected members for the training in Japan mainly from C/P officials and carried out the two-weeks training two times. Table 2-4 shows the results of the trainings in Japan.

The purpose of the training is for trainees to see and learn present efforts for better air quality by central and local governments and private businesses in Japan. Trainees were expected to deepen their understandings on activities by the Project.

The first training in Japan aimed at observing the existing condition of exhaust gas measurement, environmental analysis and air quality monitoring, which would benefit to their activities in Kosovo. Through these activities, they learned that it is important to obtain accurate data by organizing equipment, inspecting collected data, and to conduct proper O&M of analyzers. At the same time, they listened to the officials in charge of mechanism of compliance with laws and regulations from the main emission sources, and learned that in Japan, air quality is protected through collaboration between governments and private businesses.

In the second training in Japan, Trainees learned of data collection system for emission inventory and the necessity of accurate data collection through analytical works making use of emission inventory. They learned how to use simulation results based on emission inventory. In same way as in the first training, they learned that in Japan air quality is protected through collaboration between governments and private businesses.

Both groups of trainees commented that they would like to set Japanese environmental protection system as a target for the future in Kosovo.

Table 2-4 Result of the trainings in Japan

(1/2)

List of Officials who participated in the First Counterpart Training in Japan

(In the table below, MESPI/MESP is described as MESP)

Title of the training：The training for the exhaust gas measurement, analysis and monitoring for air quality management, and the construction of the framework for the compliance with regulations from the main emission sources

Aims of Training : To draft a proposal or an action plan for establishing an institutional framework such as administrative system, collaboration system with enterprises, etc. regarding air quality management based on the exhaust gas measurement results and air quality monitoring data.

Targets：

1. To understand that in Japan, private business operators voluntarily conduct emission measurement and adjust the operation considering measurement results, and at the same time, municipalities enter and inspect facilities through measurement as necessary in order to assess the compliance with emission limit values. Trainees will use this experience for proposing or drafting an action plan.
2. To draft a proposal or an action plan for establishing future institutional framework for air quality measurement and exhaust gas measurement by observing and understanding actual situation in Japan.
3. To visit and observe facilities and exhaust gas monitoring system for air quality protection by private business operators including the coal fired plant, and to understand relationship and information sharing between private business operators and municipalities.
4. To understand the ways of exhaust gas measurement equipment organization, analysis laboratory, their operation and maintenance and know-how. To learn the significance of daily maintenance and periodical maintenance.

Training location：JICA Yokohama

Name	Field of work in Kosovo	Training period and content	occupation
Ms. Nezakete	Project manager Coordinator of Air	Training Period： February 27 ~ March 13, 2019	Head of Division, Department of Environmental Protection and

HAKAJ	Quality Management Policy	Contents of training February 28 (Thu) 09:30～11:30 Briefing 13:30～16:30 Purposes and assignment of the training February 29 (Fri) 10:30～12:30 Environmental administration by the Ministry of Environment 14:30～16:00 Environmental administration by the Tokyo Metropolitan March 4 (Mon) 10:00～11:30 Tour to Air Quality Monitoring Station: (Monitoring Center →AQMS at Honmoku, Naka-ku→Monitoring Center) 13:30～16:30 Lecture for air quality monitoring: Introduction of remote exhaust gas monitoring system for a power plant March 5 (Tue) 10:00～12:00 Tour to a private coal fired power plant 13:30～15:10 Introduction of the History of Environmental Agreement in Yokohama city 15:15～16:30 Regulation for air by Yokohama city March 6 (Wed) 10:00～10:30 Tour to Chassis Dynamo testing machine 10:30～12:00 Procedures for emission control from vehicles 13:00～14:00 Group discussion by trainees 15:30～16:30 Courtesy visit to Kosovo Embassy March 7 (Thu) 09:00～12:30 Tour to a private factory with many emission sources 13:30～15:30 Continued 14:45～17:30 Tour to analysis laboratory March 8 (Fri) 09:30～10:15 Tour to stock place for measurement equipment 10:15～12:15 Lectures on environmental analysis and exhaust gas measurement	Water, Ministry of Environment and Spatial Planning (2002)
Mr. Sabri SIMNICA	On-site Stack Gas Measurement Power Plant Control (Boiler and ESP)		Chief Engineer for Environment Monitoring, Department of Engineering and Project Management, TPP-A. Kosovo Energy Corporation J.S.C.(2012)
Mr. Abdullah PIRCE	On-site Stack Gas Measurement Simulation Modeling		Officer for Climate Change, Division for Protection from Industrial Pollution, Ministry of Environment and Spatial Planning(2010)
Mr. Agim MORINA	JCC member		Manager of the Department for Environment Protection, Kosovo Energy Corporation JSC(2010)
Mr. Agron SHALA	Coordinator of On-site Stack Gas Measurement		Technical Officer for Analysis, Air Protection Sector, Hydro meteorological Institute of Kosovo(2018)
Mr. Ismet DERVARI	On-site Stack Gas Measurement		Environmental Protection Inspector, MESP Inspectorate, Ministry of Environment and Spatial Planning(2002)
Mr. Kastriot ABAZI	On-site Stack Gas Measurement Power Plant Control (Boiler and ESP)		Engineer of Environment Monitoring, Department of Project Management, Kosovo Energy Corporation J.S.C.(2016)
Mr. Musli KOZHANI	On-site Stack Gas Measurement Air Quality		Officer for Air Quality Protection, /, Hydro-Meteorological Institute

	Monitoring	13:15～13:50 Lectures on principles, usage and maintenance for the analyzer donated by JICA 14:00～14:30 Practice on maintenance for the analyzer donated by JICA 15:15～16:15 Lectures on analysis principles for analyzers used for air quality monitoring and exhaust gas measurement March 11 (Mon) 09:30～12:00 Seminar: experience of planning air pollution control measures in Tokyo metropolitan 13:00～18:30 Group discussion for presentation on the training, and preparation of the presentation March 12 (Tue) 09:30～12:00 Discussion for presentation on the training 13:30～16:00 Presentation on the training and closing ceremony	of Kosovo(2016)
Mr. Naim ALIDEMA	Power Plant Control (Boiler and ESP)		Senior Officer, Department for Environment and Water Protection, Ministry of Environment and Spatial Planning(2018)
Ms. Qefsere MULAKU	On-site Stack Gas Measurement		Environmental Protection Inspector, Inspection of Environment Protection , Nature & Water, Ministry of Environment and Spatial Planning (MESP)(2015)

Table 2-4 Result of the trainings in Japan

(2/2)

List of Officials Participated in the Second Counterpart Training in Japan

(In the table below, MESPI/MESP is described as MESP)

Title of the training course：The training on development of the institutional framework for data collection procedure and the use of calculation results of emission inventory and simulation

Aims of Training: To draft a proposal or an action plan for establishing a system for an effective use of the results of emission inventory and simulation for air quality management through understandings of data preparation procedures

Targets：

1. Understanding of data preparation procedures for emission inventory under the responsibility and role sharing of relevant institutions/agencies.
2. Understanding of data preparation procedures for simulation under the responsibility and role sharing of relevant institutions/agencies.
3. Understanding of the administrative use of emission inventory
4. Understanding of the administrative use of simulation results
5. Understanding of air protection equipment and monitoring systems for main emission sources, and information sharing between municipalities and private business operators regarding air quality protection

Training location：JICA Tokyo

Name	Field of work in Kosovo	Training period and content	occupation
Mr. Afrim BERISHA	Coordinator of Emission Inventory	Training Period： August 31 ~ September 13, 2019 Contents of training September 2 (Mon) 10:30～12:30 Briefing 13:30～16:00 Purposes and assignment of the training	Director of Directorate for Monitoring, Assessment and Reporting KEPA/MESP
Mr. Rizah Murseli	Simulation Model		Head of GIS Division ISP/MESP

		September 3 (Tue) 10:00～12:00 Introduction of the environmental administration and research on emissions of pollutants in the air by the Ministry of Environment 14:00～16:45 Air quality administration by Kawasaki city Air quality monitoring system in Kawasaki city. September 4 (Wed) 10:00～11:45 Tour to Air Quality Monitoring Station: (Monitoring Center →AQMS at Honmoku, Naka-ku→Monitoring Center) 13:30～17:00 Lecture for air quality monitoring: Introduction of remote exhaust gas monitoring system for a power plant September 5 (Thu) 9:30～11:30 Tour to a private factory with many emission sources Tour to analysis laboratory and lecture on analysis 14:00～16:00 Tour to a private coal fired power plant September 6 (Fri) 10:00～12:00 Lecture on statistical research of actual CO_2 emission from households 13:45～15:00 Courtesy visit to Kosovo Embassy 16:00～17:00 Intermediate review on the training September 9 (Mon) 10:30～12:00 Lectures on simulation and effective use of the results by Japan Automobile Research Institute, and tour to emission measurement from vehicles such as Chassis Dynamo testing machine 13:30～15:30 Lectures on effective use of emission inventory and simulation by National Institute for Environmental Studies, and introduction of study case by academic–industrial cooperation 15:30～16:30 Clarification of issues of emission inventory and simulation in Kosovo	
Ms. Vlora SPANCA	Emission Inventory		Officer for database KEPA/MESP
Mr. Mentor SHALA	Emission Inventory		Specialist for air quality KHMI/KEPA/MESP
Mr. Armend AGUSHI	Emission Inventory		Officer for waste and chemicals KEPA/MESP
Mr. Sabit RESTELICA	Emission Inventory Air Pollution Control		Officer for air quality and noise KEPA/MESP
Ms. Letafete LATIFI	Coordinator of Simulation Model		Director of KHMI
Mr. Ajet MAHMUTI	Emission Inventory Simulation Model		Officer for monitoring of emission in the air KEPA/MESP
Mr. Shkumbin SHALA	Coordinator of Air Quality Monitoring		Specialist for air quality KHMI/KEPA/MESP
	Simulation		Head of sector for

Mr. Përparim GASHI	Model	September 10 (Tue) 9:30～10:30 Introduction of study cases by academic–industrial cooperation 10:45～11:45 Procedures for emission control from vehicles, and introduction of an in-vehicle analyzer possessed by Suuri-Keikaku. 14:30～16:15 Introduction of air quality management by Tokyo Metropolitan September 11 (Wed) 09:30～12:00 Seminar: experience of planning air pollution control measures in Tokyo metropolitan 14:30～16:30 Group discussion for presentation on the training, and preparation for a document September 12 (Thu) 9:00～11:30 Discussion for presentation on the training and preparation for a document 13:30～16:30 Presentation on the training and closing ceremony	Environmental Information System KEPA/MESP
Mr. Lulzim Mjekiqi	From the municipality of Obiliq		Environment Officer Municipality of Obiliq, Directorate for Environment Protection
Mr. Drilon Meha	From the University of Pristina		Teaching Assistant The University of Pristina

2.3.3 Provision of equipment

In order for technology transfer and activities in Kosovo to go more effectively, the Project carried out the handover of necessary equipment. Table 2-5 shows the Equipment Handover List.

In handover list, equipment for exhaust gas measurement was the majority, and others were, air quality measurement equipment, equipment for environmental analysis, simulation computers, etc.

Table 2-5 Equipment Handover List

Name of the Property	Standard, Part Number	Quantity	Date of Inspection	Price		Location	Current State	Activities related to the PDM	Remarks
				Yen	Euro				
PC for simulation	PC HP PRPDESK 440 G4 INTEL CORE 17-7700 + MONITOR	2	2017/11/15	204,815	(1,524.00)	KHMI, Pristina, Kosovo	Under Operation	Activity 5.3, 5.4, 5.5,5.6, 5.7	
	POWER TREE UPS 1250 VA	2	2017/11/15	19,353	(144.00)	KHMI, Pristina, Kosovo	Under Operation	ditto	
	HD ENCLOSURE 2.5 LC-POWER EH-LC-PRO24WU	4	2017/11/15	13,439	(100.00)	KHMI, Pristina, Kosovo	Under Operation	ditto	
	CRUCIAL 16GB 2400MTS PC4-19200	2	2017/11/15	37,630	(280.00)	KHMI, Pristina, Kosovo	Under Operation	ditto	
	NB DELL INSPPIRON 3567 INTEL CORE 17-7500U 4MB 15.6” DDRA24000MHZ 1TB	1	2017/11/15	92,731	(690.00)	KHMI, Pristina, Kosovo	Under Operation	ditto	
PC for measurement	NB DELL INSPPIRON 3567 INTEL CORE 17-7500U 4MB 15.6” DDRA24000MHZ 1TB	1	2017/11/15	92,731	(690.00)	KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Standard Gas Dilutor	KIMOTO ELECTRIC CO., LTD. Standard Gas Dilutor: SG-741	1	2018/4/4	270,000		KHMI, Pristina, Kosovo	Under Operation	Activity 3.3, 3.5	
Pitot tube	Octscience CO.,LTD W-23	1	2018/4/16	87,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	

Inclined manometer	MARUNI SCIENCE CO.,LTD M2-P1	1	2018/4/16	120,400		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Heating pipe	Octscience CO.,LTD B-60HP	1	2018/4/16	92,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Moisture absorption pot	Octscience CO.,LTD 10/Set, SK-250-2010	1	2018/4/16	84,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Gas Washer bin	3/Set 4619-03	1	2018/4/16	61,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Wet type gas meter (1L)	MARUNI SCIENCE CO.,LTD W-NK-1B	1	2018/4/16	219,450		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Wet type gas meter (5L)	MARUNI SCIENCE CO.,LTD W-NK-2.5B	1	2018/4/16	262,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Diaphragm type pump	MARUNI SCIENCE CO.,LTD M2-17D050-0	1	2018/4/16	315,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Sealed vacuum rotary pump(NOx)	ULVAC Kiko Inc. G-50SA	1	2018/4/16	70,400		KHMI, Pristina, Kosovo	Under Operation	Activity 4.5	
Hot-wire anemometer	6501-00	1	2018/4/16	102,400		KHMI, Pristina, Kosovo	Under Operation	Activity 7.3	

Fortran Compiler	Intel Parallel Studio XE 2018 Composer Edition Fortran	3	2018/4/23	411,600		KHMI, Pristina, Kosovo	Under Operation	Activity 5.3, 5.4, 5.5,5.6, 5.7	
High Volume Sampler	KIMOTO ELECTRIC CO., LTD. MODEL-120SL	2	2018/5/17	920,000		KHMI, Pristina, Kosovo	Under Operation	Activity 4.7	
GIS Software	ArcGIS Desktop Basic SU	1	2018/7/10	377,175	(2,950.00)	KHMI, Pristina, Kosovo	Under Operation	Activity 4.7	
Equipment for Ion Chromatograph	SHIMADZU CORPORATION Micro-syringe, six-way valve, etc.	1	2018/10/31	442,510		KHMI, Pristina, Kosovo	Under Operation	Activity 4.2, 4.3	
trolley	HKW-180	2	2018/11/8	92,400		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Digital PM counter	SIBATA SCIENTIFIC TECHNOLOGY LTD. Model LD-5R	2	2019/1/10	695,550		KHMI, Pristina, Kosovo	Under Operation	Activity 3.9	
Automated gas analyzer	HORIBA, Ltd. PG-350	1	2019/2/21	5,240,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	directly supplied by JICA
data logger	GL240-SD	1	2019/2/21			KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Tool set	TONE TSA3331	1	2019/4/24	55,300		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Pitot tube	Octscience CO.,LTD W-23	1	2019/4/24	87,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	

Heating pipe	Octscience CO.,LTD B-60HP	1	2019/4/24	92,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Moisture absorption pot	Octscience CO.,LTD 10/Set, SK-250-2010	1	2019/4/24	84,000		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Dust measurement equipment	Octscience CO.,LTD 1 set	1	2019/4/24	414,240		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	One set for Dust measuremen t
Wet type gas meter (1L)	MARUNI SCIENCE CO.,LTD W-NK-1B	1	2019/4/24	214,830		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Wet type gas meter (5L)	MARUNI SCIENCE CO.,LTD W-NK-2.5B	1	2019/4/24	256,680		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Diaphragm type pump (1L)	MARUNI SCIENCE CO.,LTD 4617-70	1	2019/4/24	290,500		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Diaphragm type pump (1L)	ULVAC Kiko Inc. DA-30S	1	2019/4/24	46,900		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Diaphragm type pump （5L)	MARUNI SCIENCE CO.,LTD 4617-71	2	2019/4/24	655,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Sealed vacuum rotary pump(NOx)	ULVAC Kiko Inc. G-50SA	1	2019/4/24	66,880		KHMI, Pristina, Kosovo	Under Operation	Activity 4.5	
Pretreatment equipment for Hg analysis	MARUNI SCIENCE CO.,LTD 5285-33	20	2019/4/24	1,230,000		KHMI, Pristina, Kosovo	Under Operation	Activity 4.3	
Cylinder stand	KBIS15-3 for 3 cylinders	3	2019/4/24	62,100		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Ultrasonic washing machine	SANSYO Co., LTD AU-50C	2	2019/4/24	124,200		KHMI, Pristina, Kosovo	Under Operation	Activity 4.2, 4.3	

Portable gas analyzer	TESTO320	1	2019/4/24	62,100		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Extended sampling tube for portable gas analyzer	700mm for TESTO 320	1	2019/4/24	124,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Pretreatment equipment for Hg analysis	TFM vessel, Indicator spring, Special Spring, Adaptor Plate, etc.	1	2019/4/24	437,488	(3,516.53)	KHMI, Pristina, Kosovo	Under Operation	Activity 4.3	Set of equipment for Hg analysis
Regulators	Double stage pressure regulators	15	2019/4/24	1,064,908	(8,432.98)	KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Desktop anti-vibration table	VAM－II	1	2019/11/14	55,200		KHMI, Pristina, Kosovo	Under Operation	Activity 2.2, 2.3, 2.5	
Copy machine	KM Bizhub C227 and attachment	1	2017/11/15	475,103	(3,600.00)	KHMI, Pristina, Kosovo	Under Operation	-	for office use
				16,223,213					

2.3.4 Local duties cost

Local duties cost in each period are shown in Table 2-6.

Table 2-6 Results of local duties cost

(Yen)

		First Period	Second Period	Third Period	Total
General Cost					
	Local interpreter, assistant and consultant cost	4,991,227	5,736,977	13,797,783	24,525,987
	Rental car cost	1,788,155	1,902,055	730,362	4,420,572
	Rental cost	15,254	5,011	53,531	73,796
	Consumables expenses	6,136,498	6,476,243	407,972	13,020,713
	Travel costs	105,788	14,444	6,006	126,238
	Communication and transportation fee	44,193	47,519	407,972	499,684
	Material preparation expenses, etc.	27,098	39,317	1,144,087	1,210,502
	Meeting expenses	21,269	18,034	29,312	68,615
	Student Research (Research Interviews, Traffic counting)	1,801,976	367,795	0	2,169,771
	Miscellaneous expense	0	34,428	1,236,470	1,270,898
Equipment cost		6,943,856	8,181,421	53,200	15,178,477
Equipment shipping cost		485,293	806,984	70,470	1,362,747
Local sub-contract work cost		4,810,000	51,858,691	1,168,683	57,837,374
Total		27,170,607	75,488,919	19,105,848	121,765,374

Contents and outcomes regarding Local sub-contract work are as follows.

(1) First Period

In the first period, in the field of air quality monitoring, the Project conducted inspection of existing condition of all analyzers in AQMSs in Kosovo, and diagnosis of re-functionalization of laboratory analyzers (the IC and ICP-MS) in KHMI. JET also conducted analysis on heavy metals in PM in Japan.

Furthermore, the Project, for the purpose of the study on emission reduction measures for TPP Kosovo A, carried out velocity distribution simulation by CFD inside ESP and analysis of lignite and fly ash for inspecting boiler operation characteristics.

1) Inspection of analyzers in AQMSs in Kosovo

Kosovo has twelve AQMSs. The Project inspected the existing condition of analyzers all over Kosovo. Detailed report is attached in Appendix-1 “Second Period: 3-2)-1 Summary of Air Quality Monitoring Station Inspection all over Kosovo”. The Project inspected all analyzers in AQMSs for five days from June, 4 to June, 8, 2018.

The Report was used as a basic document for rehabilitation of five AQMSs in the Pristina Area implemented in the second period, and at the same time, was provided as a reference document for the rehabilitation of analyzers by MCC/MFK.

2) Repair and re-functionalization of the IC

The Project selected the analysis method by the IC as a Standard Reference Method for exhaust gas analysis for SO_X and NO_X. The IC is the analyzer measuring ions in solution and is possible to be used for analysis of SO_X and NO_X in the air. The IC was brought to KHMI in 2012, but it had not operated since the test operation at the time of the introduction. Therefore, The Project made a diagnosis in the first period and listed up necessary parts, etc. for re-functionalization of the IC. The Project with the assistance of the engineer from the regional agent for Balkan area made a diagnosis from June 5 to 8, 2018. As a result, the Project found some parts not to be operational because of the adherence of solutions, and listed up necessary parts for re-functionalization. Detailed report is attached in Appendix-1 “Second Period: 4-2)-4 Report on Ion Chromatograph” which includes the second period activity.

3) Diagnosis on possibility of ICP-MS operation

The Project made a diagnosis on ICP-MS in KHMI that can analyze heavy metals in PM in the air. However, since the Project was going to discuss with C/P that the operation of the ICP-MS depended on the results analyzed in Kosovo, JET only inspected the possibility of ICP-MS operation. However, when C/P and JET inspected the inside ICP-MS beforehand, they found that much of the wiring inside was damaged by a mouse gnawing. The Project gave up a diagnosis in Kosovo, and then, sent the ICP-MS to the regional agent in Croatia and conducted the diagnosis including repair of the damaged wiring. As a result, the wiring was restored to the original state, and the ICP-MS was confirmed to be functioning normally. Detailed report is attached in Appendix-1 “Second Period: 4-2)-1 Service report (ICP-MS)”

4) Analysis of heavy metals in PM

The Project sampled PM in the air in Drenas and Mitrovica, brought them back to Japan and analyzed heavy metals in PM. As a result, it turned out that some components in the PM sampled in Mitrovica exceed Japanese guideline values. Details are described in 3-3. Detailed report is attached in Appendix-1 “Second Period: 4-2)-3 Result of Heavy Metal analysis from TSP and PM_{10}”

5) Velocity distribution simulation inside ESP in TPP Kosovo A by CFD

The Project studied Dust reduction measures for TPP Kosovo A and proposed measures. Since the velocity distribution inside ESP was not uniform, the Project studied the modification to make velocity distribution inside ESP more uniform in order for ESP to have a better performance. In the study, the Project decided on the modification by establishing flow analysis by CFD based on the actual measurement result of flow distribution and studying how to modify the inside ESP. TPP Kosovo A accepted the proposal and implemented the modification. The Project confirmed the uniformity of the velocity distribution.

The modification was studied through industry-academy-government cooperation among UP, KEK, MESPI/MESP and JET which is unusual in Kosovo, and the collaboration achieved the purpose.

Detailed report on flow analysis by CFD is attached in Appendix-1 “Second Period: 7-3)-4 Simulation results of ESP by UP”

6) Analysis cost (Lignite and fly ash)

The Project made analysis on lignite and fly ash in TPP Kosovo A. Through understanding the property of lignite and fly ash from analysis results, the Project analyzed the boiler operation in order to study emission reduction measures. The analysis results were used to study emission reduction measures for SO_2 and Dust, and became important database. Detailed results are attached in Appendix-1 “First Period: 7-2)-3 Lignite Analysis Kosovo A” and “First Period: 7-2)-4 Lignite Analysis Kosovo B”

(2) Second Period

In the second period, in the field of air quality monitoring, the Project rehabilitated analyzers for five AQMSs in the Pristina Area, housing replacement of three out of five AQMSs, and installed air quality data displays.

As for laboratory analysis, the Project re-functionalized the IC and adjusted the ICP-MS in KHMI.

JET sampled the PM in the air again and analyzed heavy metals in Japan, in response to the request from C/P.

1) Rehabilitation of AQMS analyzers

Based on the inspection results in the first period, the Project rehabilitated analyzers of five AQMSs in the Pristina Area. Rehabilitation works finished in June of 2019 as scheduled. Since MCC/MFK finished works for other seven AQMSs in November of 2019, all analyzers of AQMSs in Kosovo were rehabilitated. Detailed report is attached in Appendix-1 “Second Period: 3-2)-4 Rehabilitation of AQMS in the Prishtina Area”.

2) Housing replacement of three AQMSs

Three out of five AQMSs in the Pristina Area had small housings and the small spaces caused difficulties for the maintenance work for analyzers, and troubles with analyzer overheating, etc. The Project replaced the housings with larger ones and works finished in June of 2019 as scheduled. Detailed report is attached in Appendix-1 "Second Period: 3-2)-3 Housing renewal of 3 (three) AQMSs in the Prishtina Area"

3) Installation of air quality data displays (construction of data network and data transmission)

Kosovo has twelve AQMSs, but since the data network for AQMSs was not established, data were not quickly collected. The Project planned to establish data network for five AQMSs in the Pristina Area. However, JICA decided to leave the establishment of data network work to MCC/MFK since MCC/MFK had planned to establish the data network for all AQMSs in Kosovo and Kosovo side requested an integrated network. Instead, the Project changed the original plan of installing one indoor display in the city of Pristina to installing a larger number of outdoor displays in the Pristina area (four locations in the city of Pristina and one location in Obiliq).

The Project originally planned to use the data for displays from the data network established by MCC/MFK. However, it turned out that the establishment of MCC/MFK data network will not finish on time for the second period of the Project. The Project aimed to disclose data before winter when air quality was supposed to become worse. Therefore, the Project decided to use the European Commission (hereinafter referred to as "EC") network established in 2018 for displaying the data. However, since the EC data network did not have connection with the AQMS in Obiliq, the Project installed the displays only in the city of Pristina. The Project installed displays at four locations in the city of Pristina in August of 2019 and started to display air quality data to the public from October of 2019 at the start of the third period of the Project. Detailed report is attached in Appendix-1 "Third Period: 3-2)-1 Air Quality Information Display in Prishtina"

4) Repair and re-functionalization of the IC

In "Repair and re-functionalization of the IC" in the first period, the Project identified necessary parts for re-functionalization of the IC. The Project procured necessary parts and called an engineer from regional agent for the Balkan area and repaired the IC for a period of one week from November 12, 2019. After the confirmation of the re-functionalization work, another engineer carried out the training on the IC operation for a period of one week from November 19, 2019. The IC was confirmed to be re-functionalized and the preparation for exhaust gas measurement by Standard Reference Method was completed. Detailed report is attached in Appendix-1 "Second Period: 4-2)-4 Report on Ion Chromatograph" which includes the first period activity.

5) Analysis cost (heavy metal analysis in PM)

The Project, in the first period, sampled PM in the air in Drenas and Mitrovica and analyzed them in Japan. As a result, some components sampled in Mitrovica exceeded Japanese guide line values. On the other hand, PM sampled in Drenas had no problem. However, since the factory which was presumed to be a polluter was not under operation, in response to the request by C/P, the Project conducted the sampling and analysis again in the second period As a result, analysis results showed that some components sampled in Drenas exceeded Japanese guide line values too. Detailed is described in 3-3. Detailed report is attached in Appendix-1 "Second Period: 4-1)-6 "Draft Result of Heavy Metal Analysis at Drenas".

6) Adjustment work of ICP-MS

Since some components in the PM sampled in both Mitrovica and Drenas exceed Japanese guide line values, Kosovo side decided to continue with monitoring heavy metals in the future. Therefore, re-functionalization of ICP-MS was required in order to analyze heavy metals. MCC/MFK has planned the training for ICP-MS operation. On the other hand, the Project confirmed the possibility of ICP-MS operation but did not adjust the ICP-MS for analysis of heavy metals. MCC/MFK found out that the adjustment work was required for the first time when it heard it from the Project, but MCC/MFK did not plan to cover the extension of works for contractor services. Therefore, it was hard to carry out adjustment work. In this situation, C/P requested for the Japanese side to carry out the adjustment work for the ICP-MS in order to be able to analyze heavy metals in PM in the air. The Project decided to implement this work since the intent of the work matched the purpose of the Project to develop capacities for air quality monitoring. The Project implemented this adjustment work for a period of one week from May 6, 2019 with the assistance of the engineer from regional agent for Balkan area. The ICP-MS was adjusted to be able to analyze heavy metals and the Project confirmed the outcome. The details are described in 3-4. The training for the operation of ICP-MS is planned to be held by MCC/MFK.

(3) Third Period

In air quality monitoring field, the Project in the third period followed up the work of air quality data displays that were installed in the second period.

1) Air quality data displays

The Project installed displays at four locations in the city of Pristina, but they still required the change of the data source from the EC to MCC/MFK network and the installation of a display in the Obiliq since the MCC/MFK network provides the air quality data from Obiliq. In late November of 2019, the Project changed the data source, following the confirmation of the establishment of MCC/MFK network. Then the Project installed a display in Obiliq in March, 2020, although the installation was delayed due to the effect of the COVID-19". Detailed report is attached in Appendix-1 Third Period: "3-2)-2 Secondary works for Air Quality Information Display"

2.3.5 Output list

(1) Reports, etc.

Project reports and supplementary materials were submitted as shown in Table 2-7.

Table 2-7 Project reports and supplementary materials

<table>
<tr><th rowspan="2">Period</th><th rowspan="2">Name of the report, etc.</th><th rowspan="2">Time submitted</th><th colspan="4">Number of copies</th></tr>
<tr><th>Albanian</th><th>English</th><th>Japanese</th><th>Serbian</th></tr>
<tr><td rowspan="5">First Period</td><td>Project Duties Plan^{*1)}</td><td>October 2017</td><td>—</td><td>3</td><td>—</td><td>—</td></tr>
<tr><td>Work Plan (First Period)</td><td>November 2017</td><td>5</td><td>3</td><td>5</td><td>—</td></tr>
<tr><td>JICA Project Brief Note (First Period)</td><td>August 2018</td><td colspan="3">Submitted as PDF and Word file</td><td>—</td></tr>
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<tr><td rowspan="2">Project Completion Report</td><td rowspan="2">August 2021</td><td>5</td><td>5</td><td>5</td><td>3</td></tr>
<tr><td colspan="4">One CD-R (Progress Report and output materials)</td></tr>
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*1) the document was submitted to JICA only. There is only the Japanese version, and has not submitted to the Kosovo side.

(2) Output materials of the Project

In the Project, technology transfer was the main element and the Project provided many technical reports, etc. as output materials. The content of the output materials is shown below.

1) Lectures and seminars materials as technical materials for every field
2) Materials for research interviews, research reports, etc.
3) Materials on Exhaust gas measurement results, studies on emission reduction measures, etc.
4) Materials for workshops
5) Manuals, SOPs, etc.
6) Presentation for Minister of MESPI/MESP
7) Materials for the Japanese trainings
8) Materials for the Final Seminar
9) Materials for the Regional Conference

Output materials of the Project provided in each period are listed in Table 2-8. Materials are attached in Appendix-1.

Table 2-8 Output materials of the Project

1. First Period: October 6, 2017 ~ September 28, 2018

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

1) Presentation, etc. for Emission Inventory

No.	Date	Title
1	Dec. 1, 2017	2017 EI Seminar 00: Outline of Activity
2	Dec. 4, 2017	2017 EI Seminar 01: What is Emission Inventory
3	Dec. 4, 2017	2017 EI Seminar 02: Introduction of Emission Inventory (Sector, Scope, Concept, etc.)
4	Dec. 4, 2017	2017 EI Seminar 03: Introduction of Emission Inventory (Key category analysis and Data collection)
5	Dec. 5, 2017	2017 EI Seminar 04: Introduction of Emission Inventory (Time Series Consistency and Uncertainties)
6	Dec. 6, 2017	2017 EI Seminar 05: Introduction of Emission Inventory (Spatial Mapping of Emissions and Projections)
7	Dec. 7, 2017	2017 EI Seminar 06: Introduction of Emission Inventory (Inventory Management, Improvement, and QA/QC)
8	Dec. 12, 2017	2017 EI Seminar 07: Energy Industries Category
9	Dec. 13, 2017	2017 EI Seminar 08: Manufacturing Industries and Construction Category
10	Dec. 14, 2017	2017 EI Seminar 09: Small Combustion Category
11	Feb. 7, 2018	2018 EI Seminar 13: Industrial Process and Product Use (hereinafter referred to as "IPPU") Sector
12	Feb. 7, 2018	2018 EI Seminar 14: AFLOU (Agriculture, Forestry, and

		Other Land Use) Sector
13	Feb. 8, 2018	2018 EI Seminar 15: Waste Sector
14	Feb. 9, 2018	2018 EI Seminar 16: Road transport Category
15	Apr. 11, 2018	2018 EI Seminar 10: Non-Road Mobile and Machinery Category
16	Apr. 11, 2018	2018 EI Seminar 11: Aviation Category and Railway Category
17	Apr. 11, 2018	2018 EI Seminar 12: Fugitive Emissions from Solid Fuels Category
18	Apr. 11, 2018	2018 EI Seminar 16: Other
2) Lecture materials for the University of Prishtina		
1	Jan. 29, 2018	Outline of Air Quality Assessment & Air Pollutant Emission Inventory
3) Instruction materials for the Emission Inventory research by the students of the University of Prishtina		
1	Feb. 16, 2018	Instruction Documents on Household Survey
2	Feb. 16, 2018	Instruction Documents on Public/Private Service Survey
3	Feb. 16, 2018	Instruction Documents on Small Facility Survey
4) Instruction material for the Traffic counting research by the students of the University of Prishtina		
1	Apr. 13, 2018	Instruction on Traffic Volume Survey
5) Emission Inventory data for LCP		
1	July, 2018	Measurement Record in TPP Kosovo A and TPP Kosovo B for EI
2	July, 2018	Lignite Analysis Kosovo A & B TPP
Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.		
1) Presentation, etc. for Exhaust gas measurement		
1	Apr. 11, 2018	On-site Stack Gas Measurement
2	Apr. 26, 2018 May 4, 2018	Dust Isokinetic sampling calculation (For 1 point)
2) Exhaust gas measurement results		
1	May 9,2018	TPP Kosovo A Emission measurement results
3) Standard Operating Procedure (SOP) for Exhaust gas measurement		
1	May 4, 2018	Standard Operating Procedure (SOP) for Dust content Measurement
2	August, 2019	Standard Operating Procedure (SOP) for Exhaust Gas Measurement by PG-350
Output 3: Air quality monitoring activities are sustained		

No materials			
Output 4： Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.			
No materials			
Output 5： Capabilities for air quality simulation modeling are developed.			
1) Seminar materials for Simulation			
	1	Dec.11, 2017	Simulation Model: Introduction
	2	Dec. 20, 2017	Simulation Model: Necessary Data
2) Workshop materials for simulation			
	1	May 14, 2018	Input Data: Elevation
	2	May 17, 2018	Input Data: Land Use
	3	May 18, 2018	Input Data: MAKEGEO program
	4	May 21, 2018	Supplement: Overall Procedure
	5	May 21, 2018	Supplement: How to Display CTGPROC Output Grid Map
Output 6： Decision making by Kosovo side is improved based on technical evidence for air pollution control.			
No materials			
Output 7： Emission control measures are developed at LCPs.			
1) Seminar and presentation materials			
	1	Dec. 1, 2017	Outline of Emission Reduction Plan for LCPs
	2	Dec. 1, 2017	Introduction of Boiler Group activities
	3	Dec. 4, 2017	Schedule of Boiler Group
	4	Dec. 4, 2017	Explanation of ESP Investigation
	5	Dec. 4, 2017	ESP Appendix (No SQ version)
	6	Dec. 13, 2017	SO2 Reduction of LCP
	7	Dec. 15, 2017	Explanation of ESP Principle
	8	Dec. 15, 2017	Additional Description
	9	Apr. 6, 2018	Study of velocity measurement in ESP
	10	Apr. 6, 2018	SO_2 and Dust reduction of LCP
	11	Apr. 6, 2018	Inside inspection of Kosovo A ESP
	12	Apr. 12, 2018	Introduction of ESP Performance Improvement
	13	Apr. 12, 2018	Safety of ESP Internal Work
	14	May 8, 2018	Investigation Report of Kosovo-A ESP
	15	May 25, 2018	Report on SO_2 Behavior
	16	May 29, 2018	Environmental measures for LCP
2) Material on TPP Kosovo A			
	1	Dec. 13, 2017	Operation Record and Measurement Results in TPP Kosovo A

2	Dec. 18, 2017	Specification of Kosovo A ESP
3	May 19, 2018	Lignite Analysis Kosovo A
4	May 19, 2018	Lignite Analysis Kosovo B
Output 8： Capabilities for evaluating air pollution control measures of Kosovo side are developed.		
1) Seminar		
1	Apr. 20, 2018	Seminar: History of air pollution measures in Japan
Other materials (9)		
1) Presentation material for the minister of MESPI/MESP		
1	Nov. 1, 2017	Capacity Development Project for Air Pollution control in the Republic of Kosovo: Outline
2	Feb. 12, 2018	Capacity Development Project for Air Pollution control in the Republic of Kosovo: Outline
3	July 11, 2018	Capacity Development Project for Air Pollution control in the Republic of Kosovo: Progress in the first period (Oct.2017~June 2018)

2. Second Period: Oct-12, 2018 ~ Sep-30, 2019

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.		
No.	Date	Title
1	Oct. 19, 2018	2nd Period Work Plan EI & Sim
2) Seminar and lecture materials		
1	Oct. 24, 2018	Progress of EI Overview
2	Oct. 24, 2018	Progress of EI Overview (detailed)
3	Oct. 24, 2018	Progress of EI (IPPU, Agriculture, Forestry, and Other Land Use (hereinafter referred to as “AFOLU”), Waste)
4	Jun. 5, 2019	Progress of EI (Small Combustion Sub-Sector Service & Business)
5	Jun. 5, 2019	Progress of EI (Small Combustion Sub-Sector Household)
3) On the Job Training (OJT) Materials		
1	Oct. 29, 2018	Emission Inventory Calculation File Structure
2	Oct. 29 and 30, 2018	OJT on Emission from Small Combustion Household
3	Jan. 30, 2019	OJT on Emissions from KEK
4	Feb. 4, 5, and 6, 2019	OJT on Emissions from KEK
Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.		

1) Exhaust gas measurement results

1	Jan. 21, 2019	Ferronickel Measurement Report_1
2	May 22,2019	Ferro-nickel Measurement Report_2
3	May 22,2019	Brick Factory Measurement Report_1

Output 3: Air quality monitoring activities are sustained

1) Presentation, etc. for Emission Inventory for air quality monitoring

1	Oct. 26, 2018	Introduction of AQM
2	Oct. 26, 2018	Topics: Air Quality Monitoring
3	Jun. 21, 2019	Request on AQMS configuration
4	Jun. 13, 2019	Request on AQMS configuration for Display
5	Jun. 17, 2019	AQMS Analyzers Data Management
6	Jun. 13, 2019	Suggestion for Air Quality Monitoring Maintenance

2) Reports, etc.

1	October, 2018	Summary of Air Quality Monitoring Station Inspection all over Kosovo
2	August 7, 2018	FINAL REPORT from AGS
3	May 27, 2019	Housing renewal of 3 (three) AQMSs in the Pristina Area
4	May 27, 2019	Rehabilitation of AQMS in the Pristina Area

3) SOPs and manuals

1	Feb. 2019	SG741 Introduction to KHMI

Output 4： Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

1) Presentations, etc. for laboratory analysis

1	Apr. 26, 2019	Presentation of Standard Reference method

2) Reports, etc.

1	August, 2018	Service report (ICP-MS)
2	Oct. 12, 2018	Report on ICP-MS
3	Jan. 27, 2019	Result of Heavy Metal analysis from TSP and PM10
4	April, 2019	Report on Ion Chromatograph
5	April, 2019	Detailed version of Report on Ion Chromatograph
6	July, 2019	Draft Result of Heavy Metal Analysis at Drenas

3) SOP

1	Apr. 15, 2019	SOP for gas sampling for SO_X
2	Apr. 15, 2019	SOP for gas sampling for NO_X
3	Apr. 15, 2019	SOP for gas sampling for Hg

Output 5： Capabilities for air quality simulation modeling are developed.

1) Presentations, etc. for simulation

1	June, 2019	Preliminary Result of Simulation Model

2) Workshop and seminar materials, etc. for simulation

1	Nov. 12 and 13, 2018	Simulation Model 06 Input Data - READ62 (Upper air data preprocessor)
2	Nov. 15 and 16, 2018	Simulation Model 07 Input Data – SMERGE (Surface meteorology data preprocessor)
3	Nov. 21,23 and 30, 2018	Simulation Model 08 CALMET (Meteorology model)
4	Feb. 15 and 20, 2019	Simulation Model 09 Input Data - Emission Data
5	Feb. 20, 21, 22 and 25, 2019	Simulation Model 10 Input Data – MAIN program
6	May 24 and 29, 2019, Jun. 6 and 7, 2019	Simulation Model 11 Input Data - Emission Data

Output 6 : Decision making by Kosovo side is improved based on technical evidence for air pollution control.

No materials

Output 7 : Emission control measures are developed at LCPs.

1) Presentation materials

1	Oct. 23, 2018	Explanation of ESP Performance Improvement
2	Oct. 23, 2018	Prezanimi KEK - SH. Lajqi (UP)
3	Oct. 25, 2018	Explanation of ESP Performance Improvement
4	Oct. 30, 2018	ESP Energization Control
5	Oct. 30, 2018	Smoke Reduction of Oil Firing
6	Oct. 31, 2018	NO_X Reduction Test Procedure
7	Mar. 22,2019	Air flow Distribution Measurement of TPP Kosovo A ESP
8	Mar. 27,2019	ESP-Internal Inspection
9	Apr. 8,2019	SO_2 Reduction Measure Plan
10	May 1,2019	In-furnace De-Sulfurization

2) Workshop and seminar materials

1	Oct. 26, 2018	Environmental measures for LCP(1)
2	Oct. 31, 2018	NOx Reduction of Existing Boiler
3	Nov. 1, 2018	ESP presentation
4	Nov. 9, 2018	Environmental measures for LCP(2)
5	Mar. 28,2019	Study on SO_2 Reduction
6	Mar. 29,2019	ESP Energization Control
7	Apr. 12,2019	Performance Improvement of Kosovo-A ESP

8	Apr. 24,2019	Environmental measures for LCP
3) Reports, etc.		
1	Nov. 5,2018	Inquiry for Energization (draft)
2	Nov. 5,2018	Attached sheet for inquiry
3	Nov. 8,2018	Guide Vane remodeling Plan
4	Dec. 3, 2018	Simulation results of ESP by UP
5	May 8,2019	SO_2 vs. Not Operating Mill Location
6	May 9,2019	Data Comparison of April 26 and 30
7	May 19,2019	Consideration on SO_2 vs Boiler Operation Change
8	July 9,2019	Emission Control measures of LCPs
Output 8 : Capabilities for evaluating air pollution control measures of Kosovo side are developed.		
1) Presentations, etc.		
1	January, 2019	2030 Agenda for Sustainable Development
2	Jan. 28, 2019 Jan. 29, 2019	Review of Measures using 17 Goals of Sustainable Development Goals (herein after referred to as “SDGs”)
3	Apr. 19, 2019	Evaluation of air pollution control measures
Other materials (9)		
1) Presentation material for the minister of MESPI/MESP		
1	Oct. 29, 20178	Capacity Development Project for Air Pollution control in the Republic of Kosovo: Outline of Emission Inventory
2	June. 21, 2019	Capacity Development Project for Air Pollution control in the Republic of Kosovo: Preliminary Result of Simulation Model
2) Materials for the first training in Japan		
1	Feb. 28, 2019	Kosovo side Assignment during the Training in Japan
2	Mar. 1, 2019	Training document of MOEJ
3	Mar. 1, 2019	Environmental measures for LCP(2)
4	Mar. 4, 2019	Air Quality Monitoring in Yokohama
5	Mar. 5, 2019	Yokohama_History_Agreement
6	Mar. 5, 2019	Yokohama_Regulations
7	Mar. 6, 2019	Procedure for Traffic Pollution Management
8	Mar. 8, 2019	Environmental measurement/analysis
9	Mar. 11, 2019	Experience of Nihei-san in TMG
10	Mar. 12, 2019	Final Presentation by Kosovo

3. Third Period: Sep-27, 2019 ~ June-30, 2021

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

1) Presentations, etc. for emission inventory

No.	Date	Title
1	Nov. 5, 2019	Institutional Framework for Emission Inventory Preparation
2	Nov. 6, 2019	Progress of Emission Inventory on Small Combustion (Commercial/ Institutional Stationary) Category
3	Nov. 19, 2019	Vehicle Emission Calculation Method
4	Nov. 28, 2019	Structure for Emission Inventory Preparation
5	Jan.27. 2020	Remaining Tasks for Emission Inventory Preparation
6	Mar. 3, 2020	Final Lecture for Emission Inventory Preparation

2) Lecture materials for the University of Prishtina

1	Feb.27, 2020	Lecture for Vehicle Emission Calculation Method

3) Discussion materials for MCC/MFK

1	Oct. 31, 2019	Structure for Emission Inventory Preparation by the Project
2	Apr. 6, 2020	JICA Activity on Emission Inventory Preparation (Skype meeting)

4) Questionnaires of the research interview for Municipalities

1	Nov. 26, 2019	Data Request for the Municipality of Obiliq
2	Nov. 29, 2019	Data Request for the Municipality of Fushe Kosovo

5) Data set for OJT on emission inventory preparation

1	Dec. 2, 2019	Set of Emission Inventory Calculation Files for OJT

6) Manual on emission inventory preparation

1	May 29, 2020	Air Pollutant Emission Inventory Preparation Manual

Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

1) Presentation for exhaust gas measurement

1	Feb. 2020	Lecture for exhaust gas measurement

2) Exhaust gas measurement results

1	Nov.2019	Asphalt Company Measurement Report
2	Nov.2019	Oil Recycle Company Measurement Report
3	Dec. 2019	Brick Company Measurement Report_2
4	Mar, 2020	LCP measurement data sheet

Output 3: Air quality monitoring activities are sustained

1) Presentations, etc. for air quality monitoring

1	Nov. 14, 2019	AQMS_Seminar: Japanese Manual
2	Nov. 14, 2019	Reducing invalid data in AQMS

2) Reports, etc.

1 2 3	Aug. 26, 2019 Nov.2019 May, 2020	Air Quality Information Display in Prishtina AQMS Proper Distribution Guideline Air Quality Data Display in Obiliq

3) SOP and/or manuals			
	1	Mar.2020	AQMS Maintenance Manual Attachment-1 SOP for SG-741 Attachment-2 Analyzer Check Sheet (Only English)
	2	Jan. 2020	SOP Emergency NO_2, SO_2, PM_{10} and $PM_{2.5}$
Output 4： Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.			
1) Reports, etc.			
	1	Jan. 2020	Standard Reference Method for gas measurement
2) SOP and/or manuals			
	1	Nov. 2019	SOP (IC-Reagents, standard and sample solution)
	2	Nov. 2019	SOP (IC-Operating)
	3	Nov. 2019	SOP (Hg for AAS, Reagents)
Output 5： Capabilities for air quality simulation modeling are developed.			
1) Presentation materials for simulation			
	1	Mar. 3, 2020	Wrap up for Simulation Modeling
2) Workshop materials for simulation			
	1	Nov. 7, 2019	Simulation Model: Air Quality Monitoring Data
	2	Nov. 19, 21, 2019	Simulation Model: Input Data –Emission (3) Area source -Waste
	3	Feb. 12, 19, 21, 2020	Simulation Model: Input Data –Emission (5) Line source -Vehicle
	4	Apr. 8, 2021	Simulation Model: Brick Factory Emission
3) Manual			
	1	June 28, 2021	Simulation Manual
Output 6： Decision making by Kosovo side is improved based on technical evidence for air pollution control.			
1) Seminar materials			
	1	Jan. 2020	Emission from industry-1
	2	Jan. 2020	Emission from industry-1_Calculation
	3	Jan. 2020	Emission from industry-2-0
	4	Feb. 2020	Emission from industry-2-1
	5	Feb. 2020	Emission from industry-2_Calculation-1
	6	Feb. 2020	Emission from industry-2_Calculation-2
	7	Feb. 2020	Emission from industry-3
	8	Feb. 2020	Emission from industry-3_Calculation
	9	Feb. 2020	Emission from industry-4
Output 7： Emission control measures are developed at LCPs.			
1) Presentation materials			

	1	Mar. 19 2021	Additional Info for Boiler
	2	Mar. 19 2021	Troubleshooting of TPP Kosovo A ESP
2)	Reports, etc.		
	1	Nov. 28, 2019	Study on Kosovo A Operation Data
	2	Feb. 8, 2020	SO_2 & NO_X Data Analysis
	3	Mar.1, 2020	Environment Measures of Kosovo A
	4	Nov. 19,2020	Kosovo A-5 Boiler Load Change
	5	Nov. 20,2020	Fuel Flow Control of Drum Type Boiler
	6	Dec. 01,2020	Impact of Boiler Load down on NOx
3)	Materials on TPP Kosovo A		
	1	Nov. 28, 2019	Operation data during measurement, November 2019
Output 8： Capabilities for evaluating air pollution control measures of Kosovo side are developed.			
1)	Seminar materials		
	1	Nov. 5, 2019	Policy Measures for Discussion Materials
	2	Nov. 20, 2019	Policy Measures for Household Content
	3	Nov. 22, 2019	Policy Measures for Vehicle Content
	4	Nov. 25, 2019	Policy Measures Seminar
	5	Dec.3, 2019	Policy Measures Household Scenario
	6	Dec.5, 2019	Policy Measures Vehicle Scenario
	7	Jan. 22, 2020	Policy Measures Draft Evaluation Sheet
	8	Feb. 11, 2020	Policy Measures Progress Lecture
	9	Mar. 4, 2020	Policy Measures Final Lecture
Others materials (9)			
1)	Presentation material for the minister of MESPI/MESP		
	1	Feb 19, 2020	Presentation to the minister
	2	July 30, 2020	Presentation to the Secretary General of MEE
2)	Materials for the second training in Japan		
	1	Sep. 2, 2019	Assignment-2nd Japanese Training
	2	Sep. 3, 2019	Air Quality Management Policy in Japan
	3	Sep. 3, 2019	Air Pollution Control in Kawasaki A
	4	Sep. 3, 2019	AQMS in Kawasaki
	5	Sep. 4, 2019	Air Quality Monitoring in Yokohama
	6	Sep. 6, 2019	MOEJ_CO2Statistics_Household
	7	Sep. 9, 2019	JARI-Emission Inventory
	8	Sep. 9, 2019	NIES EI and Simulation
	9	Sep. 10, 2019	Joint research in Japan-Air Joint research in Japan-Water

	10	Sep. 10, 2019	Procedure for Traffic Pollution Management
	11	Sep. 10, 2019	Air Quality Control in Tokyo
	12	Sep. 10, 2019	Introduction of Policy in Tokyo (English version only and no word file)
	13	Sep. 11, 2019	Nihei Presentation
	14	Sep. 12, 2019	Final Presentation by Kosovo
3)	Additional activities		
	1	Nov. 27, 2020	Discussion on Draft completion report
	2	Nov. 24, 2020	Establishment of Institutional framework for simulation
	3	Nov. 30, 2020	Analysis of Air Quality during the Lockdown
	4	Dec. 7, 2020	Seminar on Air quality Data management
	5	Jan. 7, 2021	Discussion on Kosovo air pollution law
	6	Jan.29, 2021	Discussion on ISO17025
	7	Mar. 24, 2021	Wrap Up of Remote Activities of the Simulation Modeling Group
	8	Apr. 2, 2021	Wrap Up of Remote Activities of the Emission Inventory Group
	9	Apr. 6, 2021	Wrap Up of Remote Activities of the Policy Making Group
	10	June 21, 2021	Support for analysis and evaluation of air quality data during one year
4)	Materials for the Final Seminar		
	1	June 9, 2021	Introduction of the Project “Capacity development for air pollution control”
	2	June 9, 2021	Improvement of Air quality monitoring activities
	3	June 9, 2021	National Emission Reduction Plan in Kosovo and current situation
	4	June 9, 2021	Emission measurement and Emission reduction measure for TPP Kosovo A
	5	June 9, 2021	Preparation of Emission Inventory in the Pristina Area
	6	June 9, 2021	Simulation of the air quality condition in the Pristina Area
	7	June 9, 2021	The evaluation of possible air pollution control measures
	8	June 9, 2021	Results of Capacity Assessment
	9	June 9, 2021	Issues remained and Future direction for air pollution control
5)	Materials for the Regional Conference		
	1	June 23, 2021	Issues on air quality management in Kosovo and Introduction of the Project “Capacity development for air pollution control”
	2	June 23, 2021	Improvement of Air quality monitoring activities

		3	June 23, 2021	National Emission Reduction Plan in Kosovo and the current situation
		4	June 23, 2021	Emission measurement and Emission reduction measure for TPP Kosovo A
		5	June 23, 2021	Preparation of Emission Inventory for the Pristina Area
		6	June 23, 2021	Simulation of the air quality condition in the Pristina Area
		7	June 23, 2021	The evaluation of possible air pollution control measures
		8	June 23, 2021	Air Quality Management and Monitoring in Croatia
		9	June 23, 2021	Current Air Pollution situation in North Macedonia

2.4 Kosovo side Input

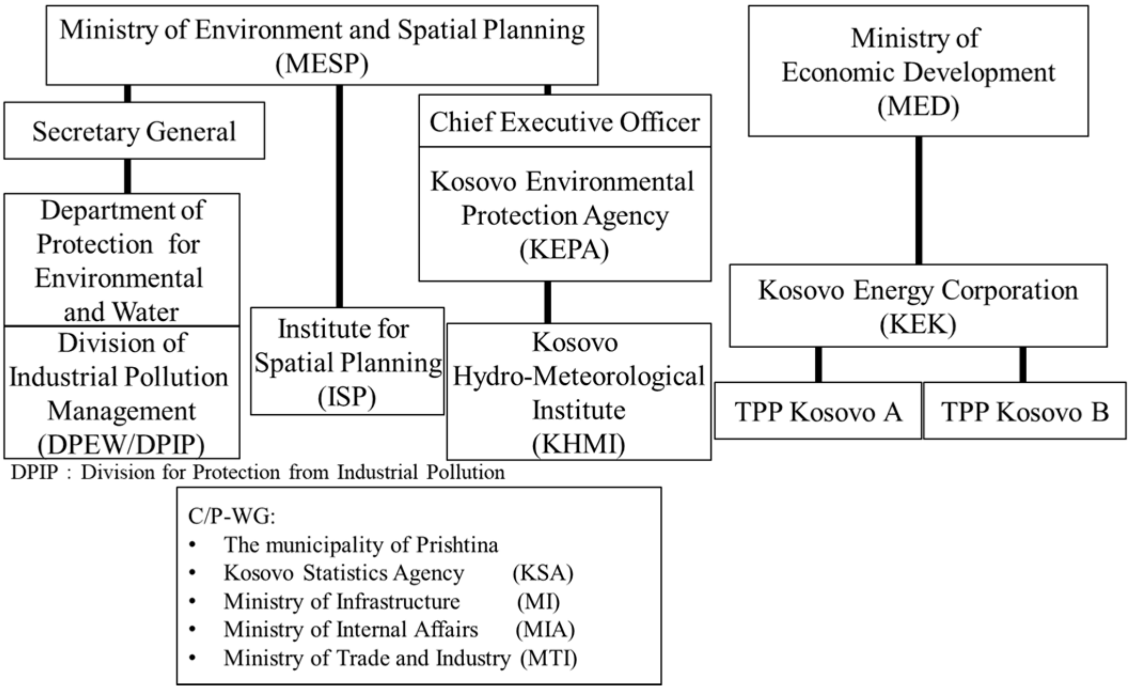
2.4.1 Implementation structure of the Kosovo side

In the implementation structure of the Kosovo side, MESPI/MESP is the main C/P, and KEK which is the national power generation company under ME/MED, the municipality of Prishtina, etc. are C/P-WG.

During the Project period in Kosovo, changes of the government have occurred in October 2019 and June 2020, and March, 2021. In the second and third changes of the government, the central government ministries and agencies were reorganized, and political structures were changed.

Figure 2-4 shows the implementation structure of the Kosovo side at the starting time of the Project and at the present. MESP is now MESPI due to the integration with the Ministry of Infrastructure.

(Starting time of the Project)



(Ending time of the Project)

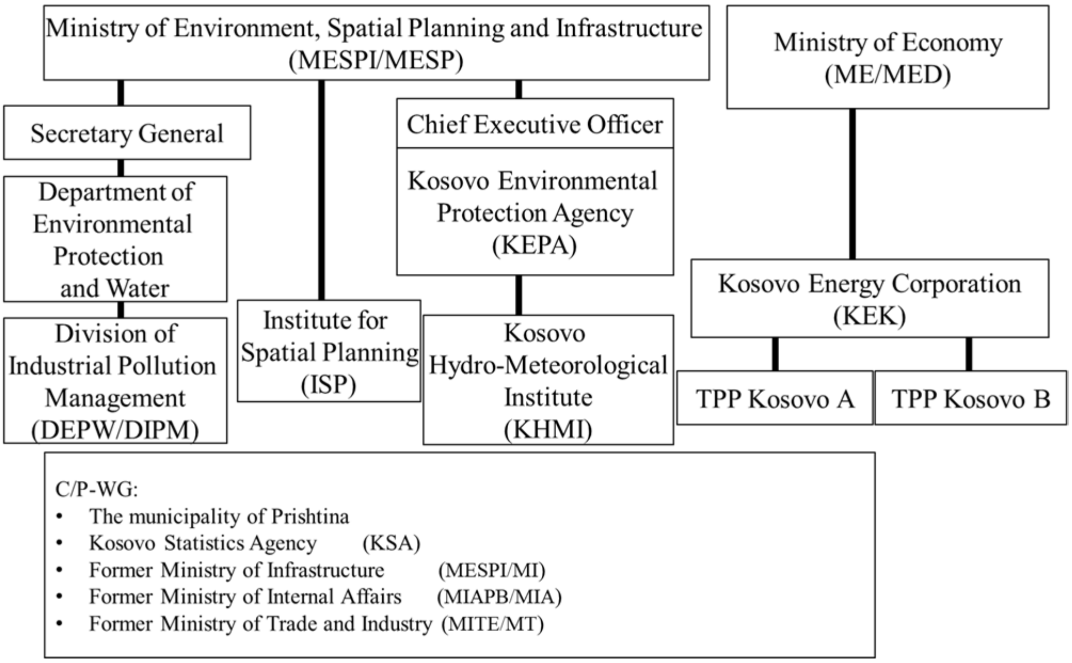


Figure 2-4 Implementation structure of the Kosovo side

2.4.2 Positioning of counterparts

Activities were implemented by eight (8) C/P-WGs corresponding to each output. Table 2-9 shows the final member list at the end of the Project.

Table 2-9 Constitution of C/P-WG

Name of the C/P-WG	Output corresponding to activities	Members
Air Pollution Control	Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.	1. Albana Kashtanjeva, DEPW/DIPM Coordinator of the W.G 2. Visare Hoxha, DEPW/DIPM 3. Pajtim Bytyqi, DEPW/DIPM 4. Sabit Restelica, KEPA
On-site Stack Gas Measurement	Output 2: Capabilities for emission measurements are developed for LCPs and for other sources. Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.	1. Agron Shala, KHMI, Coordinator of the W.G 2. Sabri Simnica, KEK, TPP Kosovo A, sub coordinator 3. Musli Kozhani, KHMI 4. Abdullah Pirqe, DEPW/DIPM 5. Qefsere Mulaku, Inspectorate of environmental protection 6. Ismet Dërvari, Inspectorate of environmental protection 7. Pajtim Bytyqi, DEPW/DIPM 8. Kastriot Abazi, KEK, TPP Kosovo A

		9. Xhemajl Sejdiu, KEK, TPP Kosovo B 10. Florent Tahiri, KEK, TPP Kosovo B 11. Jeton Aliu, Kosovo Accreditation Directory KAD
Power Plant Control (Boiler and ESP)	Output 7: Emission control measures are developed at LCPs.	1. Milaim Kelmendi/Sabri Simnica, KEK, Coordinator of the W.G 2. Naim Alidema, DEPW/DIPM 3. Adem Tusha, DEPW/DIPM 4. Lulzim Korenica, ME/MED 5. Sabri Simnica, KEK, TPP Kosovo A 6. Kastriot Abazi, KEK, TPP Kosovo A 7. Xhemajl Sejdiu, KEK, TPP Kosovo B 8. Florent Tahiri, KEK, TPP Kosovo B
Air Quality Monitoring	Output 3: Air quality monitoring activities are sustained. Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.	1. Shkumbin Shala, KHMI, Coordinator of the W.G 2. Musli Kozhani, KHMI 3. Zineta Isufi, KHMI
Emission Inventory	Output 1: Capabilities to elaborate emission inventory (hereinafter referred to as "EI") for LCPs and other sources are developed at Kosovo side.	1. Afrim Berisha, Director of Directorate for Monitoring, Assessment and Reporting, KEPA, Coordinator of WG 2. Sabit Restelica, KEPA, sub coordinator of the W.G 3. Tafë Veselaj, KEPA 4. Mentor Shala, KHMI 5. Vlora Spanca, KEPA 6. Ajet Mahmuti, KEPA 7. Albana Kashtanjeva, DEPW/DIPM 8. Haki Kurtaj, KSA 9. Nijazi Miftari, MIA 10. Jeton Aliu, MTI 11. Arsim Mulaku, MI 12. Jehona Mavraj, Municipality of Prishtina 13. Mr. Armend Agushi, KEPA
Simulation Model	Output 5: Capabilities for air quality simulation modeling are developed.	1. Letafete Latifi, KHMI, Coordinator of the W.G 2. Përparim Gashi, DEPW/DIPM, sub coordinator of the W.G 3. Ajet Mahmuti, KEPA 4. Abdullah Pirqe, DEPW/DIPM 5. Beqir Gashi, KHMI 6. Mr. Atdhe Sefa, KHMI 7. Mr. Rizah MURSELI (ISP (MESPI/MESP))
Air Quality Management Policy	Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.	1. Nezakete Hakaj/Albana Kashtanjeva, DEPW/DIPM, Coordinator of the W.G 2. Visare Hoxha, DEPW/DIPM 3. Pajtim Bytyqi, DEPW/DIPM

Publication and Public Awareness	Output 3: Air quality monitoring activities are sustained. Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control. Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.	1. Zymer Mrasori, MESPI/MESP, Coordinator of the W.G 2. Bajram Kadriu, MESPI/MESP

2.4.3 Provision of services

The Project was provided an office in KHMI for a working space where equipment from Japan could be received and kept. Air conditioning, tables were also provided, and JET could have a healthy environment for conducting works.

C/P also supported custom procedures and tax exemption procedures for equipment from Japan. The Project could conduct the works very smoothly.

2.5 Project Joint Coordinating Committee (JCC)

During the project period, JCC meeting were held six times in total. All stakeholders from the Kosovo side and Japanese side participated in the JCC meeting, and discussed and approved the plan of activities, progress, change of activities and structures, etc. At the starting time of the second period, although the JCC meeting was not held, the Project explained the plan of activities in the second period to the JCC chairman, the Project director and all C/P-WG members, and received the approval by the Kosovo side. In the middle of the third period, there was a meeting on the extension of the Project period due to COVID-19, and the revision of R/D and the changes in PDM were approved. Furthermore, in the sixth meeting (Final JCC meeting), PDM was amended by incorporating additional activities and it was approved.

Table 2-10 shows the main subjects discussed in the JCC meeting. Relevant documents including Minutes of Meeting (hereinafter referred to as "M/M") for each JCC meeting are attached in ANNEX-1. The Project explained beforehand the content of JCC meetings to C/P-WG, and comments from C/P-WG were reflected as necessary.

Table 2-10 Main subjects in the JCC meetings

Date, Venue, participants	Main Content of discussion
First JCC Meeting ・November 2, 2017 ・MESPI/MESP 17F Meeting room Participants	The meeting was held as a kick-off meeting of the Project. In the meeting, total plan of activities and their content were introduced, and the Draft Work Plan (First Period) was approved. Activities were explained based on the documents: "Draft Work plan (First period)" and "Issues for discussion".

・JCC member: 13 ・JICA: 2 ・Observer: 1 ・JET: 3	  Issues discussed 1 Presentation of "Draft Work Plan (First period)" and the approval of the plan 2 Confirmation of JCC member list 3 Approval of member list and role of C/P and C/P-WG 4 Expression of willingness to participate in the Project activities by the municipality of Prishtina 5 Implementation of request for cooperation to relevant municipalities by MESPI/MESP 6 Provision of Project office 7 Securement of the safety of the Project activities nearby Mitrovica 8 Collaboration with faculties of the University of Prishtina in the field of emission inventory, etc. 9 Consistency of transferred technology from Japan with Kosovo standard 10 Measurement method for emergency air quality monitoring 11 Request for cooperation on measurement of PM_{10} and $PM_{2.5}$ in accordance with European Standard 12 Contribution on the report of SDGs indicator 11.6.2 by the Kosovo side through the improvement of AQMS analyzers 13 Request for the improvement of meteorological instruments in the AQMSs in the Pristina Area 14 Purpose of the provision of two sets of automated gas analyzers (NO_X, SO_2 and Dust) 15 Importance of continuity of exhaust gas measurement at TPP Kosovo A and TPP Kosovo B 16 Request from the Japanese side for reception of Feasibility study (hereinafter referred to as "F/S") report on TPP Kosovo B 17 Request from the Japanese side for information on TPP Kosovo A such as rehabilitation, investment, etc. 18 Request from the Kosovo side for trainings in Japan
Second JCC Meeting ・July 9, 2018	In the meeting, outcomes in the first period were presented and the Draft Progress Report (First Period) was approved. Donor

・MESPIMESP 18F Meeting room Participants ・JCC member: 9 ・JICA: 3 ・Observer: 2 ・JET: 2 ・C/P-WG, etc.: 2	coordination structure was also defined. Outcomes were explained based on the documents: "Draft Work plan (First period)" and "Issues for discussion".   Issues discussed 1. Presentation of "Draft Progress Report (First Period)" and approval of the report, and introduction of the activities in the second period 2. Change of the PDM (the number of the AQMS rehabilitated by JICA, Change of activities for TPP Kosovo B and Change of Objectively Verifiable Indicators in the PDM.) 3. Addition of two new members to C/P-WG 4. Proposals for the improvement of ESPs in TPP Kosovo A and request for budget allocation for the proposals 5. Structure of donor coordination regarding the Project activities 6. Confirmation of the intention of the Kosovo side for the establishment of air quality data network 7. Request of the reinforcement of staff to the sections related to the Project activities 8. Request from the Kosovo side for the ICP-MS operation training
The Work Plan (Second Period) Meeting ・October 25, 2018 ・Secretary General Office Participants ・Secretary General and Ms. Nezakete Hakaj ・JET: 5 ・C/P-WG Meeting ・October 26, 2018 ・MESPI/MESP 18F meeting room	At the starting time of the second period, plan of activities in the second period are presented to the JCC chairman, the Project director and C/P-WG respectively without holding JCC meeting, and the Draft Work Plan (Second Period) was approved. Activities were explained based on the documents: "Draft Work plan (Second period)" and "Issues for discussion".   Issues discussed 1. Presentation of "Draft Work Plan (Second Period)" and the

Participants ・JICA: 2 ・JET: 5 C/P-WG: 14	approval of the plan 2. Change of role sharing regarding air quality data network (leave it to MCC/MFK) and decision of holding JCC meeting for approval of the change. 3. Acceptance of the proposal for the improvement of ESP performance by TPP Kosovo A and the proposal for the evaluation for the implementation result. 4. Request by the Kosovo side for the re-sampling of PM in the air in Drenas and re- analysis of heavy metals in Japan 5. Request from the Kosovo side for the adjustment of ICP-MS for heavy metal analysis 6. Proposal for holding a seminar regarding exhaust gas measurement to private companies/University as an support for establishing institutional framework
Third JCC Meeting ・January 25, 2019 ・MESPI/MESP 18F Meeting room Participants ・JCC member: 7 ・JICA: 4 ・Observer: 3 ・JET: 4 ・C/P-WG, etc.: 2	For the purpose of the change of the role sharing regarding the air quality data network, JCC meeting was held and the PDM was revised. At the same time, plan of activities, progresses, etc. in the second period was introduced based on “Work plan (Second period)” and “Issues for discussion and other Topics”   Issues discussed 1. Approval of the change of the role sharing regarding the air quality data network 2. Acceptance of the re-sampling of PM in the air in Drenas and re- analysis of heavy metals in Japan by Japanese side
Fourth JCC Meeting ・June 21, 2019 ・MESPI/MESP 18F Meeting room Participants ・JCC member: 8 ・JICA: 2 ・Observer: 2 ・JET：3	In the meeting, outcomes in the second period were presented and the Draft Progress Report (Second Period) was approved. Outcomes were explained based on the documents: “Draft Work plan (Second period)” and “Issues for discussion”.  

・C/P-WG, etc.: 2	Issues discussed 1. Presentation of "Draft Progress Report (Second Period)" and approval of the report 2. Addition of a new member to C/P-WG 3. Request by the Kosovo side for an additional training regarding exhaust gas analysis by Standard Reference Method 4. Request by the Japanese side for utilization of Low Volume Sampler in accordance with EU standard, and request for procurement of Argon gas for operation of the ICP-MS 5. Request for securement of budget for maintenance for air quality data displays installed by the Japanese side 6. Request by the Japanese side for continuous effort for application of Intermittent Energization Control for ESPs for the improvement of ESP performance 7. Expression of intention for continuous technical support for emission reduction measures for TPP Kosovo A by the Japanese side 8. Request by the Japanese side for the appointment of the persons in charge of air quality data management from AQMSs 9. Request by the Japanese side of the reinforcement of staff to the sections related to the Project activities 10. Request by the Kosovo side for acquisition of many more air quality data in the Pristina area 11. Necessity of the construction of closer collaboration with relevant ministries/agencies 12. Strategy of information disclosure to the public on the result of air pollution simulation 13. Request for JICA by the Kosovo side for continuous support for air quality management and air quality control
Fifth JCC Meeting ・October 25, 2019 ・Hotel Sirius 8F Meeting room Participants ・JCC member: 8 ・JICA: 4 ・Observer: 1 ・JET: 3 ・C/P-WG, etc.: 6	In the meeting, plan of activities in the third period was presented and the Draft Work Plan (Third Period) was approved. Plan of activities were explained based on the documents: "Draft Work plan (Third period)" and "Issues for discussion".  

	Issues discussed 1. Presentation of "Draft Work Plan (Third period)" and the approval of the plan 2. Appointments of successors in response to the retirement of two JCC members 3. Appointment of the successor in response to the retirement of donor coordinator 4. Appointment of the successor in response to the retirement of the coordinator in the field of Air Quality Management Policy 5. Proposal by the Japanese side for the method for the validation of simulation results 6. Proposal by the Japanese side for the improvement of air quality data management system 7. Handling of high volume sampler for sampling PM in the air 8. Proposal by the Japanese side for construction of institutional framework for implementation of exhaust gas measurement 9. Agreement of handover of only one set of exhaust gas measurement equipment 10. Request by the Japanese side for continuous effort for application of Intermittent Energization Control for ESPs for the improvement of ESP performance 11. Sharing of recognition on the significance of holding the final seminar and the regional conference 12. Request by the Japanese side for presentation by the Kosovo side in the final seminar and the regional conference 13. Request for securement of budget for maintenance for air quality data displays installed by the Japanese side 14. Expression of needs and ownership of the request by the Kosovo side for next phase project supported by JICA 15. Request by MCC/MFK for cooperation in the field of emission inventory
Meeting on the amendment of R/D and PDM ・ July 30, 2020 ・ Virtual Meeting Participants ・MESPI/MESP: 2: Mr. Mentor Sylmeta	The Project had the meeting with next JCC chairperson (Acting Secretary General of MEE), and introduced the activities in the environmental fields by JICA in Kosovo and the Project activities, and explained the revision of the content of activities and schedule of the Project affected by COVID-19. This meeting was held virtually.

(Acting Secretary General), Mr. Bedri Berisha (the Chief of Cabinet of the Minister) ・JICA Head Office: 3 ・JICA Balkan Office: 2 ・JET: 4 and local assistants, etc.: 3	 Issues discussed ・ Amendment of the name of implementing organization of the Kosovo side from MESP to MEE ・ Amendment of the Project period from three years to three years and nine months The above-mentioned amendment was approved and signed as M/M on August 4, 2020.
Sixth (Final) JCC Meeting ・ June 16, 2021 ・ Hotel Sirius 8F Meeting room, and communication through internet Participants ・JCC member: 8 ・JICA: 2 ・Japanese Embassy: 2 ・Observers: 4 ・JET: 3 Virtual participants ・JICA:4 ・MCC/MFK: 2 ・JET: 7	The final JCC meeting was held with the participation of the minister of MESPI and the Embassy of Japan in Kosovo. In the meeting, the content of draft Project completion report and future issues related to the Project were discussed. In addition, the Phase 2 project following the current Project was introduced. The meeting took the form where local participants gathered at the venue, and the Japanese side participated virtually.   (The minister of MESPI) (Japanese Embassy of Kosovo)   (Secretary General of MESPI) (JICA Balkan Office)   (Scenery of the meeting) (Group photograph)

	Issues discussed 1. Presentation of the draft Project completion Report. 2. Presentations on the issues remained and proposals of measures for the solution, and the recommendations from JET on necessary future activities and the requests from the Kosovo side. 3. The introduction of the phase 2 project following the current Project, and the presentation by JICA on the requests and questions related to the phase 2 project. The draft Project completion Report was approved by the JCC members. As for the requests and questions by JICA, Kosovo side promised to reply by the end of July 2021. The answer was given in the form of a document on July 12, 2021.

3. Project Activities and output

3.1 Outline of activities

3.1.1 Overview of the Project activities

The Project activities are mainly divided into four fields, and activities have been conducted in each field. In the field of Air Quality Monitoring, since air quality data is the base for all activities, the activities of Air Quality Monitoring such as rehabilitation analyzers in AQMS, etc. were preferentially conducted in the first and second period. In Measurement and Emission Reduction Measures field, the activities were also preferentially conducted in the first and second period, since the proposals for the emission reduction measures were required as soon as possible, since the activities started from the Precedent Activity and the NERP started from 2018. In Emission Inventory and Modeling field, since this was the first experience for the Kosovo side, the Project started to give lectures on basic knowledge and collect basic data in the first period and the second period, and in the third period, taking advantage of the Project extension period, the Project supported for the Kosovo side to prepare final emission inventory and conduct air quality simulation. In Decision Making and Evaluation field, based on the information from other three fields, concrete air pollution control measures were studied, taking advantage of the Project extension period.

The activities and achievements in each output are show as follows.

3.1.2 Changes of external conditions and responses

Changes of external conditions, which need changes and/or coordination of activities, are described from the start of the Project as follows.

(1) Changes of external conditions and responses in the first period

The following is a brief summary of the changes of external conditions.

1) Change in line with the implementation of rehabilitation for TPP Kosovo B supported by the EU (in the field of Measurement and Emission Reduction Measures)

It was decided that TPP Kosovo B was going to be rehabilitated with the support of EU. Therefore, KEK (TPP Kosovo B) requested for the Project not to study emission reduction measures for TPP Kosovo B. The Project accepted the request, but obtained permission to conduct exhaust gas measurement. Hence, the emission reduction measures were only studied for TPP Kosovo A. The content of the changes is shown in Table 2-2.

2) Change in line with activities coordinated with MCC/MFK (in the field of Air Quality Monitoring)

MCC/MFK started the project centering on the promotion of energy preservation from September, 2019. This project includes the activities of improving air quality monitoring, where concretely, rehabilitation of analyzers in AQMSs, establishment of air quality data network, etc. were the duplicated activities with those of JICA. Therefore, both sides discussed and coordinated the roles in order to avoid the duplication. The content of the changes is shown in Table 2-1.

- Coordination regarding rehabilitation analyzers in AQMSs

  The Project planned rehabilitation of analyzers in five AQMSs in the Pristina Area out of twelve AQMSs all over Kosovo. Meanwhile MCC/MFK planned rehabilitation of analyzers in all AQMSs in Kosovo. Therefore, in April 2018, MESPI/MESP, MCC/MFK and JET held a meeting and agreed that Japanese side will rehabilitate analyzers in five AQMSs in the Pristina Area and MCC/MFK will rehabilitate analyzers in all other AQMSs.

- Establishment of air quality data network

  Responding to the request by the Kosovo side for constructing Kosovo independent air quality data network for all AQMSs, MCC/MFK and JET agreed to make every effort to establish the network with same system.

(2) Changes of external conditions and responses in the second period

Changes of external conditions are shown as follows. All these changes followed the activities in the first period.

1) Change in line with activities coordinated with the MCC/MFK (Establishment of air quality data network)

In the second JCC meeting, Kosovo side unified the opinion and strongly requested the establishment of an integrated and independent air quality data network for all AQMSs in Kosovo. JICA had an internal discussion and decided to leave the establishment of the whole air quality data network to MCC/MFK. JICA proposed this to MCC/MFK and MESPI/MESP, and the proposal was readily accepted. The content of the changes including rehabilitation of analyzers in AQMSs is shown in Table 2-1. MCC/MFK had also decided to provide meteorological instruments for all AQMSs, since the Kosovo side requested to install the same kind of instruments.

Instead, JET changed the plan of air quality data display installation from installing one indoor display in the city of Pristina to installing a larger number of outdoor displays in the Pristina Area (five locations). JET originally planned to exhibit the data obtained from the network established by MCC/MFK, but because of the delay of the government budget execution in the U.S, at the end of 2018, JET decided to use the data from data network established by EC. However, the EC network did not include the data from AQMSs in Obiliq area, and therefore displays were installed in four locations in the city of Prishtina and not in Obiliq.

2) Change in line with activities coordinated with MCC/MFK (Handling of ICP-MS)

The analysis of heavy metals by the ICP-MS became necessary as the analysis results of heavy metals in the PM sampled in Drenas and Mitrovica showed that some components exceeded the Japanese guideline values.

Kosovo side has the ICP-MS in KHMI, but it was hardly operated since the introduction around 2012, and re-functionalization was required. Meanwhile, MCC/MFK planned the operation training in response to the request by the Kosovo side.

The ICP-MS required adjustment work for analysis of heavy metals in order to carry out operation training. The Kosovo side requested the implementation of the operation training from the Japanese side, but the Japanese side could not conduct the training due to budget deficit. Therefore, Kosovo side requested the training from MCC/MFK, and MCC/MFK planned to conduct the training for heavy metal analysis by the ICP-MS.

However, in order to analyze heavy metals there was a need for the ICP-MS to be adjusted. Since Japanese side's scope of work for ICP-MS was to inspect the possibility of operation, the adjustment work was not included. At the same time, MCC/MFK recognized the necessity of the adjustment work for the first time after understanding of the diagnosis work by the Project, and the scope of their work did not include the adjustment work either. In this situation, it was difficult to carry out the adjustment work.

Owing to this circumstance, C/P requested for the Project to carry out the adjustment work in order to analyze heavy metals for the purpose of monitoring of heavy metals in PM with the ICP-MS. the Project was determined to conduct the work since the work meets the purpose of the Project to enhance capacities for air quality monitoring.

(3) Change of external conditions and responses in the third period

1) The delay of the Installation of air quality data display affected by COVID-19

MCC/MFK established the air quality data network in November, 2019. Project carried out the change of data source from EC network to MCC/MFK network and the installation of a display in Obiliq. The Project originally planned to install the display in Obiliq in March 2020, but because of the effect of the COVID-19, the installation was postponed to March, 2020, and the display started in May, 2020.

2) Additional duties accompanied with the Project period extension because of the COVID-19

In early 2020, the Project period was extended because of the COVID-19. The Project decided to add activities during the extension period. Concrete added activities have been described in “1-4-2 additional activities”.

3.2 Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

3.2.1 Activities

JET carried out the seminars, lectures, and OJTs shown in Table 3-1 to C/Ps, in order for C/Ps to understand the emission inventory deeply and to be able to continuously prepare the emission inventory autonomously. Through these activities, the capacity for the emission inventory preparation was enhanced. The list of documents used in this activity is attached in Appendix-1.

Table 3-1 Seminars, Lectures, OJTs conducted for Preparation of Emission Inventory

Date	Content	Participant
First Period (seven lectures, eight seminars and four others)		
Dec. 4, 2017, 9:30~10:00	2017 Emission Inventory (EI) Seminar 01: What is Emission Inventory	9 C/Ps
Dec. 4, 2017, 10:30~11:30	2017 EI Seminar 02: Introduction of Emission Inventory (Sector, Scope, Concept, etc.)	9 C/Ps
Dec. 4, 2017, 13:15~15:45	2017 EI Seminar 03: Introduction of Emission Inventory (Key category analysis and Data collection)	9 C/Ps
Dec. 5, 2017, 9:15~11:45	2017 EI Seminar 04: Introduction of Emission Inventory (Time Series Consistency and Uncertainties)	8 C/Ps
Dec. 6, 2017, 9:15~12:00	2017 EI Seminar 05: Introduction of Emission Inventory (Spatial Mapping of Emissions and Projections)	7 C/Ps
Dec. 7, 2017, 9:15~12:00	2017 EI Seminar 06: Introduction of Emission Inventory (Inventory Management, Improvement, and QA/QC)	8 C/Ps
Dec. 12, 2017, 9:15~16:00	2017 EI Seminar 07: Energy Industries Category	9 C/Ps
Dec. 13, 2017, 9:15~16:00	2017 EI Seminar 08: Manufacturing Industries and Construction Category	10 C/Ps
Dec. 14, 2017, 9:15~16:00	2017 EI Seminar 09: Small Combustion Category	11 C/Ps
Dec. 18, 2017, 9:15~16:00	2017 EI Workshop 01: Discussion of the procedure of the survey interview for small combustions using the experience and know-how of the C/P	12 C/Ps
Jan. 29, 2018, 13:30~14:30	Outline of Air Quality Assessment & Air Pollutant Emission Inventory	Over 100 students
Feb. 7, 2018, 9:15 – 12:00	2018 EI Seminar 13: IPPU (Industrial Process and Product Use) Sector	8 C/Ps
Feb. 7, 2018, 13:15～14:45	2018 EI Seminar 14: AFOLU Sector	7 C/Ps
Feb. 8, 2018, 9:15~11:45	2018 EI Seminar 15: Waste Sector	10 C/Ps
Feb. 9, 2018, 9:15~11:30	2018 EI Seminar 16: Road transport Category	6 C/Ps
Feb. 16, 2018	Instruction Documents on Research Interviews for households	20 students
Feb. 16, 2018	Instruction Documents on Research Interviews for tertiary industry	18 students

From Feb. to April, 2018	Research Interviews for households by students	20 students
From Feb. to April, 2018	Research Interviews for tertiary industry by students	18 students
Apr. 11, 2018, 9:15~10:00	2018 EI Seminar 10: Non-Road Mobile and Machinery Category	10 C/Ps
Apr. 11, 2018 10:15~11:15	2018 EI Seminar 11: Aviation Category and Railway Category	10 C/Ps
Apr. 11, 2018 11:15~12:00	2018 EI Seminar 12: Fugitive Emissions from Solid Fuels Category	10 C/Ps
Apr. 13, 2018	Instruction on Traffic Volume Survey	Over 100 students
Apr. 25 (Wed.) 19:30 ~ Apr. 26 (Thu.) 22:00, 2018 Apr. 28 (Sat.) 5:30 ~ Apr. 29 (Sun.) 7:30, 2018	Traffic Volume Counting Research in Prishtina area by students	Total number of students is 156
2nd Period (seven lectures, six OJT and ten others)		
Oct. 19, 2018 13:45~15:15	2nd Period Work Plan Emission Inventory & Simulation Modeling	10 C/Ps
Oct. 24, 2018 10:00~12:00	Overview of Emission Inventory Progress (detailed) and Energy Sector	10 C/Ps
Oct. 25, 2018 9:30~12:00	Progress of Emission Inventory (IPPU, AFOLU and Waste Sectors)	10 C/Ps
Oct. 29, 2018 10:00~12:00	OJT on Emissions from TPPs (part 1) Confirmation of data collection activity for preparation of emission inventory in 2017	9 C/Ps
Oct. 30, 2018 9:30~12:00	OJT on Emissions from TPPs (part 2) Discussion of calculation method for vehicle emissions	9 C/Ps
Nov. 23, 2018 9:30~12:00	Lecture for Emissions from Vehicle and discussion on necessary data	6 C/Ps
Nov. 26, 2018 9:30~12:00	Lecture for Emissions from Vehicle on data arrangement of Traffic Volume Counting Research	9 C/Ps
Jan. 18, 2019 9:30~12:00	Discussion on Data Collection Activity for preparation of Emission Inventory	6 C/Ps
Jan. 25, 2019 14:00~15:15	Discussion on Data Collection Form for preparation of Emission Inventory	6 C/Ps
Jan. 30, 2019 13：30~15：45	OJT of Emissions from TPPs on Emissions Calculation Procedure for TPPs	5 C/Ps
Feb. 4, 2019 14：00~16：00	OJT of Emissions from TPPs on Confirmation of results of exhaust gas measurement conducted by the Project	6 C/Ps
Feb. 5, 2019 09：30~11：50	OJT of Emissions from TPPs on Confirmation of calculation procedure for emission factors using results of exhaust gas measurement	6 C/Ps
Feb. 6, 2019	OJT of Emissions from TPPs on Confirmation of emission	6 C/Ps

09：30~11：50	calculation procedure	
Feb. 7, 2019 09:30~11:30	Discussion on Emissions with Emission Inventory Group & Simulation Modeling Group	7 C/Ps
Apr. 10, 2019 13:30~14:30	Discussion on Research Interviews of vehicle information	3 C/Ps
Apr. 12, 2019 14:00~14:45	Discussion on GIS Data	2 C/Ps
Apr. 17, 2019 10:00~11:00	Discussion on vehicle information in Prishtina area	6 C/Ps
Apr. 18, 2019 13:30~15:30	Lecture for Students on Research for vehicle information	1 C/P
Apr. to June, 2019	Research Interviews for vehicle information by students	6 Students
Apr. 19, 2019 13:30~15:30	Research Interview with the Public Bus Company in Municipality of Prishtina	2 C/Ps
Jun. 5, 2019 9:30~11:30	Lecture on emission calculation procedure for emissions from residential stationary and tertiary industry sub-category of Small Combustion category	7 C/Ps
Jun.17, 2019 13:30~14:30	Interview with the Ministry of Infrastructure and Transportation on Vehicle Information	1 C/P
Jun.26, 2019 10:00~12:00	Lecture for Simulation Modeling Group on Procedure of calculating Emission Inventory	5 C/Ps
Jul.1, 2019 8:15~9:30	Wrap-up meeting on Emission Inventory Preparation	6 C/Ps
3rd Period (nine discussions, thirteen seminars and seven others)		
Oct. 31, 2019 9:00~11:20	Introduction to MCC/MFK on Framework of Emission Inventory preparation conducted by the Project	3 C/Ps
Nov. 5, 2019 09：30~11：50	Discussion on development of institutional framework for Emission Inventory Preparation (part 1)	4 C/Ps
Nov. 6, 2019 09：30~10：00	Discussion on development of institutional framework for Emission Inventory Preparation (part 2)	4 C/Ps
Nov. 6, 2019 10：00~11：50	Discussion on emission calculation improvement method for the tertiary industry sub-category of Small Combustion category	4 C/Ps
Nov. 8, 2019 09：30~11：30	Discussion on emission calculation improvement method for residential stationary and tertiary industry sub-category of Small Combustion category	4 C/Ps
Nov. 19, 2019 09：30~11：50	Lecture for calculation method of vehicle emissions	6 C/Ps
Nov. 20, 2019 09：30~11：50	OJT on set of emission factors for vehicle emissions	6 C/Ps
Nov. 21, 2019 09：30~11：50	OJT on calculation procedure for activity data for vehicle emissions	6 C/Ps
Nov. 26, 2019 10：00~11：00	Interview with the Municipality of Obiliq on Official Data	1 C/P
Nov. 29, 2019 13：30~14：15	Interview with the Municipality of Fushe Kosovo on Official Data	1 C/P
Dec. 2, 2019	OJT on calculation of emissions from residential stationary	4 C/Ps

09：30~11：30	sub-category of Small Combustion category	
Dec. 3, 2019 13：30~15：30	OJT on calculation of emissions from residential stationary sub-category of Small Combustion category	4 C/Ps
Dec. 4, 2019 09：30~11：50	OJT on calculation of emissions from residential stationary sub-category of Small Combustion category	5 C/Ps
Dec. 4, 2019 13：30~15：00	OJT on calculation of emissions from tertiary industry sub-category of Small Combustion category	5 C/Ps
Dec. 6, 2019 09：30~11：00	Wrap-up meeting on Emission Inventory Preparation	6 C/Ps
Jan. 27, 2020 9:30~12:00	Discussion on Draft Manual, additional data collection activities such as statistical yearbook, operation information on TPPs.	5 C/Ps
Jan. 28, 2020 9:30~12:00	Discussion on institutional framework for Emission Inventory Preparation	7 C/Ps
Jan. 29, 2020 9:30~12:00	OJT of updating Emission Inventory on emissions from residential stationary sub-category of Small Combustion category	5 C/Ps
Feb. 3, 2020 13:30~14:00	Final discussion on institutional framework for Emission Inventory Preparation	7 C/Ps
Feb. 3, 2020 14:00~15:30	OJT of updating annual data on emission calculation from residential stationary sub-category of small combustion category	7 C/Ps
Feb. 6, 2020 13:30~15:30	Lecture on Emissions from Vehicle	5 C/Ps
Feb. 13, 2020 13:30~15:30	OJT of updating annual data on emission calculation from Agriculture sector	4 C/Ps
Feb. 19, 2020 13:30~15:30	OJT of updating annual data on emission calculation from Agriculture and Waste sectors	4 C/Ps
Feb. 20, 2020 13:30~15:30	OJT of updating annual data on emission calculation from Waste sector and Manufacturing industry and construction category of Energy sector	4 C/Ps
Feb. 26, 2020 9:30~10:00	Final Confirmation and Discussion on updating Emission Inventory of Waste Sector	3 C/Ps
Feb. 26, 2020 10:00~11:00	Final Confirmation and Discussion on updating Emission Inventory of Agriculture Sector	5 C/Ps
Feb. 27, 2020 10:30~11:30	Confirmation of Content of Lecture on Emissions from Vehicle Final OJT on Preparation of Emission Inventory	5 C/Ps
Feb. 27, 2020 14:00~15:30	Lecture on Emissions from Vehicle at the University of Prishtina	5 C/Ps Over 100 students
Mar. 3, 2020 9:30 ~11:50	Wrap-up Lecture on Preparation of Emission Inventory with other Groups	10 C/Ps
April 6, 2021 9:00~11:00	Discussion on the Final Report	4 C/Ps
April 13, 2021 9:00~11:00	Discussion on the Final Report	4 C/Ps

April 20, 2021 9:00~11:00	Discussion on the Final Report and preparation of presentation materials for the Final Seminar	4 C/Ps
April 27, 2021 9:00~11:00	Discussion on the Final Report and preparation of presentation materials for the Final Seminar	4 C/Ps
May 18, 2021 9:00~11:00	Preparation of presentation materials for the Final Seminar	4 C/Ps
May 25, 2021 9:00~11:00	Preparation of presentation materials for the Final Seminar	4 C/Ps
Additional activities in the third period		
Nov. 3, 2020 9:00~11:00	Discussion and Confirmation of the additional remote activity contents	5 C/Ps
Nov. 11, 2020 9:00~11:00	Discussion of the data collection activities for the emission inventory for 2018	4 C/Ps
Nov. 17, 2020 9:00~11:00	Confirmation of progress of data collection activities	4 C/Ps
Nov. 24, 2020 9:00~11:00	Discussion on the establishment of data collection procedure for Manufacturing Industries for IPPC Permits and Environmental Permits.	4 C/Ps
Dec. 1, 2020 9:00~11:00	Discussion on the establishment of data collection procedure for Manufacturing Industries for IPPC Permits and Environmental Permits.	3 C/Ps
Dec. 8, 2020 9:00~11:00	Confirmation on the start of the data collection activities and Information of IPPC Permits and Environmental Permits	4 C/Ps
Dec. 15, 2020 9:00~11:00	Discussion and Lecture on QA by JET on Emission Inventory of Energy Industry Category	4 C/Ps
Jan. 12, 2021 9:00~11:00	Discussion of calculation procedure on Small Combustion Category (Household) and Agriculture Sector	4 C/Ps
Jan. 19, 2021 9:00~11:00	Discussion and Lecture of QA by JET on Small Combustion Category (Household) and Agriculture and Waste Sector	4 C/Ps
Jan. 26, 2021 9:00~11:00	Discussion and Lecture of QA by JET on Agriculture Sector and Waste Sector	4 C/Ps
Feb. 2, 2021 9:00~11:00	Discussion on the near future emission calculation procedure for emissions from Vehicles sub-category and IPPU Sector	4 C/Ps
Feb. 9, 2021 9:00~11:00	Discussion on IPPU Sector, Transportation Category, and Small Combustion (Tertiary Industry) category	4 C/Ps
Feb. 19, 2021 9:00~11:15	Wrap-up of Data Collection Activities and Compilation of the Emission Inventory Calculation Files	4 C/Ps
Mar. 2, 2021 9:00~11:00	Confirmation of Emission Inventory for 2018 and preparation of presentation materials for additional remote activities	4 C/Ps
Mar. 9, 2021 9:00~11:00	Confirmation of Emission Inventory for 2018 and preparation of presentation materials for additional remote activities	4 C/Ps
Mar. 16, 2021 9:00~11:00	Preparation of presentation materials for additional remote activities	4 C/Ps
Mar. 30, 2021 9:00~11:00	Wrap-up of additional remote activities	4 C/Ps

Apr. 2, 2021 9:00~11:00	Seminar with JICA HQ and JICA Balkan Office on Achievement of additional remote activities on Output 1	4 C/Ps
Apr. 13, 2021 9:00~11:00	Wrap-up of activities on emission inventory preparation, and discussion on the content of the Final Completion Report	4 C/Ps
Apr. 20, 2021 9:00~11:00	Discussion on the proposals and lessons learned in the Final Completion Report	3 C/Ps
Apr. 27, 2021 9:00~11:00	Discussion on the proposals and lessons learned in the Final Completion Report, and discussion on the content of the presentation for the Final Seminar	4 C/Ps
May. 18, 2021 9:00~11:00	Discussion on the content of the presentation for the Final Seminar	4 C/Ps
May. 25, 2021 9:00~11:00	Discussion and finalization of the presentation for the Final Seminar	4 C/Ps

(1) Framework for Preparation of Emission Inventory

The second emission inventory, which is the final inventory in the Project, was prepared by using the framework shown in Table 3-2.

Table 3-2 Framework for the second Emission Inventory

Object substance	SO_2, NO_X, TSP, PM_{10}
Target Area	The Prishtina Area (refer to Figure 3-1)
Target Year	Year 2017; including Year 2015 and Year 2016 for the purpose of understanding the emission trend for each year
Calculation Method	Calculation by the method of EMEP/EEA air pollutant emission inventory guidebook 2016 & 2019 (EMEP/EEA Guidebook)
Target Sector	The sector classification follows the EMEP/EEA Guidebook as follows: Energy Sector (Thermal Power Plant, Manufacturing, Transport, Small Combustion, Fugitive Emissions from fuel): High Priority for calculation Industrial Process and Product Use (IPPU) Sector: Low Priority for calculation Agriculture Sector: Low Priority for calculation Waste Sector: Low Priority for calculation
Activity Data	Each Statistical Yearbook in Kosovo Research Interview for household and service business by Students Research Interview for service business by Students Research Interview on vehicle information by Students Traffic Volume Counting World Energy Statistics (IEA)
Emission Factor Data	Actual Measurement Data by the Project EMEP/EEA Guidebook
Time Resolution of Emissions	Time resolution of emission is set for each emission source. For example, thermal power plant is set as continuous operation during each month, daily pattern for household is set as low operation in night and day time, and vehicles are set based on results of traffic counting
Spatial Resolution of Emissions	Emissions are distributed in accordance with the Standard Mesh Information on mapping in Kosovo (1km x 1km). Standard Mesh Information is population, land cover, etc.

The outline of the EMEP/EEA Guidebook used is shown in Table 3-3.

Table 3-3 Outline of EMEP/EEA Guidebook

Authority of publication	European Environment Agency(EEA)
User of Guidebook	Member States under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP) The Member States are recommended to review and apply the information contained in the EMEP/EEA guidebook, when compiling their emission inventory data sets.
Objective pollutant	TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO, Halides (hydrogen chloride, fluorine, etc.) VOCs (Volatile Organic Compounds), Mercury, Cadmium, heavy metals (excluding Mercury and Cadmium), PAH (Polycyclic Aromatic Hydrocarbons), DXNs (Dioxin, polychlorinated biphenyl (PCB), HexaChloroBenzene (HCB), NH_3, H_2S, Black Carbon (BC)
Sectors, categories, and subcategories	Pollutant emissions estimates are divided into sectors — groupings of related processes and sources — these include: Energy Sector; Industrial Processes and Product Use (IPPU) Sector; Agriculture Sector; Waste Sector; and Other Sectors. Each sector comprises individual categories (e.g. transport) and subcategories (e.g. passenger vehicles).
A tiered methodology for estimating emissions.	Simple (Tier 1) methods are given for all the sources and substances which the countries that have ratified Convention protocols need to report. More advanced (Tier 2) methods are given for key categories. Further information is given for advanced (Tier 3) approaches for key categories where suitable methods are available.
Inventory Quality	In order to maintain and manage the emission inventory so that the quality of the emission inventory will be continuously improved over the long term, this guideline has the approach of building inventories that are consistent, comparable, complete and accurate. Accuracy: Emission estimates should be accurate in the sense that they are systematically neither overestimated nor underestimated, as far as they can be judged. Comparability: Comparability means that estimates of emissions reported by Parties (Regional Emissions and/or National Emissions) in their inventories should be comparable. Completeness: Completeness means that an annual inventory covers at least all sources, as well as all pollutants, for which methodologies are provided in the latest EMEP/EEA Guidebook. For sub-categories for which numerical values could not be obtained, it is necessary to indicate the calculation status and ensure completeness by describing the notation keys such as NE: Not Estimated, NO: Not Occurring. Consistency: An inventory is consistent if the same methodologies are used for all the years of the inventory, as far as consistent data sets are used to estimate emissions.
Note	The EMEP/EEA Guidebook is compatible with and complementary to the 2006 IPCC Guidelines. The EMEP/EEA is given on: key category analysis and methodological choice; data collection (including measurement methodologies); time series

	consistency; uncertainties; inventory management, improvement and quality assurance/quality control (QA/QC); spatial emissions inventories; projections.

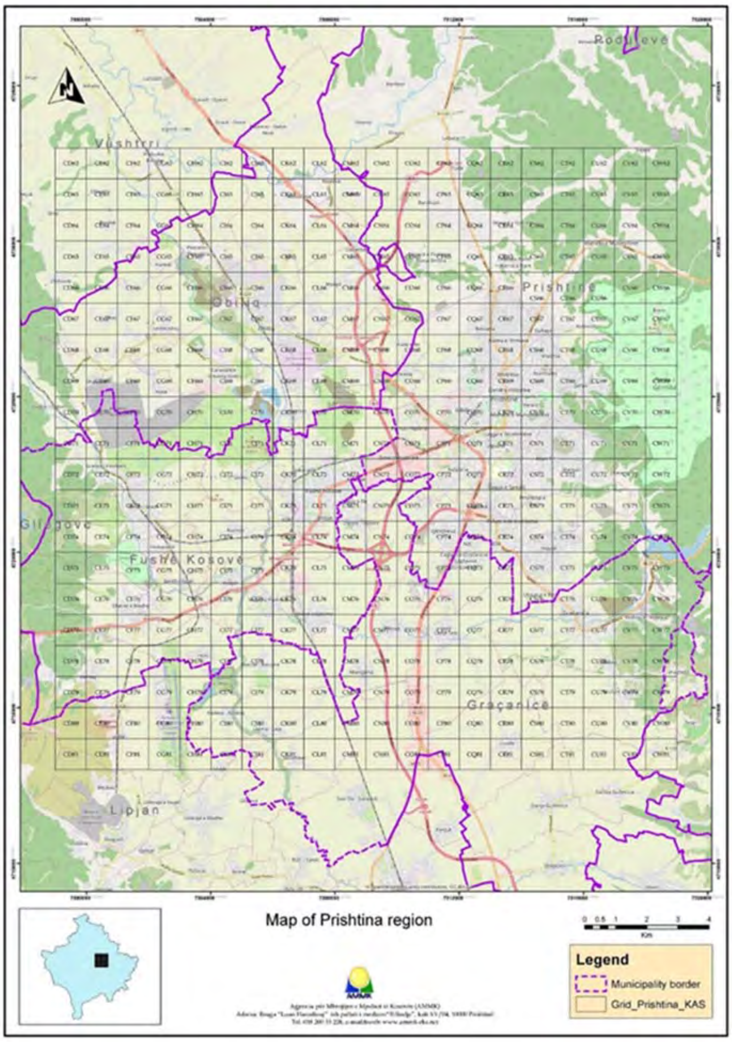


Figure 3-1 Target Area for Emission Inventory Preparation

(2) Support for Establishment of Institutional Framework on Preparation of Emission Inventory

The Project supported the establishment of institutional framework on the preparation of emission inventory. However, it has not yet been integrated into legislation, and it is an issue as to how it is going to be integrated. The Institutional Framework of the emission inventory is proposed as shown in Figure 3-2.

For implementation of this institutional arrangement, the definition of the roles and responsibilities for the relevant organizations is important.

The Project proposed the roles and responsibilities described in Table 3-4.

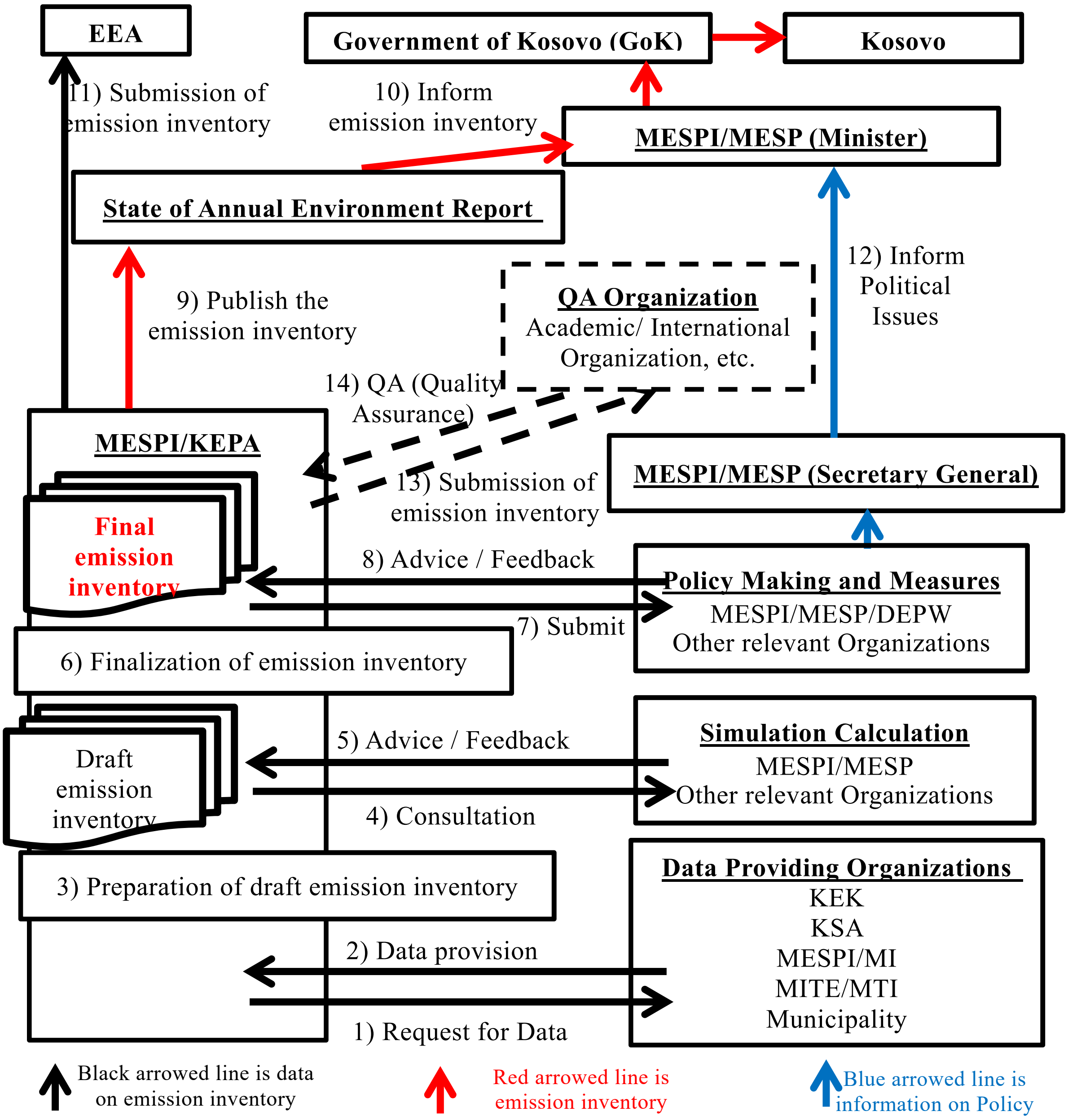


Figure 3-2 Institutional Arrangement for Emission Inventory Preparation

Table 3-4 Roles and Responsibilities of Relevant Organizations for Emission Inventory Preparation

	Roles and Responsibilities
MESPI/MESP/KEPA	Publish the emission inventory Submission of the emission inventory to EEA Preparation of the emission inventory Preparation, confirmation, and approval of improvement plan on preparation of emission inventory Performs actual work of emission inventory compilation Responsible for emission inventory calculations, compiling, archiving and management of all data Quality control

	Send the emission inventory to the Simulation Modeling Group (KEPA/KHMI) for calculation of ground level concentration map of air quality Sent the emission inventory to DIPM for policy making
MESPI/MESP/DEPW/DIPM	Policy making for air quality using air pollutant emission inventory Policy making for air quality using ground level concentration map of air quality under calculation of simulation modeling
MESPI/MESP/KEPA/KHMI	Feedback for emission improvement using results of simulation modeling
Data Providing Organizations	Data provision Quality control for provided data Data validation Responding to inquiries regarding data it has provided

The current Action Plan under the Strategy for Air Quality is prepared every three years, but it is planned to be changed to be prepared every five years. The recommendation of the schedule of Air Pollutant Emission Inventory Preparation is shown in Table 3-5, such that the emission inventory prepared every year is used for considering air pollutant control measures for every five years.

Table 3-5 Schedule of Air Pollutant Emission Inventory Preparation
(In the table below, MESPI/MESP is shown as MESP)

Schedule of Air Pollutant Emission Inventory Preparation

Preparation for Every Year For example: Preparation Year = 2020

Target Year of Air Pollutant Emission Inventory: n-2 (two years before) Target Year = 2018

	Process	Relevant Organizations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug.	Sep	Oct.	Nov	Dec	Jan	Feb
1	Preparation	MESPI/KEPA	→	→												
2	Data request	MESPI/KEPA			→											
3	Data preparation	Data Providing Organizations				→										
4	Data Collection	MESPI/KEPA				→	→									
5	Preparation of draft air pollutant emission inventory	MESPI/KEPA					→	→	→	→						
6	Feedback on draft air pollutant emission inventory (every 5 years)	Data Providing Organizations								→	→					
7	Feedback from Simulation Modeling (every 5 years)	MESPI/KEPA									→	→				
8	Finalizing air pollutant emission inventory	MESPI/KEPA										→	→			
9	Submitting air pollutant emission inventory to MESPI (DEPW) (every 5 years)	MESPI/KEPA MESPI/DPIP											→			
10	Publishing air pollutant emission inventory	MESPI/KEPA												→		
11	Reporting data to EEA	MESPI/KEPA													→	→

(3) Emission Calculation Method for each Sector of Emission Inventory

The emission inventory is calculated for the emission sources shown in Table 3-6.

Table 3-6 Tabulated list of emission sources calculated in the emission inventory

Sector of EMEP/EEA Guidebook	Category of EMEP/EEA Guidebook	Sub-category of EMEP/EEA Guidebook estimated in this emission inventory	Sub-category of EMEP/EEA Guidebook not estimated in this emission inventory
Energy Sector	Energy Industries (refer to Table 3-10)	TPP: Emissions from combustion of Lignite	Heat Production, Petroleum refining
	Manufacturing Industries and Construction (refer to Table 3-12 & Table 3-13)	Food and Beverages Brick manufacture Non-metallic minerals	Iron and steel Non-ferrous metals Chemicals Pulp, paper and print
	Transportation ‘refer to Table 3-39 & Table 3-40)	Vehicle: exhaust gas Emissions from combustion of fuels Railway Aviation	Fugitive dust from road vehicle tire and brake wear Evaporative emissions Navigation Pipeline, etc.
	Small Combustion (refer to Table 3-23)	Emissions from residential stationary equipment Emissions from tertiary industry	Off-road vehicles (mobile machinery in manufacturing industries and construction, tertiary industry, residential areas, agriculture/forestry, etc.)
	Fuel leakage (refer to Table 3-42)	Fugitive emissions from solid fuel (Lignite): Coal mining and handling	Oil and Natural Gas – Exploration, production, transport
IPPU Sector (refer to Table 3-45)	Mineral industries	Storage, handling and transport of mineral products	Cement production, Glass production, Quarrying and mining of minerals, etc.
	Chemical industry	Not estimated sub-category	Chemical industry, etc.
	Metal production	Not estimated sub-category	Iron and steel production, non-ferrous metal, etc.
	Solvent and product use	Asphalt	Domestic solvent use, Dry cleaning, etc.
	Other industry production	Wood processing	Pulp and paper industry, Food and beverages industry, etc.
Agriculture	Livestock	Manure management	Not estimated

Sector (refer to Table 3-46)			sub-category
	Crop production and agricultural soils	Crop production and agricultural soils	Agriculture other including use of pesticides
	Field burning of agricultural waste	Field burning of agricultural waste	Not estimated sub-category
Waste Sector (refer to Table 3-48)	Livestock	Manure management	Not estimated sub-category
	Crop production and agricultural soils	Crop production and agricultural soils	Agriculture other including use of pesticides
	Field burning of agricultural waste	Field burning of agricultural waste	Not estimated sub-category
	Livestock	Manure management	Not estimated sub-category

Outline of the emission inventory calculation files is shown in Figure 3-3. The yellow boxes are data possessed by the authorities in Kosovo, the orange boxes are calculated by the International Guidebook data such as EMEP/EEA Guidebook and 2006 IPCC Guidelines, and the green boxes are results from the research interviews and traffic volume counting by students who assisted the Project. The blue boxes are emission inventory calculation files.

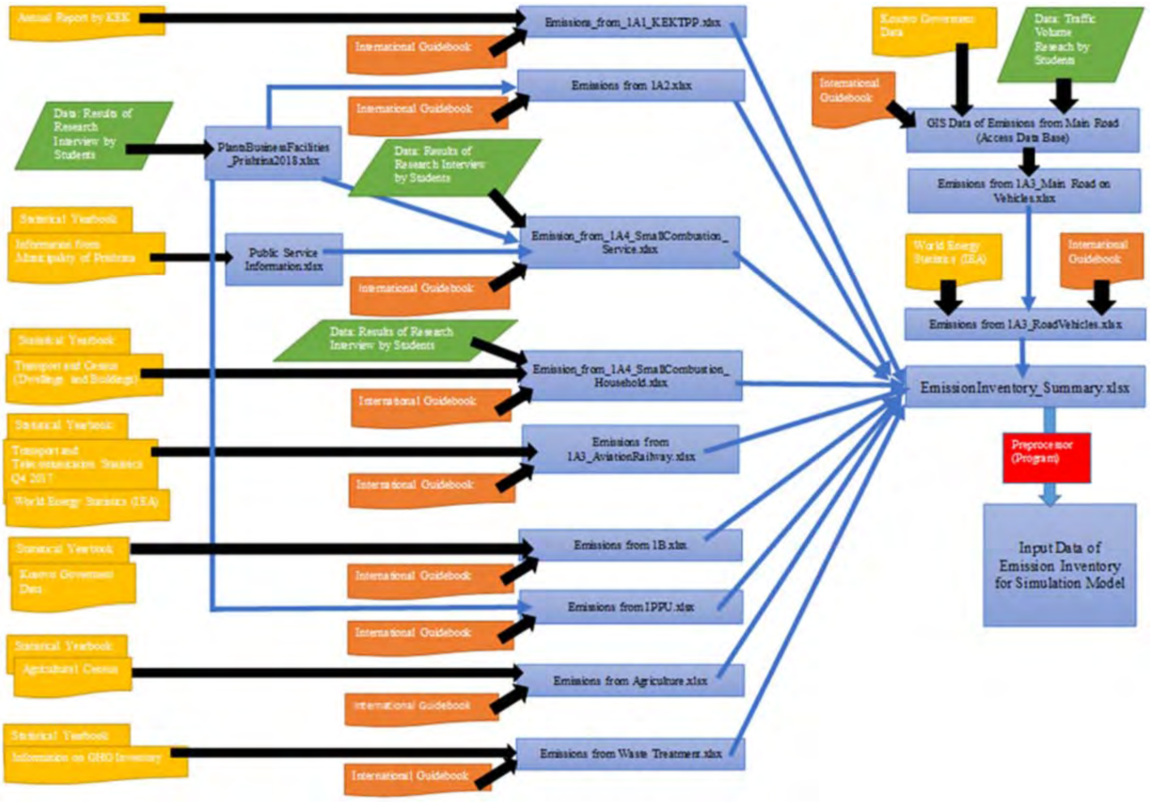


Figure 3-3 Outline of Calculation File Structure for Emission Inventory

Emissions were calculated in accordance with sector classification and calculation methods in the EMEP/EEA Guidebook. The basic emission calculation formula is "Emissions = Activity Data × Emission Factor".

The summary of emission calculation procedure of each sector is as follows.

(4) Calculation Method for each Sector

1) Energy Sector (Power Plants)

Emissions from Energy Industry category in Energy sector are emissions from the thermal power plants. These emissions were calculated as shown in Table 3-7

Table 3-7 Calculation Method of Emissions from Thermal Power Plants

Emission Factor	Emission factors prepared from results of exhaust gas measurement by the Project
Activity Data	Monthly Fuel Consumption Data: Annual Report by KEK
Parameter	Net Calorific Value: Analyzing Data by the Project
Note	Tier 3 method on EMEP/EEA Guidebook
Spatial Resolution of Emissions	Point Sources: Allocating the location of each stack in each thermal power plant
Time Resolution of Emissions	Monthly emissions are calculated for each year. Hourly emissions are allocated uniformly on basis of monthly emissions.

OJT for C/Ps on emissions from thermal power plants were carried out from October 2018 to January 2019. JET held a lecture on how to calculate emissions of 2016 from power plants, and C/Ps calculated the emissions for 2015 and 2018 independently from November 2020 to March 2021.

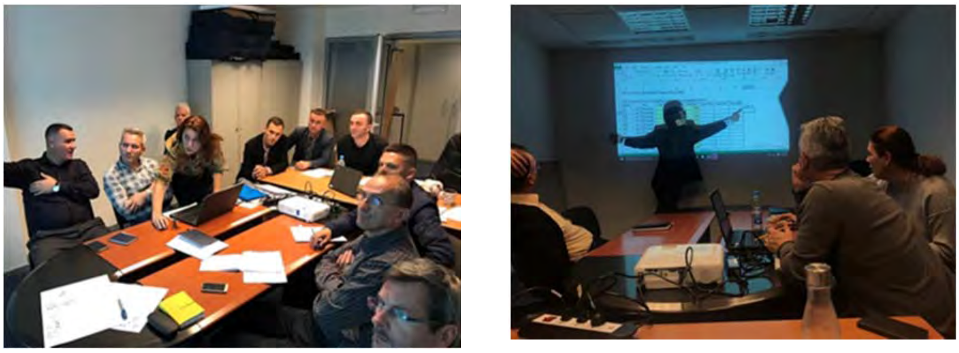


Photo 3-1 OJT for Energy Sector on Emission Inventory Preparation

In January 2019, JET lectured emission factor calculation procedure by using actual results of exhaust gas measurement by the Project. After that, C/Ps calculated emission factors using these results. Therefore, this was the first case that C/Ps calculated emissions by themselves by using Kosovo own emission factors.

The activity data on emissions are shown in Table 3-8.

Table 3-8 Activity Data on TPPs

TPP Kosovo A	Unit	Year 2015	Year 2016	Year 2017	Year 2018
Lignite Consumption at Unit A3	TJ/year	11,519.12	8,352.47	4,889.80	9,896.67
Lignite Consumption at Unit A4	TJ/year	9,211.01	10,178.53	9,528.99	8,106.02
Lignite Consumption at Unit A5	TJ/year	3,356.88	5,987.98	6,260.67	5,496.09
TPP Kosovo B		Year 2015	Year 2016	Year 2017	Year 2018
Lignite Consumption at Unit B1	TJ/year	20,084.50	19,061.60	19,193.92	11,187.79
Lignite Consumption at Unit B2	TJ/year	18,259.97	19,527.73	16,882.07	21,807.46

In January 2020, it was found that some of the measured data on the emission factors of TPPs were significantly different from other data. After discussing how to treat it, C/P-WG decided the following: to compare the largest value with the second largest value, and if the largest value is more than twice as large as the second largest value, then this value is treated as an abnormal value. The finalized emission factors are shown in Table 3-9. These are the Kosovo own emission factors.

Table 3-9 Finalized Emission Factors on TPPs

	SO_2 (g/GJ)	NO_X (g/GJ)	TSP (g/GJ)	PM_{10} (g/GJ)
TTP Kosovo A	454	338	191	129
TTP Kosovo B	655	655	282	190

Using these activity data and emission factors, the emissions from TPPs are shown in Table 3-10.

Table 3-10 Emissions from TPPs

SO_2 Emissions	Unit	Year 2015	Year 2016	Year 2017	Year 2018
TPP Kosovo A	ton SO_2/year	9,682.62	10,093.01	8,512.93	9,673.43
TPP Kosovo B	ton SO_2/year	25,197.39	25,347.42	23,745.02	21,716.02
TPP Total	ton SO_2/year	34,880.01	35,440.44	32,257.95	31,386.05
NOx Emissions	Unit	Year 2015	Year 2016	Year 2017	Year 2018
TPP Kosovo A	ton NOx/year	7,877.68	8,211.29	6,926.04	7,870.16
TPP Kosovo B	ton NOx/year	17,023.20	17,128.79	16,027.09	14,657.10
TPP Total	ton NOx/year	24,900.88	25,340.07	22,953.13	22,527.26
TSP Emissions	Unit	Year 2015	Year 2016	Year 2017	Year 2018
TPP Kosovo A	ton TSP/year	4,451.87	4,640.72	3,914.07	4,447.67
TPP Kosovo B	ton TSP/year	9,462.08	9,521.72	8,905.04	8,144.25
TPP Total	ton TSP/year	13,913.95	14,162.44	12,819.10	12,591.92
PM_{10} Emissions	Unit	Year 2015	Year 2016	Year 2017	Year 2018
TPP Kosovo A	ton PM_{10}/year	3,006.87	3,134.42	2,643.62	3,004.03
TPP Kosovo B	ton PM_{10}/year	6,391.22	6,431.48	6,015.06	5,501.16
TPP Total	ton PM_{10}/year	9,398.08	9,565.90	8,658.68	8,505.19

2) Energy Sector (Manufacturing)

Emissions from the manufacturing industries and construction category of the Energy sector are calculated as shown in Table 3-12 and Table 3-13, by using the calculation method shown in Table 3-11. The brick factory was identified as a point source from the results of exhaust gas measurement by the Project and fuel consumption data. For others, out of the 16 business facilities identified by the research interviews by students, the emissions corresponding to manufacturing industries were calculated. Emissions were calculated as area source by using the fuel consumption data collected from these research interviews and the default emission factors of Tier 1 method from the EMEP/EEA Guidebook.

Table 3-11 Emission calculation method

Calculation Method	Brick Factory: Tier 3 method on EMEP/EEA Guidebook Others: Tier 1 method on EMEP/EEA Guidebook
Emission Factor	Brick Factory: Emission Factors prepared from results of exhaust gas measurement by the Project Others: Emission factors listed in EMEP/EEA Guidebook
Activity Data	Brick Factory: Data provided by the factory Others: Results of research interviews by students
Parameter	2006 IPCC Guideline for National Greenhouse Gas Inventories
Spatial Resolution of Emissions	Brick Factory: Allocating to location of factory as a point source Others: Allocating to Mesh on Industrial zone
Time Resolution of Emissions	Allocating emissions uniformly to each business hour

Table 3-12 SO_2 Emissions from Manufacturing Industries and Construction Category

SO_2 Emissions from Prishtina Area

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.A Combustion							
	1.A.2 Manufacturing industries and construction						
			SO2 ton/year	NO	NO	NO	NO
		1.A.2.b Non-ferrous metals	SO2 ton/year	NO	NO	NO	NO
		1.A.2.c Chemicals	SO2 ton/year	IE	IE	IE	IE
		1.A.2.d Pulp, paper and print	SO2 ton/year	IE	IE	IE	IE
		1.A.2.e Food processing, beverages and tobacco	SO2 ton/year	**0.12**	**0.12**	**0.12**	**0.12**
		Wood	SO2 ton/year	0.12	0.12	0.12	0.12
		Lignite	SO2 ton/year	0.00	0.00	0.00	0.00
		Pellet	SO2 ton/year	0.00	0.00	0.00	0.00
		LPG	SO2 ton/year	0.00	0.00	0.00	0.00
		Gas/ Diesel	SO2 ton/year	0.00	0.00	0.00	0.00
		Fuel Oil/Heavy Oil	SO2 ton/year	0.00	0.00	0.00	0.00
		Others	SO2 ton/year				
		1.A.2.f Non-metallic minerals	SO2 ton/year	**184.75**	**184.75**	**184.75**	**184.65**

		Point Source: Brick Factory					
		LPG (brick factory)	SO2 ton/year	0.00	0.00	0.00	0.00
		Diesel(brick factory)	SO2 ton/year	0.09	0.09	0.09	0.00
		Others (Petro-Coke, brick factory)	SO2 ton/year	184.24	184.24	184.24	184.24
		Area Source:					
		Wood	SO2 ton/year	0.00	0.00	0.00	0.00
		Lignite	SO2 ton/year	0.05	0.05	0.05	0.05
		Pellet	SO2 ton/year	0.00	0.00	0.00	0.00
		LPG	SO2 ton/year	0.00	0.00	0.00	0.00
		Gas/ Diesel	SO2 ton/year	0.05	0.05	0.05	0.05
		Fuel Oil/Heavy Oil	SO2 ton/year	0.31	0.31	0.31	0.31
		Others	SO2 ton/year	0.00	0.00	0.00	0.00
		1.A.2.g Other	SO2 ton/year	NO	NO	NO	NO
		Sub Total	SO2 ton/year	**184.98**	**184.98**	**184.98**	**184.89**

Table 3-13 PM_{10} Emissions from Manufacturing Industries and Construction Category PM_{10} Emissions from Prishtina Area

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.A Combustion							
		1.A.2.d Pulp, paper and print	PM_{10} ton/year	IE	IE	IE	IE
		1.A.2.e Food processing, beverages and tobacco	PM_{10} ton/year	**1.53**	**1.53**	**1.53**	**1.53**
		Wood	PM_{10} ton/year	1.53	1.53	1.53	1.53
		Lignite	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Pellet	PM_{10} ton/year	0.00	0.00	0.00	0.00
		LPG	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Gas/ Diesel	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Fuel Oil/Heavy Oil	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Others	PM_{10} ton/year				
		1.A.2.f Non-metallic minerals	PM_{10} ton/year	**196.59**	**196.59**	**196.59**	**196.55**
		Point Source: Brick Factory					
		LPG (brick factory)	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Diesel(brick factory)	PM_{10} ton/year	0.04	0.04	0.04	0.00
		Others (Petro-Coke, brick factory)	PM_{10} ton/year	196.39	196.39	196.39	196.39
		Area Source:					
		Wood	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Lignite	PM_{10} ton/year	0.01	0.01	0.01	0.01
		Pellet	PM_{10} ton/year	0.00	0.00	0.00	0.00
		LPG	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Gas/ Diesel	PM_{10} ton/year	0.02	0.02	0.02	0.02
		Fuel Oil/Heavy Oil	PM_{10} ton/year	0.13	0.13	0.13	0.13
		Others	PM_{10} ton/year	0.00	0.00	0.00	0.00
		1.A.2.g Other	PM_{10} ton/year	NO	NO	NO	NO
		Sub Total	PM_{10} ton/year	**199.64**	**199.64**	**199.64**	**199.61**

3) Energy Sector (Small Combustion Category)

The emissions from small combustion category were calculated as shown in Table 3-14. The small combustion category consists of the commercial/ institutional facilities (tertiary industry stationary sources) and the residential equipment (residential stationary). The results of the research interviews by students are attached in Appendix-1.

Table 3-14 Calculation Method of Emissions from Small Combustion Category

Emission Factor	Tier 1 method and Tier 3 method on EMEP/EEA Guidebook
Clarification of tertiary industry	Office, kindergarten, school, university, bakery, café, restaurant, hotel, shop, warehouse, hospital, small factory, others.
Activity Data of tertiary industry	Hotel: Number of hotels is set from the statistical data for hotels. Data provided by Municipality of Obiliq: School and Hospital: Name of establishment, fuel consumption data by each establishment Others: Number of entities by each tertiary industry classification provided by Municipality of Obiliq. Data provided by Municipality of Prishtina: School and Hospital: Name of establishment, total floor area by each establishment, fuel consumption data by each establishment University: Results of research interviews for the tertiary industry by students (total fuel consumption by each fuel type) were used directly. Others: Estimation through multiplying the number of entities by each tertiary industry provided by municipality of Obiliq, by the ratio of the number of businesses registered between Prishtina and Obiliq. Data provided by Municipality of Fushe Kosovo: School and Hospital: Name of establishment, fuel consumption data by each establishment Others: Estimation through multiplying the number of entities by each tertiary industry provided by the municipality of Obiliq, by the ratio of the number of businesses registered between Fushe Kosovo and Obiliq.
Activity Data of residential stationary	Number of households by each municipality and by fuel type used: Estimation using data of household census and statistical yearbook
Parameter	Net Calorific Value: 2006 IPCC Guideline for National Greenhouse Gas Inventories Average fuel consumption per household by each fuel type: average values from research interview by students for household Average fuel consumption per entity by each fuel type and by each service business, and average fuel consumption per floor area by each fuel type and by each service business: average values from research interview by students for service business
Spatial Resolution of Emissions	Allocating to Mesh on population data
Time Resolution of Emissions	Allocating emissions uniformly to each business hour

The outline of research interviews for household by students conducted by the Project are shown in Table 3-15 and Photo 3-2.

Table 3-15 Outline of Research Interviews for Households by Students

Method	Visiting Interview by 20 students
Items	Location information, Type of building, Area of dwelling, Number of residents, Construction year, Daily living pattern on heating, Annual usage pattern on heating, Type of fuel, Amount of annual fuel consumption, Height of stack
Schedule	From 20th February to 31st March, 2018, each student conducted interviews for ten days.
Area	Municipality of Pristina, Municipality of Fushe Kosovo, Municipality of Obiliq
Number of sampling	Detached house: 1720, Attached house: 106, Block of flats: 135, Apartment: 24, and Others: 11

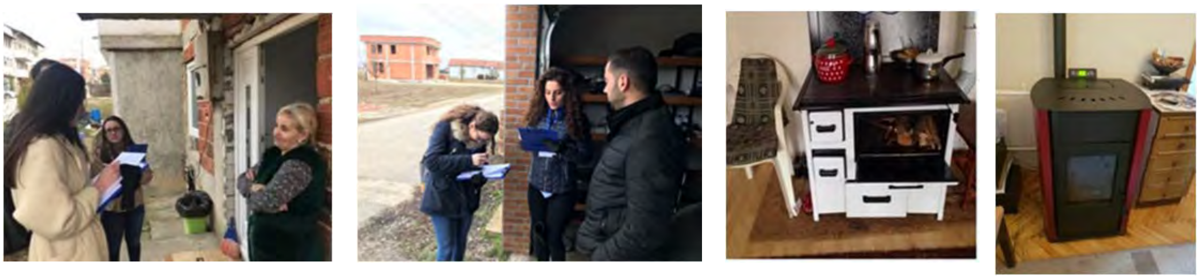


Photo 3-2 View of Research Interviews for Households by Students

The average fuel consumption per household by each type of residential building are shown in Table 3-16 by using results of the research interviews by students.

Table 3-16 Results of Average fuel Consumption per Household

Building Type	Average Wood Consumption	Unit	Average Lignite Consumption	Unit	Average Pellet Consumption	Unit
Detached houses	11.375	m^3/year	8.44	ton/year	5.19	ton/year
Attached Houses	11.339	m^3/year	7.75	ton/year	7.11	ton/year
Apartments, including blocks of flats	8.766	m^3/year	7.00	ton/year	2.17	ton/year

The number of the types of households in urban area and rural area in the Pristina Area is estimated based on the statistics after 2012, and the results are shown in Table 3-17.

Table 3-17 Example of Estimation of the number of households by each building type (Prishtina)

Prishtina	Type of Residential Building	Unit	2012	2013	2014	2015	2016	2017	2018
Urban	Detached house	number	15145	15319	15288	15115	15336	15634	15851
	Semi-detached	number	3236	3254	3252	3232	3256	3288	3312

	Row or terraced house (with at 3 attached or connected dwelling), Set as 4 household	number	948	952	948	948	952	956	960
	Apartment building or block of flats	number	15,814	16,020	15,986	15,777	16,041	16,400	16,658
	Other (No Estimated)	number	0	0	0	0	0	0	0
	Sub-total	number	35,143	35,545	35,474	35,072	35,585	36,278	36,781
Rural	Detached house	number	6023	6092	6080	6011	6098	6217	6303
	Semi-detached	number	296	298	298	296	298	302	304
	Row or terraced house (with at 3 attached or connected dwelling)	number	236	240	240	236	240	240	240
	Apartment building or block of flats	number	22	22	21	21	23	30	36
	Other (No Estimated)	number	0	0	0	0	0	0	0
	Sub-total	number	6,577	6,652	6,639	6,564	6,659	6,789	6,883
	Total number of Household	number	41,720	42,197	42,113	41,636	42,244	43,067	43,664

The number of households by each fuel type used for residential stationary in each municipality was calculated by using the census data in 2011, statistical data after 2012 and number of households connected to the district heating collected from the report by Termokos which is the local district heating company in Pristina. The example of this result for Municipality of Prishtina is shown in Table 3-18.

Table 3-18 Number of households by each fuel type used for Residential Stationary (Prishtina)

Main Type of Energy Used for Heating	Unit	2012	2013	2014	2015	2016	2017	2018
Wood	Number of household	18,517	17,685	17,418	16,894	17,073	17,294	17,516
Coal	Number of household	1,212	1,157	1,140	1,106	1,117	1,132	1,146
Pellet	Number of household	4,630	4,422	4,354	4,224	4,268	4,324	4,379
Oil (Diesel)	Number of household	424	405	399	387	391	396	401
Gaseous fuel	Number of household	336	321	316	306	309	313	317
Electricity	Number of household	7,635	7,292	7,181	6,966	7,038	7,130	7,222
District heating	Number of household	8,775	10,732	11,125	11,578	11,872	12,299	12,500
Other type of energy	Number of household	191	183	180	175	176	179	181
Total	Number of household	41,720	42,197	42,113	41,636	42,244	43,067	43,664

The number of households by building type and fuel type in urban and rural area for each municipality is calculated from Table 3-17 and Table 3-18. The example of these results for Municipality of Prishtina is shown in Table 3-19.

Table 3-19 Example of estimated number of households by building type and fuel type

Prishtina & Urban	Type of Fuel	Unit	2012	2013	2014	2015	2016	2017	2018
Detached house	Wood	Number of household	8674	8907	8920	8861	9001	9189	9321
	Coal	Number of household	568	583	584	580	589	602	610
	Pellet	Number of household	2169	2228	2231	2215	2249	2298	2330
	Oil (Diesel)	Number of household	199	204	204	203	206	210	213
	Gaseous fuel	Number of household	157	162	162	161	163	166	169
	Electricity	Number of household	3290	3143	3095	3002	3033	3073	3112
	District Heating	Number of household	0	0	0	0	0	0	0
	Other type of energy	Number of household	89	92	92	92	93	95	96

Semi-detached	Wood	Number of household	1853	1892	1898	1894	1911	1933	1948
	Coal	Number of household	121	124	124	124	125	127	127
	Pellet	Number of household	463	473	474	474	478	483	487
	Oil (Diesel)	Number of household	42	43	43	43	44	44	45
	Gaseous fuel	Number of household	34	34	34	34	35	35	35
	Electricity	Number of household	703	668	658	642	644	646	650
	District Heating	Number of household	0	0	0	0	0	0	0
	Other type of energy	Number of household	19	20	20	20	20	20	20
Row or terraced house	Wood	Number of household	180	113	97	76	72	67	67
	Coal	Number of household	12	7	6	5	5	4	4
	Pellet	Number of household	45	28	24	19	18	17	17
	Oil (Diesel)	Number of household	4	3	2	2	2	2	2
	Gaseous fuel	Number of household	3	2	2	1	1	1	1
	Electricity	Number of household	206	195	192	188	188	188	188
	District Heating	Number of household	496	602	623	656	665	677	681
	Other type of energy	Number of household	2	1	1	1	1	1	1
Apartment	Wood	Number of household	3000	1905	1645	1259	1215	1138	1147
	Coal	Number of household	196	125	108	82	80	74	75
	Pellet	Number of household	750	476	411	315	304	284	287
	Oil (Diesel)	Number of household	69	44	38	29	28	26	26
	Gaseous fuel	Number of household	54	35	30	23	22	21	21
	Electricity	Number of household	3436	3286	3236	3134	3173	3223	3271
	District Heating	Number of household	8,278	10,130	10,502	10,922	11,207	11,622	11,819
	Other type of energy	Number of household	31	20	17	13	13	12	12
Total		Number of household	35,143	35,545	35,473	35,070	35,585	36,278	36,782

The activity data on the residential stationary sources shown in Table 3-20 are calculated from Table 3-16 and Table 3-19. The detailed calculation procedure is described in the manual for emission inventory preparation provided by the Project.

Table 3-20 Activity Data on Residential Stationary

Fuel Type	Unit	2015	2016	2017
Lignite	TJ/year	529.44	541.53	541.53
Wood	TJ/year	2,826.90	2,918.07	2,918.07
Pellet	TJ/year	358.14	369.01	369.01

The emission factors on the Residential Stationary shown in Table 3-21 use the default values in Tier 1 method of EMEP/EEA Guidebook 2016.

Table 3-21 Emission Factors on Residential Stationary

Household	SO_2 (g/GJ)	NO_X (g/GJ)	TSP (g/GJ)	PM_{10} (g/GJ)
Lignite	900	110	444	404
Wood	11	50	800	760
Pellet	29	37	32	32

Source: EMEP/EEA Guidebook 2016

The activity data on the Tertiary Industry are fuel consumption by each business type of the tertiary industry. The average fuel consumption per each entity is estimated from the results of the research interviews for the tertiary industry by students conducted by the Project.

Photo 3-3 View of Research Interviews for Tertiary Industry by Students

The views of these research interviews are shown in Photo 3-3 and the example of results of these research interviews is shown in Table 3-22 as Bakery.

Table 3-22 Example of the Results of Research Interviews by Students on Bakery

Average of each fuel type	Average Value	Unit	Sample Number	Fuel Usage Percentage using Sampling Data
Wood fuel	268.25	m^3/year	32	43.06%
Coal		ton/year	0	0.00%
Pellet	2.81	ton/year	2	2.78%
LPG	257.45	kl/year	5	6.94%
Diesel		kl/year	0	0.00%
Heavy oil		kl/year	0	0.00%
Electricity	7161.04	MWh/year Euro/year	38	52.78%
Central Heating	150.00	Euro/month	1	1.39%
Others			0	0.00%

Next issue is the data collection for the number of business entities by each business type of the tertiary industry in the target area. Regarding the official service such as school and hospital, the data provided by each municipality were used.

On the other hand, the data collection for number of entities on private service was very difficult assignment. Finally, after lectures in June and November 2019, it was decided to use the ratio of the number of the entities to the number of the registered businesses provided by the Municipality of Obiliq, and this ratio was used for the calculation of the number of the entities in other cities based on the number of registered businesses in each city.

The detailed calculation procedure is described in the manual for emission inventory preparation provided by the Project. The final results of PM_{10} emissions are shown in Table 3-23.

Table 3-23 PM_{10} Emissions from Tertiary Industry

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.A Combustion							
	1.A.4 Small combustion						
		1.A.4.a.i Commercial / institutional: Stationary	PM^{10} ton/year	**117.54**	**119.29**	**119.74**	**3.10**
		Small Business Facilities	PM^{10} ton/year	0.22	0.22	0.22	0.00
		Kindergarten	PM^{10} ton/year	0.92	0.92	0.92	0.02
		School	PM^{10} ton/year	13.08	13.23	13.23	0.86
		University	PM^{10} ton/year	0.22	0.22	0.22	0.05
		Bakery	PM^{10} ton/year	51.35	51.35	51.35	0.00
		Café	PM^{10} ton/year	5.83	5.83	5.83	0.00
		Hotel	PM^{10} ton/year	1.61	1.61	1.91	0.00
		Restaurant	PM^{10} ton/year	11.95	11.95	11.95	0.00
		Shop	PM^{10} ton/year	20.55	20.55	20.55	0.00
		Warehouse	PM^{10} ton/year	0.00	0.00	0.00	0.00
		Medical institution	PM^{10} ton/year	0.75	0.75	0.75	0.20
		Office	PM^{10} ton/year	11.07	12.66	12.82	1.96

4) Energy Sector (Transportation Category)

The emissions from vehicles driven in roads, emissions from railway and emissions from aviation were calculated in the transportation category of the energy sector.

The emissions from Vehicle consisting of emissions from major roads and minor roads were calculated as shown in Table 3-24 and Table 3-25. The classification of vehicle types is shown in Table 3-26, and vehicle registration data by each vehicle type are shown in Table 3-27. The target emission sources are the exhaust emissions from the combustion of fuels.

The sub-category of evaporative emissions from liquid fuels where Non-methane volatile organic compounds (hereinafter referred to as "NMVOC") is the main pollutant was not estimated, and the sub-category of fugitive emissions by road vehicle tire and brake wear was not estimated either, because there is no sufficient information.

Table 3-24 Emission Calculation Method for Major Road

Calculation Method	Emissions = Activity Data x Emission Factors Activity Data: Traffic volume by each vehicle type on road network of each major road
Emission Factor	Emission factors: Emission Factors of Tier 3 Method on EMEP/EEA Guidebook 2016. Fuel consumption rate: Fuel Consumption Factors of Tier 3 Method on EMEP/EEA Guidebook 2016. Number of vehicle by each vehicle type and each Euro emission regulation: Vehicle registration data by each vehicle type and each manufacturing year provided by MI.
Activity Data	Hourly Traffic Volume per vehicle type for each road network of major road is set from the traffic volume counting by students conducted by the Project. Hourly Traffic Speed for each road network of major road is set from the

	traffic speed research conducted by the Project.
Spatial Resolution of Emissions	Road network data provided by Geographic Information System (hereinafter referred to as “GIS”) data
Time Resolution of Emissions	Set from the hourly average traffic volume calculated from the traffic volume counting by students

Table 3-25 Emission Calculation Method for Minor Road

Calculation Method	Emissions = Activity Data x Emission Factors Activity Data: Fuel consumption on minor road
Emission Factor	Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	The fuel consumption of minor road is calculated by subtracting the total fuel consumption for major roads form the total fuel consumption by vehicles in the target area. The total fuel consumption by vehicles in the target area is calculated by multiplying the national total fuel consumption of vehicles by the index set from statistical yearbook. The national total fuel consumption for vehicles is collected from the “World Energy Statistics” provided by IEA. Based on the data from World Energy Statistics (IEA), the total fuel consumption in the Pristina Area is set out from the one in the statistical year book. The fuel consumption of minor road is calculated by subtracting the fuel consumption of major road calculated in Table 3-24 from the total fuel consumption in the Pristina Area.
Spatial Resolution of Emissions	Total road length information by each standard mesh provided by GIS
Time Resolution of Emissions	Set from the hourly average traffic volume calculated from the traffic volume counting by students

Table 3-26 Classification of Vehicle

Classification of Vehicle Type	1. Passenger Car (hereinafter referred to as “PC”) 2. Light Commercial Vehicle (hereinafter referred to as ”LCV”). In traffic counting Mini-van was classified as “LCV”. 3. Heavy Duty Vehicle (hereinafter referred to as ”HDV”) 4. Bus
Classification of Fuel type	Petrol, Diesel, LPG
Vehicle number estimation method per Euro emission regulation	Vehicle number per Euro emission regulation is estimated from vehicle registration data by manufacturing year.

The Project obtained the registration data for vehicles all over Kosovo, and organized the data as shown in Table 3-27 in line with the vehicle classification shown in Table 3-26.

Table 3-27 Vehicle registration data by each vehicle type

Vehicle Type	Fuel Type	Total Number	Euro Emission Regulation						
			Before Euro	Euro1	Euro2	Euro3	Euro4	Euro5	Euro6

PC	Petrol	66161	19819	4810	12842	16893	7096	2901	1800
	Diesel	217067	29497	6518	21975	75065	54207	22288	7517
	LPG	2250	1085	288	373	352	117	35	0
	Sub-Total	285478	50401	11616	35190	92310	61420	25224	9317
LCV	Petrol	1331	285	189	395	283	133	39	7
	Diesel	42855	5556	4614	11034	12402	6781	2011	457
	LPG	0	0	0	0	0	0	0	0
	Sub-Total	44186	5841	4803	11429	12685	6914	2050	464
HDV	Petrol	0	0	0	0	0	0	0	0
	Diesel	12706	3366	1227	2475	3561	1011	857	209
	LPG	0	0	0	0	0	0	0	0
	Sub-Total	12706	3366	1227	2475	3561	1011	857	209
Bus	Petrol	0	0	0	0	0	0	0	0
	Diesel	2564	352	340	905	658	156	98	55
	LPG	0	0	0	0	0	0	0	0
	Sub-Total	2564	352	340	905	658	156	98	55

The emissions from railway and aviation are calculated as shown in Table 3-28.

Table 3-28 Emission Calculation Method for Railway and Aviation

Calculation Method	Emissions = Activity Data × Emission Factors Activity Data: Fuel consumption per fuel type on railway and aviation
Emission Factor	Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	Data source: Kosovo national data on "World Energy Statistics" provided by IEA. Aviation: Aviation Fuel Railway: Gas/ Diesel on Railway Transport
Spatial Resolution of Emissions	Aviation: Distributing emissions to the Mesh located at airport. Railway: Distributing emissions to the Mesh along the railway line.
Time Resolution of Emissions	Uniform Distribution of emissions, because of the small level of emissions.

Since generally emissions from vehicles are large and contribution at the ground level air quality is also assumed to be large, the emissions calculation was studied in detail. First, the traffic volume counting by students was carried out in April 2018. The counting points are shown in Figure 3-4.

The outline of the traffic volume counting by students is shown in Table 3-29 and summary of results of the traffic volume counting is shown in Figure 3-5.

Table 3-29 Outline of Traffic Volume Counting by Students

Item	Period of research	Number of Points	Vehicle Classification
Weekday, 24 hours	9 PM of 25th April (Wed.) to 9 PM of 26th April (Thu.)	8 points	1. PC 2. Mini-van 3. Bus

Weekday, 14 hours	7 AM to 9 PM of 26th April (Thu.)	17 points	4. LCV 5. HDV
Weekend, 24 hours	6 AM of 28th April (Sat.) to 6 AM of 29th April (Sun.)	8 points	

Note: In traffic counting, LCV and Mini-van was counted separately, but emissions are treated into the same Vehicle type (LCV)

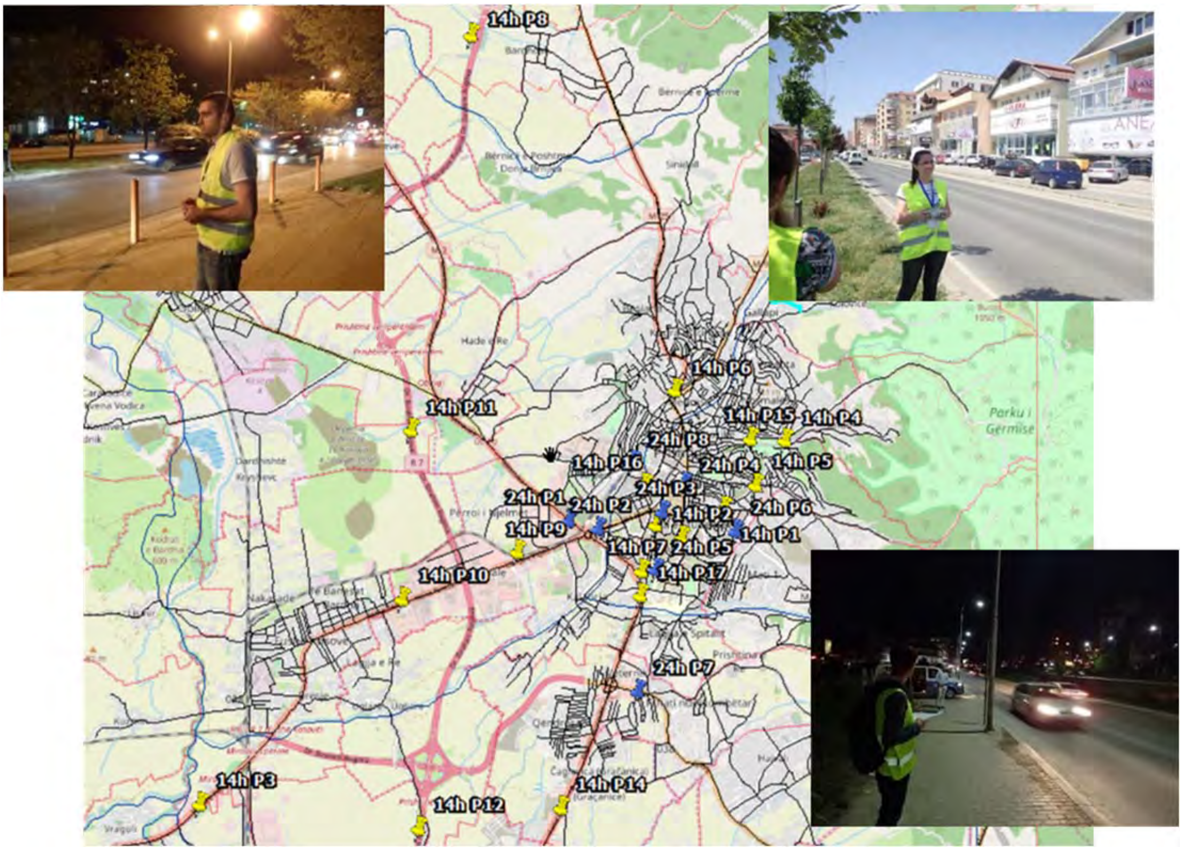
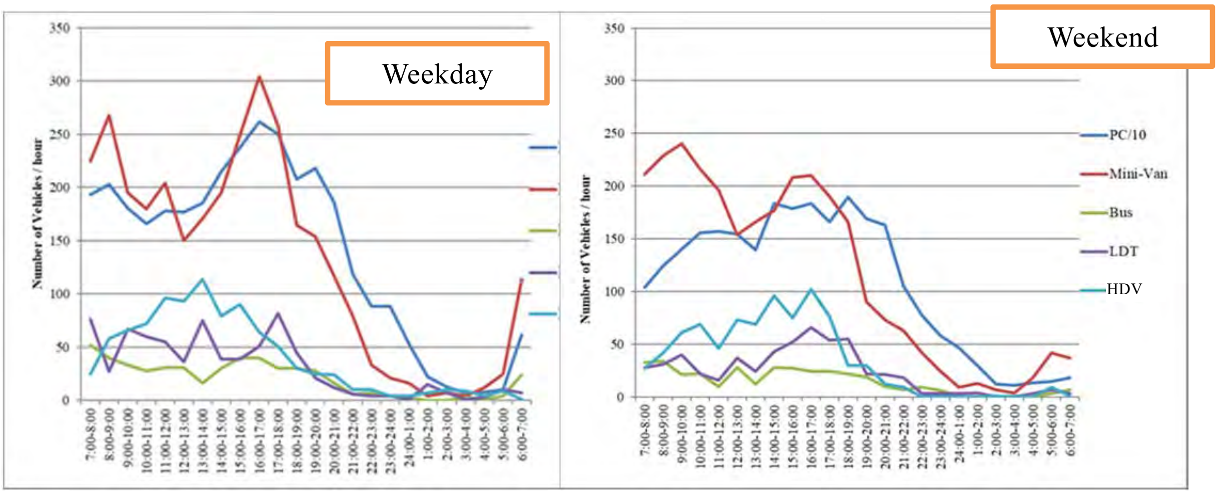


Figure 3-4 Counting Points and View from the Traffic Volume Counting by Students



.Note: Graph of PC shown on a 1/10 scale.

Figure 3-5 Results of traffic volume counting on weekday and weekend

The traffic speed research was carried out in the route shown in Figure 3-6, in the morning, daytime and evening at the same time of traffic volume counting.

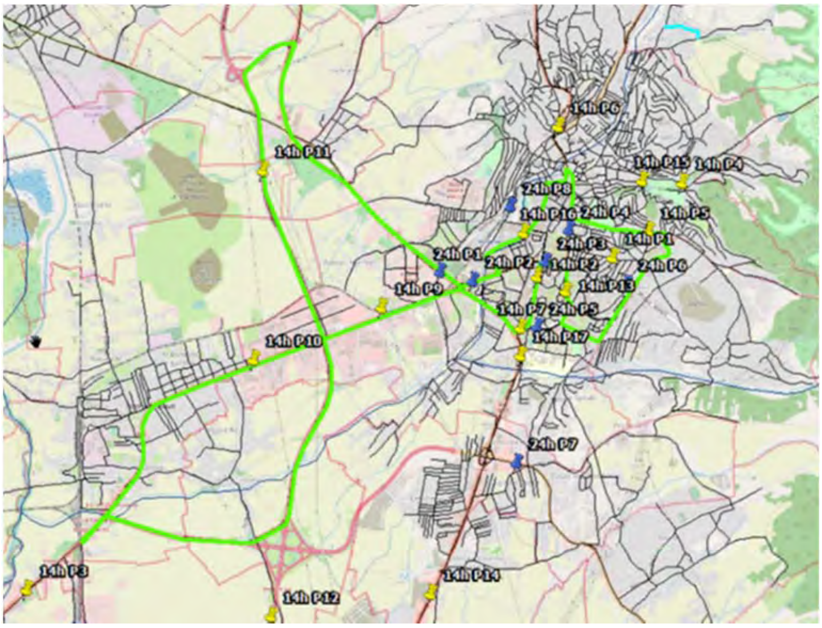


Figure 3-6 Route of Traffic Speed Research

The emission factors are calculated by using Tier 3 method of EMEP/EEA Guidebook. The calculation procedure of emission factors per vehicle type and per vehicle speed is shown in Table 3-30.

Table 3-30 Procedure of calculation on Emission Factors for Vehicle

Step 1: Data Collection for registered vehicle	The following data are provided by MI: Number of registered vehicle for each manufacturing year by vehicle type and fuel type, Number of registered vehicle by vehicle type for each Euro Emission Regulation, and Average mileage by vehicle type.
Step 2: Calculation of percentage on each vehicle type by fuel type with Euro Emission Regulation	The table for number and percentage of registered vehicles by vehicle type, by fuel type, and by Euro emission standard is prepared by using the accumulated counting of the number of vehicles from vehicle with newer Euro Emission Regulation in accordance with total number of registered vehicles with Euro Emission Regulation by vehicle type.
Step 3: Selection of data for emission factors	The emission factor data in EMEP/EEA Guidebook has parameters such as α and β for each vehicle type, each fuel type, and each Euro Emission Regulation, in accordance with the vehicle speed as a variable. $EF = \left(\alpha V^2 + \beta V + \gamma + \delta / V \right) / (\varepsilon V^2 + \zeta V + \eta) \times (1 - RF)$ Therefore, data to be used for each vehicle type, each fuel type, and Euro Emission Regulation is selected.
Step 4: Preparation of list of emission factors by vehicle type and vehicle	The emission factors are prepared for each vehicle speed by setting classification of vehicle speed from 10 km/h to 100 km/h every 5 km/h. The emission factors for each vehicle type by fuel type are calculated using the weighted average from the emission factors for each vehicle type

speed	with Euro Emission Regulation by fuel type and percentage of the number of registered vehicles by Euro regulation by vehicle type and by fuel type. In addition, the emission factors for each vehicle type are calculated by using the weight average from above emission factors (by vehicle type and by fuel type) and percentage of vehicle number by fuel type.

The NO_x and PM_{10} emission factors and fuel consumption rate for Petrol, Diesel and LPG for PC are shown in Table 3-31 and Table 3-32.

Table 3-31 Emission Factors for PC (from 10 to 55 km/h)

		Vehicle Speed									
	Unit	10	15	20	25	30	35	40	45	50	55
NOx	g/km	1.010	0.552	0.746	0.696	0.668	0.654	0.650	0.653	0.661	0.673
PM	g/km	0.047	0.020	0.048	0.044	0.040	0.037	0.035	0.033	0.031	0.030
Petrol	MJ/km	5.851	4.726	4.055	3.600	3.268	3.015	2.819	2.667	2.551	2.468
Diesel	MJ/km	3.736	3.184	2.817	2.558	2.367	2.223	2.113	2.029	1.965	1.918
LPG	MJ/km	3.105	2.922	2.759	2.616	2.491	2.383	2.292	2.218	2.162	2.122

Table 3-32 Emission Factors of PC (from 60 to 100 km/h)

		Vehicle Speed								
	Unit	60	65	70	75	80	85	90	95	100
NOx	g/km	0.687	0.704	0.723	0.743	0.765	0.787	0.810	0.835	0.861
PM	g/km	0.030	0.030	0.030	0.031	0.033	0.035	0.037	0.040	0.044
Petrol	MJ/km	2.412	2.381	2.371	2.380	2.404	2.441	2.488	2.544	2.606
Diesel	MJ/km	1.885	1.865	1.855	1.855	1.865	1.884	1.912	1.950	1.998
LPG	MJ/km	2.099	2.093	2.103	2.130	2.174	2.234	2.312	2.406	2.516

The NO_X and PM_{10} emission factors and fuel consumption rate for Petrol and Diesel on LCV are shown in Table 3-33 and Table 3-34.

Table 3-33 Emission Factors of LCV (from 10 to 55 km/h)

		Vehicle Speed									
	Unit	10	15	20	25	30	35	40	45	50	55
NOx	g/km	1.598	1.434	1.301	1.189	1.094	1.012	0.944	0.888	0.843	0.810
PM	g/km	0.114	0.104	0.095	0.087	0.080	0.075	0.070	0.067	0.065	0.064
Petrol	MJ/km	7.056	6.137	5.484	4.967	4.537	4.172	3.860	3.595	3.372	3.189
Diesel	MJ/km	4.947	4.403	3.974	3.624	3.335	3.096	2.902	2.748	2.632	2.551

Table 3-34 Emission Factors of LCV (from 60 to 100 km/h)

		Vehicle Speed								
	Unit	60	65	70	75	80	85	90	95	100
NOx	g/km	0.788	0.776	0.776	0.787	0.809	0.843	0.888	0.945	1.014
PM	g/km	0.065	0.067	0.069	0.074	0.079	0.085	0.093	0.102	0.112
Petrol	MJ/km	3.044	2.936	2.862	2.822	2.815	2.838	2.893	2.978	3.093

Diesel	MJ/km	2.506	2.494	2.515	2.569	2.655	2.773	2.924	3.106	3.321

The NO_x and PM_{10} emission factors and fuel consumption rate for Diesel on HDT are shown in Table 3-35 and Table 3-36.

Table 3-35 Emission Factors of HDT (from 10 to 55 km/h)

		Vehicle Speed									
	Unit	10	15	20	25	30	35	40	45	50	55
NOx	g/km	14.169	12.093	10.727	9.758	9.035	8.475	8.029	7.667	7.369	14.169
PM	g/km	0.485	0.398	0.337	0.292	0.260	0.237	0.219	0.207	0.197	0.485
Diesel	MJ/km	19.204	16.229	14.272	12.893	11.881	11.117	10.525	10.057	9.682	19.204

Table 3-36 Emission Factors of HDT (from 60 to 100 km/h)

		Vehicle Speed								
	Unit	60	65	70	75	80	85	90	95	100
NOx	g/km	7.120	6.911	6.733	6.581	6.452	6.341	6.318	6.185	6.141
PM	g/km	0.191	0.186	0.182	0.180	0.179	0.178	0.179	0.180	0.181
Diesel	MJ/km	9.378	9.129	8.926	8.760	8.625	8.519	8.439	8.389	8.395

The NO_X and PM_{10} emission factors and fuel consumption rate for Diesel on Bus are shown in Table 3-37 and Table 3-38.

Table 3-37 Emission Factors of Bus (from 10 to 55 km/h)

		Vehicle Speed									
	Unit	10	15	20	25	30	35	40	45	50	55
NOx	g/km	13.018	9.630	7.912	6.839	6.093	5.538	5.107	4.761	4.477	4.239
PM	g/km	0.223	0.169	0.139	0.119	0.106	0.096	0.089	0.083	0.079	0.075
Diesel	MJ/km	20.020	16.652	14.557	13.069	12.003	11.212	10.606	10.130	9.749	9.441

Table 3-38 Emission Factors of Bus (from 60 to 100 km/h)

		Vehicle Speed								
	Unit	60	65	70	75	80	85	90	95	100
NOx	g/km	4.038	3.866	3.719	3.593	3.487	3.398	3.329	3.282	3.264
PM	g/km	0.073	0.070	0.069	0.068	0.067	0.067	0.067	0.068	0.069
Diesel	MJ/km	9.192	8.991	8.836	8.725	8.666	8.683	8.852	9.603	10.862

The results of emissions from Vehicles are shown in Table 3-39 and Table 3-40.

Table 3-39 Results of NO_X Emissions from Vehicle

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.A Combustion							
	1.A.3 Transport						
		1.A.3.a Aviation	NOx ton/year				

		1.A.3.b Road transport	NOx ton/year	**1,925.41**	**1,927.18**	**2,330.61**	**2,245.38**
		Major Road: PC	NOx ton/year	683.96	683.96	683.96	683.96
		Major Road: Van	NOx ton/year	89.59	89.59	89.59	89.59
		Major Road: Bus	NOx ton/year	159.87	159.87	159.87	159.87
		Major Road: LDT	NOx ton/year	32.19	32.19	32.19	32.19
		Major Road: HDT	NOx ton/year	294.27	294.27	294.27	294.27
		Minor Road/ LPG: PC	NOx ton/year	30.96	29.20	34.33	33.60
		Minor Road/ LPG: Van	NOx ton/year	0.13	0.13	0.13	0.13
		Minor Road/ LPG: Bus	NOx ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: LCV	NOx ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: HDV	NOx ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: PC	NOx ton/year	29.13	28.52	40.88	57.40
		Minor Road/ Petro: Van	NOx ton/year	0.70	0.68	0.98	1.37
		Minor Road/ Petro: Bus	NOx ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: LCV	NOx ton/year	0.25	0.25	0.35	0.49
		Minor Road/ Petro: HDV	NOx ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Diesel: PC	NOx ton/year	303.47	305.56	499.16	448.16
		Minor Road/ Diesel: Van	NOx ton/year	1.74	1.75	2.85	2.56
		Minor Road/ Diesel: Bus	NOx ton/year	97.52	98.19	160.40	144.01
		Minor Road/ Diesel: LCV	NOx ton/year	20.08	20.21	33.02	29.65
		Minor Road/ Diesel: HDV	NOx ton/year	181.56	182.81	298.63	268.12
		1.A.3.b.v Gasoline evaporation	NOx ton/year	NO	NO	NO	NO
		1.A.3.b.vi-vii Road tire and brake wear	NOx ton/year	NE	NE	NE	NE

Table 3-40 Results of PM_{10} Emissions from Vehicle

PM_{10} Emissions from Prishtina Area

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.A Combustion							
	1.A.3 Transport						
		1.A.3.a Aviation	PM_{10} ton/year				
		1.A.3.b Road transport	PM_{10} ton/year	**106.29**	**96.38**	**112.85**	**108.58**
		Major Road: PC	PM_{10} ton/year	47.89	47.89	47.89	47.89
		Major Road: Van	PM_{10} ton/year	6.89	6.89	6.89	6.89
		Major Road: Bus	PM_{10} ton/year	4.28	4.28	4.28	4.28
		Major Road: LDT	PM_{10} ton/year	2.48	2.48	2.48	2.48
		Major Road: HDT	PM_{10} ton/year	8.81	8.81	8.81	8.81
		Minor Road/ LPG: PC	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: Van	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: Bus	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: LCV	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ LPG: HDV	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: PC	PM_{10} ton/year	0.10	0.10	0.14	0.20
		Minor Road/ Petro: Van	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: Bus	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: LCV	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Petro: HDV	PM_{10} ton/year	0.00	0.00	0.00	0.00
		Minor Road/ Diesel: PC	PM_{10} ton/year	25.76	25.93	42.37	38.04
		Minor Road/ Diesel: Van	PM_{10} ton/year	0.18	0.18	0.29	0.26
		Minor Road/ Diesel: Bus	PM_{10} ton/year	2.75	2.77	4.52	4.06
		Minor Road/ Diesel: LCV	PM_{10} ton/year	2.05	2.06	3.37	3.02
		Minor Road/ Diesel: HDV	PM_{10} ton/year	5.11	5.15	8.41	7.55
		1.A.3.b.v Gasoline evaporation	PM_{10} ton/year	NO	NO	NO	NO
		1.A.3.b.vi-vii Road tire and brake wear	PM_{10} ton/year	NE	NE	NE	NE
		1.A.3.c Railway	PM_{10} ton/year				
		1.A.3.d Navigation	PM_{10} ton/year				
		1.A.3.e.i Pipeline transport	PM_{10} ton/year				

5) Fugitive Emissions (Energy Sector)

The fugitive emissions are air pollutant emissions including all intentional and unintentional emissions from the extraction, processing, storage and transport of fuel to the point of final use, and not including emissions from fuel combustion for the purpose of heat or mechanical work, etc. Some product uses may also give rise to emissions termed as "fugitive," such as the release of refrigerants and fire suppressants which shall be reported in the Industrial Process and Product Use (IPPU) sector.

The fugitive emissions were calculated for emissions from lignite mining and stockyard of lignite as shown in Table 3-41, and the result of calculating PM_{10} emissions from Fugitive Emissions category is shown in Table 3-42.

Table 3-41 Emission Calculation Method for Fugitive Emissions Category

Calculation Method	Tier 3 method on EMEP/EEA Guidebook
Emission Factor	Default Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	Amount of Lignite production; Statistical Yearbooks Amount of Lignite treated at TPPs: Fuel consumption data from the Annual Report by KEK
Spatial Resolution of Emissions	Distributing emissions to the Mesh located at the Coal mining sites and the Coal yard of TPPs.
Time Resolution of Emissions	Uniform Distribution of emissions

Table 3-42 Emissions from Coal Mining Sites and Coal Storage Area

Activity Data on Fugitive Emissions from Solid Fuels in Prishtina Area

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy							
1.B Fugitive emissions from fuels			PM_{10} ton/year	**792.7**	**834.1**	**745.8**	**728.8**
	1.B.1.a Fugitive emissions from solid fuels: Coal mining and handling						
		Sub-total	PM_{10} ton/year	**792.7**	**834.1**	**745.8**	**728.8**
		Amount of Coal Production in Coal Mining Sites	PM_{10} ton/year	346	370	318	301
		Amount of Coal Storage Area in Coal Mining Sites	PM_{10} ton/year	0	0	0	0
		Amount of Coal Production at Kosovo A (Handling Process)	PM_{10} ton/year	131	148	125	125
		Amount of Coal Storage Area at Kosovo A (Storage Process)	PM_{10} ton/year	41	41	41	41
		Amount of Coal Production at Kosovo B (Handling Process)	PM_{10} ton/year	208	210	196	196
		Amount of Coal Storage Area at Kosovo B (Storage Process)	PM_{10} ton/year	66	66	66	66
	1.B.1.b Fugitive emissions from solid fuels: Solid fuel transformation						
			PM_{10} ton/year	NO	NO	NO	NO
	1.B.1.c Other fugitive emissions from solid fuels						
			PM_{10} ton/year	NO	NO	NO	NO
	1.B.2 Fugitive emissions from solid fuels: Oil and Natural Gas						

6) IPPU Sector

The air pollutant emissions can result from non-energy related industrial activities and product uses. These emissions occurring from industrial processes, product use, and non-energy uses of fossil fuel are reported under IPPU sector. The air pollutant emissions are generated from a wide variety of industrial activities. The main emission sources are releases from industrial processes that chemically or physically transform materials. The use of solvents and other products containing light hydrocarbon compounds can be a major source of emissions to the atmosphere of NMVOCs.

The emission calculation method for IPPU sector is shown in Table 3-43, and the result of calculating PM_{10} emissions from IPPU sector is shown in Table 3-44.

Table 3-43 Emission Calculation Method for IPPU Sector

Calculation Method	Tier 1 method on EMEP/EEA Guidebook
Emission Factor	Default Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	Amount of raw material on concrete production: Results of research interviews by students Other raw material information: Not obtained yet.
Spatial Resolution of Emissions	Uniform Distribution of emissions to Land for industrial use provided as GIS data
Time Resolution of Emissions	Uniform Distribution of emissions

Table 3-44 PM_{10} Emissions from IPPU Sector

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
2. Industrial Process and Product Use (IPPU) Sector							
	2.A Mineral production						
		2.A.1 Cement production	PM_{10} ton/year	NO	NO	NO	NO
		2.A.2 Lime production	PM_{10} ton/year	NO	NO	NO	NO
		2.A.3 Glass production	PM_{10} ton/year	NO	NO	NO	NO
		2.A.5.a Quarrying and mining of minerals other than coal					
		2.A.5.b Construction and demolition	PM_{10} ton/year	NE	NE	NE	NE
		2.A.5.c Storage, handling and transport of mineral production					
		Storage in Cement Production	PM_{10} ton/year	**0.0**	**0.0**	**0.0**	**0.0**
		Storage in Others	PM_{10} ton/year	**6.2**	**6.2**	**6.2**	**0.0**
		Handling in Cement Production	PM_{10} ton/year	**0.0**	**0.0**	**0.0**	**0.0**
		Handling in Others	PM_{10} ton/year	**0.5**	**0.5**	**0.5**	**0.5**
		2.A.6 Other mineral production	PM_{10} ton/year	NE	NE	NE	NE
		Sub-Total	PM_{10} ton/year	**6.7**	**6.7**	**6.7**	**0.5**
	2.B Chemical industry						
		2.B Chemical industry	PM_{10} ton/year	NO	NO	NO	NO
		2.B.7 Soda ash production	PM_{10} ton/year	NO	NO	NO	NO
		Sub-Total	**PM_{10} ton/year**	**0.0**	**0.0**	**0.0**	**0.0**
	2.C Metal production						
		2.C.1 Iron and steel production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.2 Ferroalloys production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.3 Aluminum production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.4 Magnesium production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.5 Lead production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.6 Zinc production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.7.a Copper production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.7.b Nickel production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.7.c Other metal production	PM_{10} ton/year	NO	NO	NO	NO
		2.C.7.d Storage, handling and transport of metal products	PM_{10} ton/year	NE	NE	NE	NE

	Sub-Total	PM_{10} ton/year	**0.0**	**0.0**	**0.0**	**0.0**
2.D Solvent and product use						
	2.D.3.a Domestic solvent use including fungicides (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.b Road paving with asphalt	PM_{10} ton/year	IE	IE	IE	IE
	2.D.3.c Asphalt roofing	PM_{10} ton/year	IE	IE	IE	IE
	2.D.3.d Coating applications (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.e Degreasing (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.f Dry cleaning (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.g Chemical products (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.h Printing (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.D.3.i, 2G Other solvent and product use (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	Sub-Total	PM_{10} ton/year	**0.0**	**0.0**	**0.0**	**0.0**
2.H Other industry production						
	2.H.1 Pulp and paper industry (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.H.2 Food and beverages industry (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	2.H.3 Other industrial processes (target air pollutant is not included)	PM_{10} ton/year	NA	NA	NA	NA
	Sub-Total	PM_{10} ton/year	**0.0**	**0.0**	**0.0**	**0.0**
2.I Wood processing		PM_{10} ton/year	**0.12**	**0.12**	**0.12**	**0.12**
2.J Production of POPs (target air pollutant is not included)		PM_{10} ton/year	NA	NA	NA	NA
2.K Consumption of POPs and heavy metals (target air pollutant is not included)		PM_{10} ton/year	NA	NA	NA	NA
2.L Other production, consumption, storage, transportation or handling of bulk products		PM_{10} ton/year	NE	NE	NE	NE
	Sub Total	**PM_{10} ton/year**	**6.8**	**6.8**	**6.8**	**0.7**

7) Agriculture Sector

Emission sources on the Agriculture sector are ‘Livestock’, ‘Crop production and agricultural soils’, and ‘Field burning of agricultural waste’ in accordance with EMEP/EEA Guidebook.

The emission calculation method for Agricultural sector is shown in Table 3-45, and the result of calculating NO_x and PM_{10} emissions from Agricultural sector is shown in Table 3-46.

Table 3-45 Emission Calculation Method for Agriculture Sector

Calculation Method	Tier 1 method on EMEP/EEA Guidebook
Emission Factor	Default Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	Statistical Yearbook and Agricultural Census
Spatial Resolution of Emissions	Uniform Distribution for emissions to Land for Agricultural use provided as GIS data
Time Resolution of	Uniform Distribution for emissions

Emissions	

Table 3-46 NOx and PM_{10} Emissions from Agricultural Sector

NOx Emissions from the Agriculture Sector

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
3. Agriculture							
3.B Livestock			NOx ton/year	5.61	5.81	5.81	5.57
3.D Land							
		Crop production and Agricultural Soils	NOx ton/year	47.0	43.3	38.6	34.2
		3.D.f, 3.I Agriculture other including Use of Pesticides	NOx ton/year	NO	NO	NO	NO
3.F Field burning of agricultural waste			NOx ton/year	0.09	0.09	0.09	0.09
		Sub Total	NOx ton/year	**52.69**	**49.19**	**44.51**	**39.83**

PM_{10} Emissions from Agriculture Sector

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
3. Agriculture							
	3.B Livestock		PM_{10} ton/year	12.7	13.2	12.5	11.9
	3.D Land						
		Crop production and Agricultural Soils	PM10 ton/year	18.6	19.1	19.1	19.2
		3.D.f, 3.I Agriculture other including Use of Pesticides	PM10 ton/year	NO	NO	NO	NO
	3.F Field burning of agricultural waste		PM10 ton/year	0.2	0.2	0.2	0.2
		Sub Total	PM10 ton/year	**31.6**	**32.6**	**31.8**	**31.3**

8) Waste Sector

Emission sources on the Waste sector are classified into ‘Biological treatment’, ‘Waste incineration’, ‘Open burning of waste’, ‘Wastewater handling’, and ‘Others’ in accordance with EMEP/EEA Guidebook. Regarding the biological treatment subcategory, the ‘Ash pond of TPP’, and ‘Solid waste disposal sites’ are estimated, but ‘Industrial waste disposal sites’, ‘Composting’, and ‘Anaerobic digestion’ are not estimated. The ‘Open burning of municipal waste’ is estimated, but the ‘Municipal waste incineration’ and the ‘Industrial waste incineration’, ‘Clinical waste incineration’ and ‘Cremation’ are not estimated.

The emission calculation method for Waste sector is shown in Table 3-47, and the result of calculating PM_{10} emissions from Waste sector is shown in Table 3-48.

Table 3-47 Emission Calculation Method for Waste Sector

Calculation Method	Tier 1 method on EMEP/EEA Guidebook
Emission Factor	Default Emission Factors of Tier 1 Method on EMEP/EEA Guidebook
Activity Data	Information on Ash Pond at TPPs: the Annual Report by KEK Others: Statistical Yearbooks
Parameter	Waste generated per person

	Source: The project for enhancement of capacity for waste management toward sound material-cycle society in the Republic of Kosovo
Spatial Resolution of Emissions	Distributing emissions to the Mesh located at the Landfill site and Ash pond site.
Time Resolution of Emissions	Uniform Distribution for emissions

Table 3-48 PM_{10} Emissions from Waste Sector

Sector	Category	Sub-Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
5. Waste							
5.A Biological Treatment of waste: Solid waste disposal on land							
		Ash Ponds of TPP	PM_{10} ton/year	0.007	0.006	0.006	0.007
		Solid Waste Disposal Sites	PM_{10} ton/year	0.004	0.005	0.005	0.005
		Industrial Waste Disposal Sites	PM_{10} ton/year	NE	NE	NE	NE
5.B.1 Biological Treatment of waste: Composting			PM_{10} ton/year	NO	NO	NO	NO
5.B.2 Biological Treatment of waste: Anaerobic digestion at biogas facilities			PM_{10} ton/year	NO	NO	NO	NO
5.C.1.a Municipal waste incineration			PM_{10} ton/year	NO	NO	NO	NO
5.C.1.b Industrial waste incineration including hazardous waste and sewage sludge			PM_{10} ton/year	NO	NO	NO	NO
5.C.1.iii Clinical waste incineration			PM_{10} ton/year	NE	NE	NE	NE
5.C.1.v Cremation			PM_{10} ton/year	NO	NO	NO	NO
5.C.2 Open burning of waste			PM_{10} ton/year	1.95	1.38	1.34	1.35
5.D Wastewater handling			PM_{10} ton/year	NO	NO	NO	NO
5.E Other waste			PM_{10} ton/year	NO	NO	NO	NO
		PM_{10} ton/year	PM10 ton/year	1.963	1.389	1.348	1.363

(5) Results of the second Emission Inventory Preparation

The Second Emission Inventories prepared by the Project are shown in Table 3-49 to Table 3-52, and Figure 3-7 to Figure 3-10.

The SO_2 emissions from TPPs account from the majority of the second Emission Inventory on SO_2 as shown in Table 3-49. Figure 3-7 shows the transition of SO_2 from 2015 to 2017.

Table 3-49 Second Emission Inventory on SO_2 Emissions

SO_2 Emissions from Prishtina Area

Sector	Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	34,880.01	35,440.44	32,257.95	31,301.43
	1.A. 2 Manufacturing industries and construction	ton/year	184.86	184.86	184.86	184.77
	1.A.3 Transport	ton/year	3.72	3.72	4.96	1.88
	1.A.4 Small Combustion	ton/year	592.25	604.07	613.34	614.55

	(Residential combustion)		(511.21)	(515.52)	(522.87)	(521.66)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	0.00	0.00
2. IPPU Sector		ton/year	0.00	0.00	0.00	0.00
3. Agriculture Sector		ton/year	0.02	0.02	0.02	0.02
5. Waste Sector		ton/year	0.05	0.03	0.03	0.03
Total		ton/year	35,660.91	36,233.14	33,061.16	32,102.69

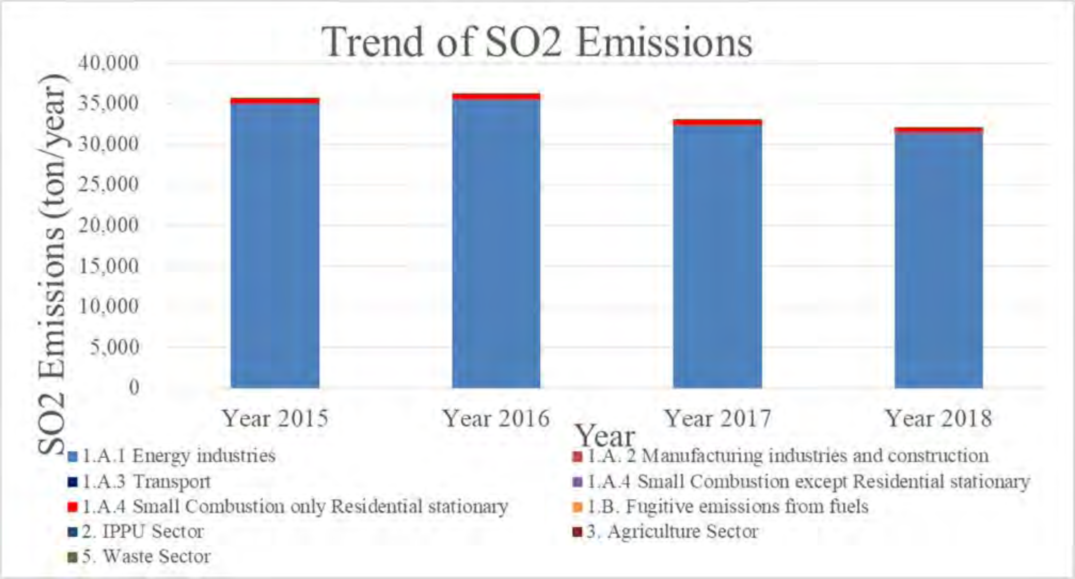


Figure 3-7 Transition of SO_2 emission

The NO_X emissions from TPPs account for the majority of the second Emission Inventory on NO_X as shown in Table 3-50. In addition, the emissions from transport category are not small, because the emissions from vehicle are large. Figure 3-8 shows the transition of NO_X from 2015 to 2018.

Table 3-50 Second Emission Inventory on NO_X Emissions

NO_X Emissions from Prishtina Area

Sector	Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	24,900.88	25,340.07	22,953.13	22,502.98
	1.A. 2 Manufacturing industries and construction	ton/year	8.71	8.71	8.71	7.83
	1.A.3 Transport	ton/year	1,948.84	1,950.72	2,366.36	2,245.38
	1.A.4 Small Combustion (Residential combustion)	ton/year	365.15 (207.46)	378.07 (209.71)	382.80 (212.82)	387.18 (214.26)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	0.00	0.00
2. IPPU Sector		ton/year	0.00	0.00	0.00	0.00
3. Agriculture Sector		ton/year	52.69	49.19	44.51	39.83
5. Waste Sector		ton/year	1.38	0.97	0.94	0.95
Total		ton/year	27,277.64	27,727.73	25,756.45	25,184.15

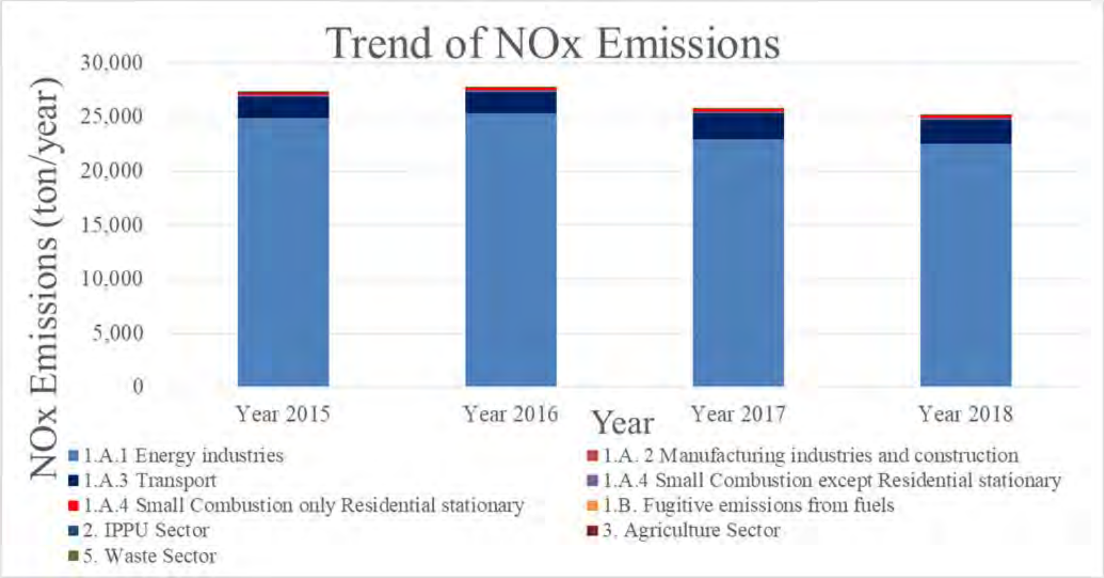


Figure 3-8 Transition of NO_X emission

The TSP emissions from TPPs account for the majority of the second Emission Inventory on TSP as shown in Table 3-51. In addition, the emissions from small combustion category are not small, because the emissions from residential combustion are also large. The emissions from fugitive emissions from fuels are not small either. Since these are emissions from a location close to the ground level, it is assumed that the influence on air pollutant concentration on the ground level can be large. Figure 3-9 shows the transition of TSP from 2015 to 2018.

Table 3-51 Second Emission Inventory on TSP Emissions

TSP Emissions from Prishtina Area

Sector	Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	13,913.95	14,162.44	12,819.10	12,585.87
	1.A. 2 Manufacturing industries and construction	ton/year	198.19	198.19	198.19	198.15
	1.A.3 Transport	ton/year	107.12	97.24	113.97	108.58
	1.A.4 Small Combustion (Residential combustion)	ton/year	2,487.48 (2,359.46)	2,517.10 (2,386.57)	2,553.05 (2,421.96)	2,576.31 (2,444.38)
1.B. Fugitive emissions from fuels		ton/year	1,720.28	1,808.05	1,621.10	1,578.90
2. IPPU Sector		ton/year	34.90	34.90	34.90	1.21
3. Agriculture Sector		ton/year	62.06	64.59	58.55	56.41
5. Waste Sector		ton/year	2.03	1.44	1.40	1.41
Total		ton/year	18,526.01	18,883.95	17,400.26	17,106.85

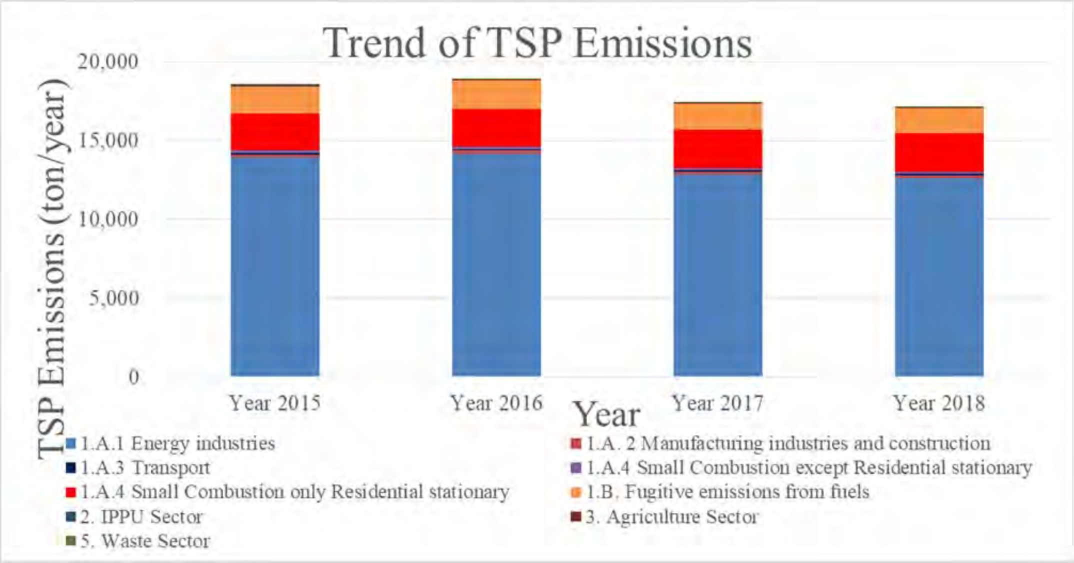


Figure 3-9 Transition of TSP emission

The trend of the second Emission Inventory on PM_{10} shown in Table 3-52 is close to the one of TSP. However, PM_{10} emission from fugitive emissions from fuels is smaller than TSP. Since emissions from small combustion, fugitive emissions from fuels, vehicle exhaust gas, etc. are emissions from a location close to the ground level, it is assumed that the influence on air pollutant concentration on the ground level can be large. The transition of PM_{10} from 2015 to 2018 is shown in Figure 3-10.

Table 3-52 Second Emission Inventory on PM_{10} Emissions

Sector	Category	Unit	Year 2015	Year 2016	Year 2017	Year 2018
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	9,398.08	9,565.90	8,658.68	8,505.19
	1.A. 2 Manufacturing industries and construction	ton/year	198.11	198.11	198.11	198.08
	1.A.3 Transport	ton/year	107.09	97.22	113.94	108.58
	1.A.4 Small Combustion (Residential combustion)	ton/year	2,355.71 (2,232.92)	2,383.86 (2,258.62)	2,417.91 (2,292.12)	2,440.08 (2,313.46)
1.B. Fugitive emissions from fuels		ton/year	792.66	834.07	745.85	725.93
2. IPPU Sector		ton/year	6.83	6.83	6.83	0.67
3. Agriculture Sector		ton/year	31.56	32.58	31.77	31.32
5. Waste Sector		ton/year	1.96	1.39	1.35	1.36
Total		ton/year	12,892.00	13,119.96	12,174.44	12,011.21

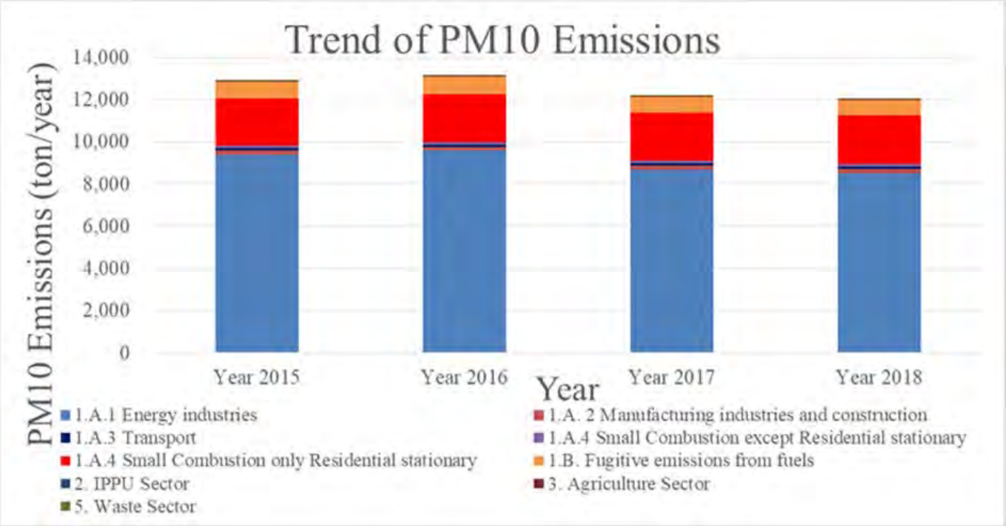


Figure 3-10 Transition of PM_{10} emission

The second Emission Inventories from 2015 to 2018 are shown in Table 3-53 to Table 3-56.

Table 3-53 Second Emission Inventory in 2015

Sector	Category	Unit	SO_2	NOx	TSP	PM_{10}
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	34,880.01	24,900.88	13,913.95	9,398.08
	1.A. 2 Manufacturing industries and construction	ton/year	184.86	8.71	198.19	198.11
	1.A.3 Transport	ton/year	3.72	1,948.84	107.12	107.09
	1.A.4 Small Combustion (Residential combustion)	ton/year	592.25 (511.21)	365.15 (207.46)	2,487.48 (2,359.46)	2,355.71 (2,232.92)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	1,720.28	792.66
2. IPPU Sector		ton/year	0.00	0.00	34.90	6.83
3. Agriculture Sector		ton/year	0.02	52.69	62.06	31.56
5. Waste Sector		ton/year	0.05	1.38	2.03	1.96
Total		ton/year	35,660.91	27,277.64	18,526.01	12,892.00

Table 3-54 Second Emission Inventory in 2016

Sector	Category	Unit	SO_2	NOx	TSP	PM_{10}
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	35,440.44	25,340.07	14,162.44	9,565.90
	1.A. 2 Manufacturing industries and construction	ton/year	184.86	8.71	198.19	198.11
	1.A.3 Transport	ton/year	3.72	1,950.72	97.24	97.22
	1.A.4 Small Combustion	ton/year	604.07	378.07	2,517.10	2,383.86

	(Residential combustion)		(515.52)	(209.71)	(2,386.57)	(2,258.62)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	1,808.05	834.07
2. IPPU Sector		ton/year	0.00	0.00	34.90	6.83
3. Agriculture Sector		ton/year	0.02	49.19	64.59	32.58
5. Waste Sector		ton/year	0.03	0.97	1.44	1.39
Total		ton/year	36,233.14	27,727.73	18,883.95	13,119.96

Table 3-55 Second Emission Inventory in 2017

Sector	Category	Unit	SO_2	NOx	TSP	PM_{10}
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	32,257.95	22,953.13	12,819.10	8,658.68
	1.A. 2 Manufacturing industries and construction	ton/year	184.86	8.71	198.19	198.11
	1.A.3 Transport	ton/year	4.96	2,366.36	113.97	113.94
	1.A.4 Small Combustion (Residential combustion)	ton/year	613.34 (522.87)	382.80 (212.82)	2,553.05 (2,421.96)	2,417.91 (2,292.12)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	1,621.10	745.85
2. IPPU Sector		ton/year	0.00	0.00	34.90	6.83
3. Agriculture Sector		ton/year	0.02	44.51	58.55	31.77
5. Waste Sector		ton/year	0.03	0.94	1.40	1.35
Total		ton/year	33,061.16	25,756.45	17,400.26	12,174.44

Table 3-56 Second Emission Inventory in 2018

Sector	Category	Unit	SO_2	NOx	TSP	PM_{10}
1. Energy Sector						
1.A. Combustion						
	1.A.1 Energy industries	ton/year	31,301.43	22,502.98	12,585.87	8,505.19
	1.A. 2 Manufacturing industries and construction	ton/year	184.77	7.83	198.15	198.08
	1.A.3 Transport	ton/year	1.88	2,245.38	108.58	108.58
	1.A.4 Small Combustion (Residential combustion)	ton/year	614.55 (521.66)	387.18 (214.26)	2,576.31 (2,444.38)	2,440.08 (2,313.46)
1.B. Fugitive emissions from fuels		ton/year	0.00	0.00	1,578.90	725.93
2. IPPU Sector		ton/year	0.00	0.00	1.21	0.67
3. Agriculture Sector		ton/year	0.02	39.83	56.41	31.32
5. Waste Sector		ton/year	0.03	0.95	1.41	1.36
Total		ton/year	32,102.69	25,184.15	17,106.85	12,011.21

Regarding the emissions in the Prishtina Area, the emissions from TPPs account for the majority of the Second Emission Inventory on each air pollutant. Regarding TPPs, the rehabilitation of TPP Kosovo B is planned and TPP Kosovo A is going to shut down after the commencement of 'TPP Kosova e Re'. Therefore, after these implementations, large emission reductions from TPPs will be expected.

However, since the emission from households is pretty high, it is presumed that it is necessary to consider implementation of measures for household heating.

Regarding NO_X emissions, the emission from vehicle tends to be large, and TSP and PM_{10} is pretty large because of the fugitive emissions from fuel in the energy sector. The accuracy of emission calculations on these sources should be improved in the future, and it is assumed that the measures for these emission sources should be considered.

In addition, although the agriculture activity is not very active in the Prishtina Area, the emissions from the Agriculture sector are not so small.

On the other hand, the issue is that there are not sufficient data for calculating emissions regarding manufacturing industry category, tertiary industry category of energy sector, IPPU sector, and waste sector.

3.2.2 Evaluation of the Objectively Verifiable Indicators in the PDM

In the PDM, the Objectively Verifiable Indicators for Output 1 is '1.1 Emission inventory on LCPs and other sources for the current year is revised at least twice'.

Since the emission inventory in current year has already prepared twice in the Progress Report of the second period and this Project Completion Report, the Objectively Verifiable Indicators are met. In addition, the national emission inventory for air pollutant in Kosovo has been already published through the "State of the Air" and "State of the environment in Kosovo" reports, but the emission inventory in Prishtina area has not been published yet.

3.2.3 Capacity development through the activities

In the first period, the activities began with lectures in order for C/Ps to deeply understand the emission inventory. After holding many lectures, C/Ps with support of JET considered the necessary data and discussed the data collection method, and the necessary data such as statistical data were collected in parallel with carrying out the research interviews and traffic volume counting by students. The capacity of C/Ps was developed through learning the concept of emission inventory and carrying out the above concreate activities.

In the second period, JET developed the emission inventory calculation files using collected data, and in parallel C/Ps learned the concrete calculation procedure through the lectures and OJT with support of JET. In addition, many C/Ps in charge of emission inventory group took part in the Training in Japan at the end of second period. They learned the use of emission inventory for policies and measures under Japanese environmental government activities, and roles and responsibilities for emission inventory preparation. Through this training, C/Ps became able to consider the future evolvement of government activity in Kosovo.

In the third period, C/Ps learned the practical and concrete activity for emission inventory preparation through OJT. Specially through compiling emission inventory by updating annual data such as statistical yearbook, C/Ps learned about the necessity for the quality control and the establishment of institutional framework for emission inventory preparation.

The additional activities in the third period were carried out based on the remote consultations and discussions almost once a week, and the C/Ps took the lead in preparing the emission inventory for 2018. JET remotely supported activities of C/Ps, and conducted QA & QC for the emission inventory prepared by C/Ps. Through these activities, the emission inventory preparation procedure was improved, the emission inventory preparation manual was revised, and the future improvement plans for the emission inventory were examined.

Through these activities, C/Ps obtained the deep understanding for activity of emission inventory preparation, and C/Ps was able to carry out the actual activity of the data collection and the actual activity of emission inventory preparation. In parallel, since the establishment of institutional framework for emission inventory preparation is progressing, JET judged that Kosovo side is already able to make the first step towards continuous emission inventory preparation in the future.

3.3 Output 2: Capacities for emission measurements are developed for LCPs and for other sources.

Technology Transfer of exhaust gas measurement of Output 2 has continued from 2015 as well as the study of emission reduction measures for LCPs. Through the Precedent Activities, C/Ps have learned the principle of the measurement and how to conduct it at site. The Project aimed at not only carrying out the measurement more precisely but also deepening the understanding of the principles and conducting the work from the preparation to reporting.

3.3.1 Activities

The acquisition of exhaust gas measurement technologies means not only conducting exhaust gas measurement but also carrying out the measurement processes that are the preparation, measurement, tidying up equipment, wrapping up measurement results and making reports. In parallel, it is important to conduct equipment management such as organization and maintenance of equipment for measurement at any time. Therefore, the Project placed the importance on C/P recognizing the necessity of the abovementioned process, and held trainings for C/P through lectures and OJT during the Project period. As a result, C/P recognized the importance and such personnel have been fostered. Through these activities, the technology transfer of the exhaust gas measurement has been completed. The technology transfer was carried out to bring up mainly the persons in charge in KHMI and KEK, and the exhaust gas measurement became possible by these persons.

On the other hand, the law requires all facilities to conduct exhaust gas measurement and submit the results, but through the Project one issue has become clear, such that almost all facilities cannot conduct proper exhaust gas measurement and reporting. Details are stated in Output 6, but both facilities and MESPI/MESP are thought to be the causes of the problem. The Project has achieved the establishment of the exhaust gas measurement capacity within the Government, but has not been able to reach the goal of establishing the institutional framework for facilities to conduct measurement and report the results.

The details of the activities are as follows.

(1) Exhaust gas measurement activities

Activities are divided into three fields, which are lectures on exhaust gas measurement and organization of equipment, exhaust gas measurement for LCPs and exhaust gas measurement for other stationary sources. These activities aimed at C/P acquiring the measurement technology for exhaust gas and Dust.

In the Precedent Activity, C/P and JET conducted measurement of SO_2, NO_X and Dust for TPP Kosovo A and TPP Kosovo B. In the activities, the measurement locations were changed and the representative measurement points were specified. Through these activities, C/Ps learned how to conduct measurement and acquired the techniques.

The main purpose of the activities was for C/P to acquire exhaust gas measurement technology, but at the same time, the measurement activities have been carried out in parallel to the other activities such as provision of the data for emission inventory, base data for studying emission reduction measures for LCPs and other stationary sources, comparison measurement with the analysis by Standard Reference Method, etc. Through these activities, C/Ps have learned that the preparation for the measurement, the organization and maintenance of equipment, etc. are very important for conducting proper exhaust gas measurement.

1) Lectures on exhaust gas measurement and organization of equipment, etc.

The activities regarding lectures on exhaust gas measurement and organization of equipment, etc. are shown in Table 3-57.

Table 3-57 Exhaust gas measurement
(Lectures on exhaust gas measurement and organization of equipment, etc.)

Date	Activity	Remarks
First Period		
Apr. 11 (Wed), 2018	Seminar; exhaust gas measurement	At TPP Kosovo A The Project held the seminar for Measurement for W.G.
Apr. 26 (Thu), 2018	Lectures on Dust measurement and iso-kinetic sampling calculation of Dust	C/P: 12 Participants
Apr. 27 (Fri), 2018	Lectures on weighing thimbles (P.M.)	KHMI: 2 Participants
May 4 (Fri), 2018	Lecture on Dust measurement and iso-kinetic sampling calculation of Dust, and on preparation for Dust measurement	KHMI: 2 Participants
May 18, (Fri) 2018	Measurement WG Meeting	Reviewing measurement activities at TPP Kosovo B by C/P
Third Period		
Nov. 26 (Tue), 2019	Organization and maintenance of measurement equipment	KHMI: 1 (JET: 1)

Nov. 27 (Wed), 2019	Assistance for equipment transfer to KEK	KHMI: 1 (JET: 1)
Nov. 28 (Thu), 2019	Assistance for equipment transfer to KEK	KHMI: 1 (JET: 1)
Nov. 29 (Fri), 2019	Assistance for wrapping up measurement data	KHMI: 1 (JET: 1)
Dec. 2 (Mon), 2019	Assistance for wrapping up measurement data	KHMI: 1 (JET: 1)
Dec. 3 (Tue), 2019	Assistance for wrapping up measurement data	KHMI: 1 (JET: 1)
Dec. 4 (Wed), 2019	OJT on measurement data analysis and calculation	KHMI: 2 (JET: 1)
Dec. 5 (Thu), 2019	OJT on measurement data analysis and calculation	KHMI: 2 (JET: 1)
Dec. 6 (Fri), 2019	OJT on measurement data analysis and calculation	KHMI: 2 (JET: 1)
Dec. 7 (Sat), 2019	OJT on measurement data analysis and calculation	KHMI: 1 (JET: 1)
Nov.19 (Thu), 2020	Discussion on measurement result of TPP Kosovo A	KHMI: 1, KEK: 1
Mar.19 (Fri), 2021	Discussion on measurement result of TPP Kosovo A	KHMI: 1, KEK: 2

Exhaust gas measurement requires not only conducting measurements but also completing all the steps shown in Figure 3-11. The steps require proper preparation for measurement, accurate recording of the results including operation conditions, organization of measured data and drawing up appropriate report.

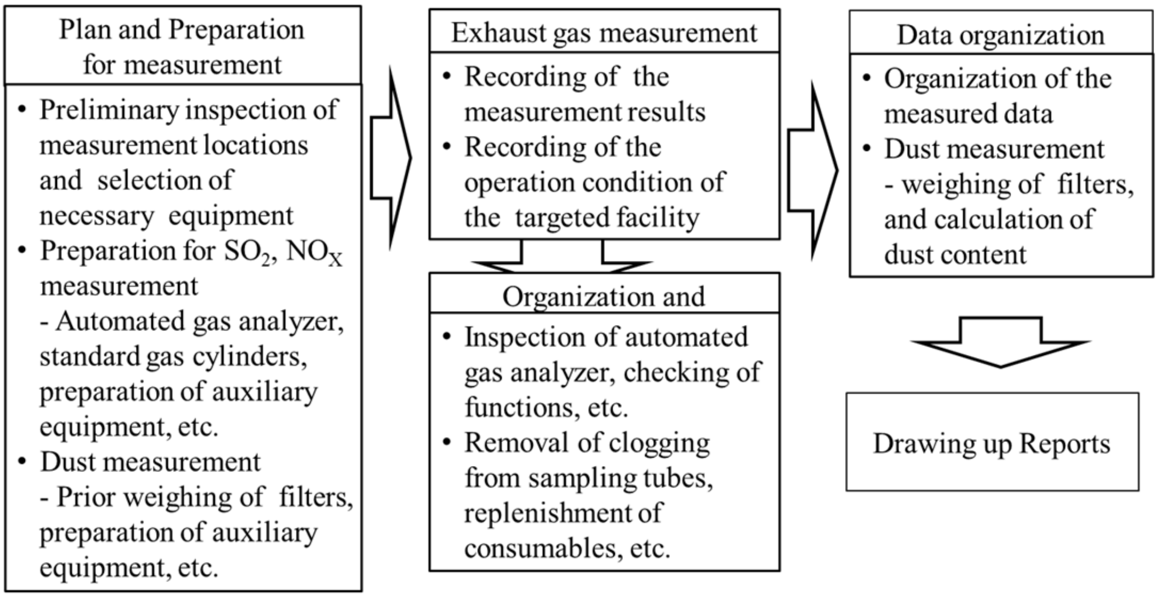


Figure 3-11 Work flow of the exhaust gas measurement (SO_2, NO_X and Dust)

In order to conduct the exhaust gas measurement, the following items should be understood and implemented.

A. To understand the measurement principles in a right way and to conduct right measurement
    - To carry out a calibration for the automated analyzer by using standard gases before starting the measurement
    - To understand the principle of the iso-kinetic sampling and to conduct Dust sampling according to the rule
B. To maintain measurement equipment all of the time in proper condition for right and accurate measurement
    - To prepare necessary equipment (instruments, auxiliary equipment, weighing of filters before Dust sampling, etc.)
    - To tidy up the equipment and maintain them after the measurement (inspection and maintenance of used equipment, keeping things tidy and in order, weighing of filters after Dust sampling, etc.)

In the first period, JET gave lectures such as the principles of measurement, etc. and C/P conducted the measurement at site considering and confirming the principles. From May 14 to May 17, 2018, only members of the Kosovo side conducted the measurement, and JET confirmed that Kosovo side can conduct measurement only by themselves. On May 18, 2018, members of On-site stack gas measurement WG had a meeting and reviewed the measurement activities. C/Ps confirmed that they carried out the right measurement. However, they recognized that they still had to improve the measurement preparation process, clean-up and maintenance of equipment after measurement as well as organization and maintenance of equipment for the next measurement.

Photo 3-4 View from measurement at TPP Kosovo B and meeting for review of activities

In the second period, C/P and JET continued exhaust gas measurement and at the same time, organized the equipment. C/Ps learned the importance of organization of equipment through the first training in Japan, and put equipment in order, enabling measurement at any time.

Measurement equipment was handed over to the Kosovo side through the ceremony held on June 11, 2019.

Photo 3-5 Condition of organization of measurement equipment

Photo 3-6 View of explanation for equipment at the handover ceremony

Total two sets of measurement equipment were donated, where one set was from the Precedent Activity, and another set was from the Project. In the third period, one of the two sets has been transferred to KEK. From now on, KHMI and KEK are expected to use them efficiently.

In the third period, the Project placed the importance on the training on data organization, analysis on acquired data and exhaust gas calculation.

Through these activities, C/Ps have learned the process for the exhaust gas measurement shown in Figure 3-11.

2) Exhaust gas measurement for LCPs

The exhaust gas measurement activities for TPP Kosovo A and TPP Kosovo B are shown in Table 3-58.

For TPP Kosovo B, only exhaust gas measurement was conducted for the purpose of understanding the real situation of emissions and the provision of data for emission inventory. On the other hand, for TPP Kosovo A the measurement was conducted for the same purpose as for TPP Kosovo B, but in addition also to study the emission reduction measures for Dust, SO_2 and NO_X, as well as for comparison with analysis results by Standard Reference Method.

The donated measurement equipment was used for these measurements. The automated gas analyzer shown in Photo 3-7 was used for SO_2 and NO_X measurement.

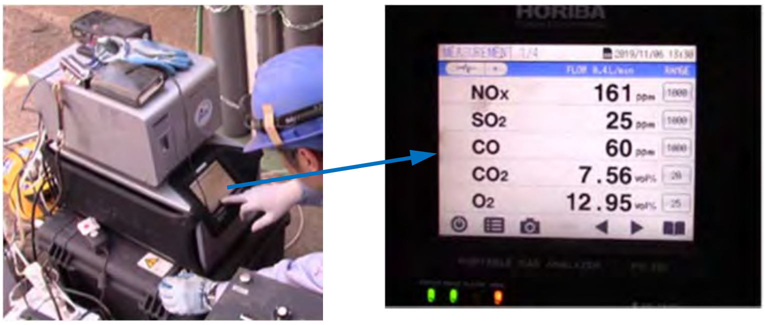


Photo 3-7 Automated gas analyzer

Table 3-58 On-site stack gas measurement Activities

Date	Activity	Remarks
	First Period	
Apr. 16 (Mon) ~25 (Wed), 2018	Apr. 16~20: TPP Kosovo A: A-4 B-Duct exhaust gas measurement April 23: TPP Kosovo A: A-4 B-Duct exhaust gas & Dust measurement April 24: TPP Kosovo A: A-4 C-Duct exhaust gas & Dust measurement April 24: TPP Kosovo A: A-4 A-Duct exhaust gas & Dust measurement	In parallel to the measurement, sampling of lignite and fly ash was conducted At the same time, velocity measurement inside ESP was supported
Apr. 30 (Mon), 2018	TPP Kosovo A: A-3 A-Duct: exhaust gas & Dust measurement (Test for change of Exhaust gas flow rate)	Test to evaluate the effect of Exhaust gas flow rate to ESP performance
May 2 (Wed)~3 (Thu), 2018	May 2: TPP Kosovo A: TPP A-3 C-Duct exhaust gas & Dust measurement (Test for change in O2 content in exhaust gas) May 3: TPP Kosovo A: A-3 B-Duct (Test for change of outlet temperature from the mills)	Exhaust gas measurement as well as sampling of lignite and fly ashes Support for velocity measurement in ESP
May 7 (Mon), 2018	TPP Kosovo A: A-3 B-Duct: exhaust gas & Dust measurement (Test for change of the number of operation mills)	KHMI: 2 KEK: 2 JET: 3
May 10 (Thu) & 12 (Sat), 2018	Preparation for exhaust gas & Dust measurement by C/P	
May 14 (Mon)~17 (Thu), 2018	May 14: TPP Kosovo B: B-1 No.1-Duct exhaust gas measurement May 15: TPP Kosovo B: B-1 No.1-Duct exhaust gas & Dust measurement May 16: TPP Kosovo B: B-2 No.1-Duct exhaust gas & Dust measurement May 17: TPP Kosovo B: B-2 No.2-Duct exhaust gas & Dust measurement	As final test, only C/P conducts measurements from preparation to measurement
	Second Period	
Nov. 5 (Mon) ~ 6 (Tue), 2018	Exhaust gas measurement for NO_X reduction test at TPP Kosovo A (No.3 boiler)	Participants KEK: 2 (JET: 2)
Mar. 22 (Fri), 2019	Support for preparation for velocity distribution measurement inside ESP at TPP Kosovo A	Participants KEK:1 (JET: 3)
Mar. 25 (Mon), 2019	Support for velocity distribution	Participants KEK:2

	measurement inside ESP at TPP Kosovo A	(JET: 3)
Mar. 29 (Fri)	Preparation for Exhaust gas measurement at TPP Kosovo A	Participants KHMI:1 (JET: 3)
Apr. 1 (Mon) ~ April 4 (Thu), 2019	Exhaust gas measurement at TPP Kosovo A (support for confirmation of Dust reduction measures) Apr. 1 ~ Apr. 3: No.5 boiler Apr. 4: A-4 boiler	Participants KEK:2, KHMI:2 (JET: 3)
Apr. 10 (Wed), 2019	Exhaust gas measurement at TPP Kosovo A: No. 5 boiler (support for SO_2, NO_X reduction test)	Participants KEK:2, KHMI:1 (JET: 2)
Apr. 11 (Thu), 2019	Exhaust gas measurement at TPP Kosovo A: No. 5 boiler (support for SO_2, NO_X reduction test)	Ditto
Apr. 14 (Mon) ~ Apr, 18 (Thu), 2019	Exhaust gas measurement at TPP Kosovo A: No. 5 boiler (support for SO_2, NO_X reduction test)	Ditto
Apr. 26 (Fri), 2019	Exhaust gas measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler	Ditto
April 30 (Tue)	Exhaust gas measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler	Participants KEK:1, KHMI:2 (JET: 2)
May 15 (Wed)	Exhaust gas measurement at TPP Kosovo B: Comparison with Standard Reference Method: B-1 boiler, Duct-1	Participants KHMI:1 (JET: 2)
May 16 (Thu)	Exhaust gas measurement at TPP Kosovo B: Comparison with Standard Reference Method: B-1 boiler, Duct-2	Participants KHMI:1 (JET: 2)
Third Period		
Nov. 1 (Fri), 2 (Sat) and 4 (Mon), 2019	Preparation for exhaust gas sampling for Standard Reference Method:	Participants KHMI:1 (JET: 2)
Nov. 5 (Tue), 2019	Bring equipment to TPP Kosovo A	Participants KHMI:2, KEK:2, (JET: 3)
Nov. 6 (Wed), 2019	Exhaust gas and Dust measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler, C-Duct	Participants KHMI:2, KEK:2, (JET: 2)
Nov. 8 (Fri), 2019	Exhaust gas and Dust measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler, C-Duct	Participants KHMI:2, KEK:2, (JET: 2)
Nov. 11 (Mon), 2019	Exhaust gas and Dust measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler, C-Duct	Participants KHMI:2, KEK:2, (JET: 2)
Nov. 12 (Tue), 2019	Tidying up the measurement equipment	Participants KHMI:1, (JET: 2)
Nov. 19 (Tue), 2019	Exhaust gas and Dust measurement at TPP Kosovo A: Comparison with Standard Reference Method: No. 4 boiler, C-Duct	Participants KHMI:2, KEK:2, (JET: 2)

Photo 3-8 View from the exhaust gas measurement at TPP Kosovo A

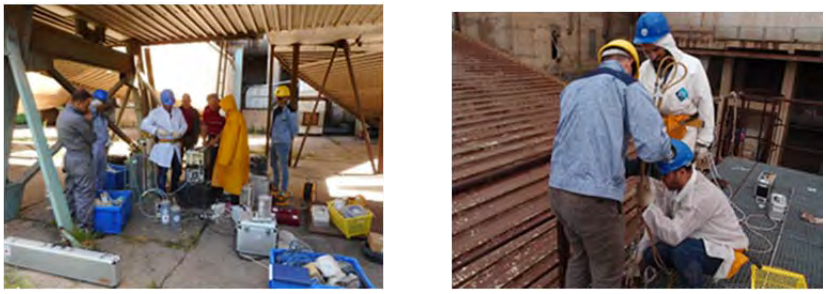


Photo 3-9 View from the exhaust gas measurement at TPP Kosovo B

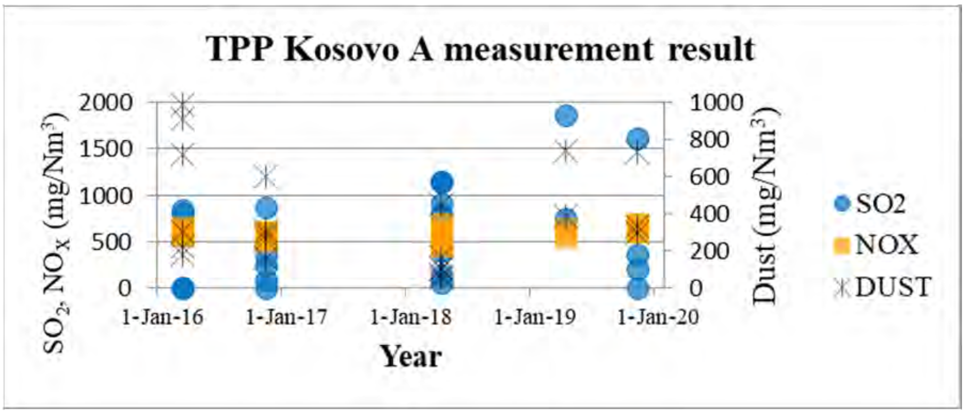
In the first period, the Project conducted exhaust gas measurement in order to understand the real situation of emissions from TPP Kosovo A and TPP Kosovo B. The purpose of the measurement was to provide data for developing emission inventory and confirm the compliance with ELVs stipulated in EU directive. For TPP Kosovo B, only measurement was conducted.

On the other hand, since the purposes of the measurement at TPP Kosovo A were to examine the behavior of Dust, SO_2 and NO_X regarding the study of emission reduction measures, carry out various tests and evaluate the test results, the measurement was continued in the second period too. Moreover, in the second period, the measurement was conducted in order to evaluate the effectiveness of the Dust reduction measure (internal modification of the ESP). The Project completed the aforementioned activities that were needed for the Project by the end of the second period.

From the last half of the second period to the first half of the third period, as an additional activity, the Project conducted the measurement in order to compare the measurement results by the automated analyzer with the analysis results by Standard Reference Method. However, as the number of the tests is small, no clear result is obtained. This is described in 3-5-1.

All the measurement results are shown in Appendix-1: Third Period: “2-2)-4 LCP measurement data sheet”. The measurement results (converted to exhaust gas O_2 =6%) are shown in time-series in Figure 3-12. Interpretation of the measurement results is described in 3.8.1. NO_X values are relatively stable, but Dust and SO_2 values change in every measurement, and SO_2 sometimes even show zero value. It has also been found that the change in Dust and SO_2 values in TPP Kosovo A is larger than those in TPP

Kosovo B. However, these emission values did not meet the ELVs for LCPs at 2018 as shown in Table 3-59, and measures are required. Measures are described in 3.8.1.



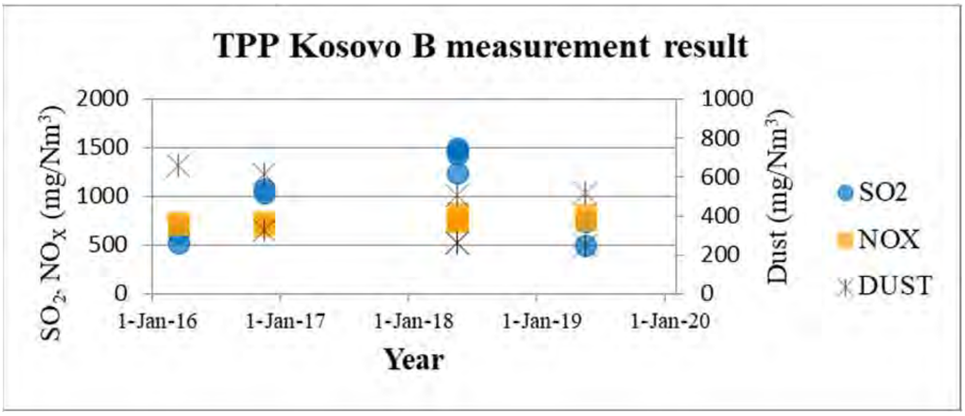


Figure 3-12 measurement results at TPP Kosovo A and TPP Kosovo B

Table 3-59 ELVs for LCPs

(Reference O_2=6%)			
	Dust (mg/Nm^3)	SO_2 (mg/Nm^3)	NO_X (mg/Nm^3)
ELVs in 2018*1)	**50**	**400**	**500**

*1) According to the NERP, ELVs change every year (see 3.7.1). This table shows ELVs for 2018.

3) Exhaust gas measurement in other stationary sources

The Project conducted the exhaust gas measurement for industrial facilities (other stationary sources) in Kosovo for the purpose of understanding the real emission situation and studies the emission reduction measures. Study results of the emission reduction measures are described in 3-7-1.

This is the list of other targeted stationary sources in Kosovo.

i) Ferro-Nickel factory
ii) Brick factory
iii) Asphalt factory
iv) Oil Recycling factory

Activities regarding the exhaust gas measurement for other stationary sources are shown in Table 3-60.

Table 3-60 Exhaust gas measurement for other stationary sources

Date	Activity	Reference
First Period		
Feb. 15 (Thu), 2018	Preliminary Inspection for Ferro-Nickel factory	Inspectorate: 1 DEPW/DIPM: 1 JET: 2
May 21 (Mon), 2018	Preliminary Inspection for Brick factory and preliminary Inspection for Oil recycling factory	Inspectorate: 1 JET: 2
May 22 (Tue), 2018	Preliminary Inspection for Asphalt factory	Inspectorate: 2 KHMI: 1 JET: 2
May 23, 2018	Interview with INKOS (analysis company): Inquiry about emission gas measurement at other stationary sources	KHMI: 1 JET: 2
Second Period		
Nov. 2 (Fri), 2018	Request for exhaust gas measurement	MESPI/MESP:3, KHMI: 2 JET: 2
Nov. 6 (Tue), 2018	Preliminary Inspection for Ferro-Nickel factory	MESPI/MESP:3, KHMI: 2 JET: 2
Nov. 8 (Thu), 2018	Bring equipment to Ferro-Nickel factory	KHMI: 1 JET: 2
Nov. 12 (Mon), 2018	Exhaust gas and Dust measurement at Ferro-Nickel factory (Rotary kiln)	MESPI/MESP: 3, KHMI: 2 JET: 2
Nov. 13 (Tue), 2018	Continued	MESPI/MESP: 3, KHMI: 2 JET: 2
Nov. 14 (Wed), 2018	Exhaust gas and Dust measurement at Ferro-Nickel factory (Converter)	MESPI/MESP 2, KHMI: 1 JET: 2
Nov. 15 (Thu), 2018	Exhaust gas and Dust measurement at Ferro-Nickel factory (Electric furnace)	MESPI/MESP: 4, KHMI: 1 JET: 2
May 3 (Fri), 2019	Bring equipment to Ferro-Nickel factory	KHMI: 1 JET: 2
May 6 (Mon), 2019	Exhaust gas and Dust measurement at Ferro-Nickel factory (Electric furnace)	KHMI: 1 JET: 2
May 7 (Tue), 2019	Exhaust gas and Dust measurement at Ferro-Nickel factory (Converter)	KHMI: 1 JET: 2
May 8 (Wed), 2019	Exhaust gas and Dust measurement at Ferro-Nickel factory (Converter) and gas sampling for Standard Reference Method	KHMI: 1 JET: 2
May 10 (Fri), 2019	Exhaust gas and Dust measurement at Brick factory	KHMI: 1 JET: 2
Third Period		
Nov. 13 (Wed), 2019	Exhaust gas and Dust measurement at Brick factory	KHMI: 2 JET: 2
Nov. 15 (Fri), 2019	Exhaust gas and Dust measurement at Asphalt factory	KHMI: 2 JET: 2
Nov. 22 (Fri), 2019	Exhaust gas and Dust measurement	KHMI: 2

	at Oil Recycling factory	JET: 2
Nov. 25 (Mon), 2019	Tidy equipment up at Oil Recycling factory, and maintenance of equipment Weighing sampled Dust	KHMI: 1 JET: 1

As for the measurement for other stationary sources, Dust, SO_2 and NO_X were measured same as for LCPs. The Project undertook steps for members to visit and inspect the target facility, and conduct the measurement after the confirmation of the necessary items such as understanding the process, specifying the locations of the measurement, confirming the measurement holes and platform at the location, etc.

Table 3-61 shows the summary of the measurement results. The interpretation of the results is described in 3.7.1. The reports are attached in Appendix-1: the second period: “2-1) - 1~3” and the third period: “2-1)- 1~3”. The measurement results show that in every facility, some components exceeded the ELVs, which means that the law is not respected. It is a major issue from now to carry out the exhaust gas measurement properly and comply with the law. This issue is also described in 3.7.1.

Table 3-61 Measurement results at other stationary sources

Ferro-Nickel factory				
	ELV and data	Dust (mg/Nm^3)	SO_2 (mg/Nm^3)	NO_X (mg/Nm^3)
Ferro-Nickel Factory (Rotary kiln)		No Reference O_2 in Exhaust gas (O_2 in exhaust gas =15.1、17.5%)		
	ELV$^{*1)}$	**30**	**600**	**350**
	November 2018	18	1,788	113
	May 2019	37	1,054	52
Ferro-Nickel Factory (converter)		No Reference O_2 in Exhaust gas (O_2 in exhaust gas =17.0、18.5%)		
	ELV$^{*1)}$	**30**	**600**	**350**
	November 2018	1,046	22	49
	May 2019	145	41	46
Ferro-Nickel Factory (Electrical furnace)		No Reference O_2 in Exhaust gas (O_2 in exhaust gas =0.1%)		
	ELV$^{*1)}$	**30**	—	—
	November 2018	692	0	0
	May 2019	207	0	0
Other stationary sources				
Brick factory		Reference O_2 in Exhaust gas = 18.0%		
	ELV$^{*2)}$	**50**	**500**	—
	May 2019	1,504	1,809	22
	November 2019	1,820	1,400	26
Asphalt factory		Reference O_2 in Exhaust gas = 10.0%		
	ELV$^{*1)}$	**50**	**400**	**800**
	November 2019	949	212	289
Oil Recycling factory		No Reference O_2 in Exhaust gas (O_2 in exhaust gas =21%)		
	ELV$^{*2)}$	**-**	**-**	**-**
	November 2019	197	19	2

*1), *2) ELVs for each facility are given in Kosovo as follows. For facilities stipulated in Law No. 03/L-043, the government gives ELVs by *1) IPPC Permit[19], and for other facilities, ELVs are given by *2) Administrative Instruction No./2007[20].

Ferro-Nickel factory

Brick factory

Oil Recycling factory

Asphalt factory

Photo 3-10 Other stationary sources

(2) Establishment of institutional framework for exhaust gas measurement

The Project completed the technology transfer of exhaust gas measurement to MESPI/MESP which is the competent authority. However, the Project could not reach the goal of disseminating the technology to private businesses, and this remains the issue for the future.

The exhaust gas measurement is indispensable in order to monitor actual emission condition and study emission reduction measures in order to improve emissions, and it is one of the most important technologies to be transferred in the Project.

Exhaust gas monitoring is classified in two types. One type is to monitor emissions by Continuous Emission Monitoring System (hereinafter referred to as ”CEMS”) and another is to monitor by using batch type measurement transferred through the Project activities. However, even for the facility equipped with CEMS, batch type measurement is obligatory to be conducted regularly in order to guarantee the results measured by the CEMS. The measurement method for the CEMS is so called “Standard Reference Method”. On the other hand, for many facilities exempted from the obligation to install the CEMS, the exhaust gas

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[19] “Law No. 03/L-043 Integrated Pollution Prevention and Control” (hereinafter referred to as “IPPC”) Permission is given based on the IPPC

[20] Administrative Instruction No./2007 “ON THE RULES AND STANDARS OF THE DISCHARGES ON AIR BY THE STATIONARY SOURCES OF POLLUTION”. This law is scheduled to be revised to the law with more strict regulations of “LIMITATION OF EMISSIONS OF POLLUTANTS INTO THE AIR FROM STATIONARY POLLUTION SOURCES”.

measurement is the only measure to monitor emissions. At the same time, the exhaust gas measurement is very useful not only for monitoring emissions but also managing O&M of facilities.

As for emission monitoring, roles of DEPW/DIPM & Inspectorate which are part of MESPI/MESP are described in Table 3-62. The DEPW/DIPM is the division mainly giving permission to facilities, and Inspectorate is the division monitoring emissions from facilities.

Table 3-62 Roles of MESPI/MESP (DEPW/DIPM & Inspectorate)

	Role	Content of work	Work of KEK (TPP)	Work of other stationary sources (private businesses)
CEMS[*1)]	Monitoring and reporting	Confirmation of compliance with ELVs during operation	○ TPP Kosovo B × TPP Kosovo A	Applied to the part of the business operators
Batch exhaust gas measurement	Audit (Monitoring)	Confirmation of compliance and instruction, and exhaust gas measurement as necessary	Reception of Monitoring and instruction by Inspectorate	Reception of Monitoring and instruction by Inspectorate
	Reception of reporting	Reception of reporting on actual emission, and exhaust gas measurement as necessary	Exhaust gas measurement by themselves [*2)*3)] and reporting to DEPW/DIPM (Standard Reference Method)	Exhaust gas measurement by contractors [*3)*4)] and reporting to DEPW/DIPM
The following is conducted by operators themselves				
Management of operations		Exhaust gas measurement for inspections and improvement of O&M	Exhaust gas measurement by themselves	Exhaust gas measurement by contractors [*4)]

*1) TPP Kosovo B possesses CEMS, but TPP Kosovo does not possess CEMS. TPP Kosovo A does not have any plan to install CEMS since it will stop the operation in 2023.

*2) For LCP, reporting on emissions by Standard Reference Method is requested. For other stationary sources, Standard Reference Method is the best choice, but reporting based on the results by the automated gas analyzer should be also permitted.

*3) EU requests the exhaust gas measurement by the agencies possessing ISO/IEC 17025 (laboratory management system), but there is no such agency in Kosovo at present.

*4) It is difficult for private business operators to conduct measurement by themselves, and it is usual to outsource the measurement to external agencies. However, since there is no agency that is able to conduct measurement in Kosovo at present, they have to have contracts with foreign agencies.

The dissemination of exhaust gas measurement is thought to be carried out in the following steps.

1) The audit and monitoring of emissions from facilities by the government (Inspectorate and DEPW/DIPM), confirmation of emissions through exhaust gas measurement and instructions as necessary, and through these activities, the strengthening of the recognition for implementation of exhaust gas measurement and reporting.
2) The dissemination of exhaust gas measurement and reporting of the results for LCPs such as TPP Kosovo A, and other stationary sources, and the dissemination of measurement for O&M of facilities.
3) Promotion of the commercialization of exhaust gas measurement business through the dissemination of measurement. Fostering private measurement agencies and capacity development for technical authorization by Accreditation Agency (hereinafter referred to as “AA”) in MITE, and then, exhaust gas measurement by accredited private measurement agencies

To date, the Project established the exhaust gas measurement technology within the government through the activities including the Precedent Activity, corresponding to the step 1). TPP Kosovo A also obtained the technology corresponding to the step 2). However, as for the step 1), it is hard to say that the audit and monitoring for facilities are functioning well. The details are described in 3.7.1. As for the step 2) and 3), the dissemination of the measurement and fostering private measurement agencies are required. In the Project, in case that an agreement was made between MESPI/MESP and a private or public agency regarding measurement technology transfer, the Project was going to support such agencies. However, this activity was not carried out since the agreements were not made.

At present, there is only one agency that has the possibility to conduct exhaust gas measurement, but even this agency does not have either sufficient technology (no Dust measurement technology) or satisfactory measurement equipment. Therefore, some facilities in Kosovo reported the measurement results by contracting foreign agencies. In Kosovo, there is only one possible private company, but it is problematic for MESPI/MESP to back up one specific private company. At the same time, even though MESPI/MESP gives a backup, the continuity of exhaust gas measurement is not thought to be realistic unless the exhaust gas measurement is established as a business.

MESPI/MESP which is the competent authority and business operators who are operating other stationary sources do not have right understanding of exhaust gas measurement and emission values, and moreover, there are no measurement agencies that have the right knowledge for measurement. When the business operators ask for the measurement from the domestic measurement agencies, the agencies conduct either very elementary measurement or use the calculations, and therefore, the reliability of the results is inevitably very low. Through the Project activities, Kosovo now is in a position where MESPI/MESP and KEK have members who are able to conduct the proper measurement.

In order to establish institutional framework for the exhaust gas measurement from now onward, there are following issues.

i) Inspectorate and DEPW/DIPM: Strengthening of the audit and monitoring capacity through the acquisition of knowledge on exhaust gas measurement and emissions

ii) Continuation of exhaust gas measurement and enhancement of utilization of measurement results for the improvement of operation in KEK

In order to conduct exhaust gas analysis by Standard Reference Method, it is necessary for KEK and KHMI to collaborate, since only KHMI has the IC.

iii) Implementation of accurate exhaust gas measurement and reporting by business operators for other stationary sources

iv) Establishment of exhaust gas measurement as a business through the dissemination of measurement and technical support for private companies.

v) Acquisition of ISO/IEC 17025 by measurement agencies

vi) Establishment of exhaust gas measurement structure: MESPI/MESP must secure exhaust gas measurement structure as necessary until the measurement and reporting of exhaust gas is well disseminated all over Kosovo. For this purpose, it is important to secure three persons in charge of this work in KHMI. However, there are only two staff at this moment, and one of the staff is mainly in charge of analysis work. Although KHMI always suffers from chronic shortage of personnel, it is desirable to reinforce staff with at least one person, if possible two persons.

The Project placed the importance on the transfer of exhaust gas measurement technologies to MESPI/MESP and KEK, and it has reached the goal. From now, it is necessary to enforce the law for private facilities run by business operators to conduct exhaust gas measurement and reporting. For this purpose, it is important for the competent authority (MESPI/MESP) to improve the awareness and knowledge on the exhaust gas measurement, instruct properly the private facilities, make the exhaust gas measurement and reporting obligatory, and increase the recognition on the importance of the compliance with ELVs. These are big issues at this moment.

This time, the Project held a seminar for private facilities (mainly for the large plants), private measurement agencies, the University, etc. regarding the recognition of the importance of the exhaust gas measurement.

Table 3-63 Seminar regarding the exhaust gas measurement

Date	Activity	Remarks
Feb. 13 (Thu), 2020 9:00 ~ 12:00	Seminar regarding the exhaust gas measurement for private operators, the University, etc.	Companies and the University: 6 C/P: 6 JET: 2

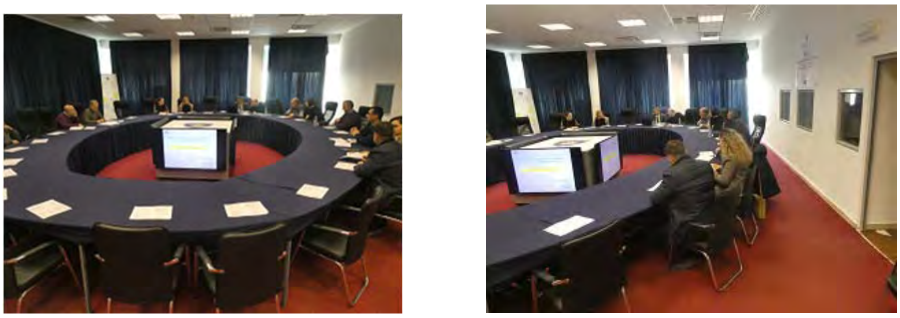


Photo 3-11 Seminar regarding the exhaust gas measurement

3.3.2 Evaluation for the Objectively Verifiable Indicators in the PDM

Objectively Verifiable Indicators for Output 2 are “2.1 On-site stack gas measurements are conducted at least 26 times for NO_X, SO_2 and Dust (Kosovo A: 3 boilers×3 ducts, Kosovo B: 2 boilers×2 ducts)” and “2.2 Standard Operating Procedures (SOPs) for on-site stack gas measurements for LCPs and other stationary sources are elaborated”.

The exhaust gas measurements for LCPs were conducted for many purposes such as providing data for emission inventory, carrying out OJT for learning measurement technologies, providing base data for studying emission reduction measures for LCPs, and comparing the measurement results by the automated gas analyzer with analysis results by Standard Reference Method. As a result, in the first period there were twelve days of measurement for TPP Kosovo A (eight days for No.3 boiler and four days for No.4 boiler) and four days for TPP Kosovo B (two days for No.1 boiler and two days for No2. boiler). In the second period, there were eleven days for TPP Kosovo A (two days for No.3 boiler, five days for No.4 boiler and five days for No.5 boiler) and two days for TPP Kosovo B (two days for No.1 boiler). In the third period, there were four days for TPP Kosovo A (four days for No.4 boiler). Sufficient number of the measurement was conducted.

Two SOPs were prepared for exhaust gas measurements. One is for SO_2 and NO_X measurement by the automated gas analyzer, and the other one is for Dust measurement. SOPs for other stationary sources are the same as those for LCPs, since equipment used and procedures are the same. SOPs are attached in Appendix-1.

3.3.3 Capacity development through the activities

As stated above, the exhaust gas measurement is an important technology in order for MESPI/MESP to confirm the condition of the compliance with ELVs, and in order for facilities to manage operations and emissions. The technology transfer for the exhaust gas measurement has continued from the Precedent Activity, and in the Project, C/Ps reached the level where they could conduct measurement. However, the exhaust gas measurement means that they can go through the process of preparation for measurement, measurement, tidying up and organization of equipment, and making a report. JET tried to transfer the whole process during the Project time through the OJT. C/Ps understood the importance of the process very well and could carry out the process, where what they experienced through the training in Japan contributed a lot in this matter. C/Ps improved their capacity quite a lot.

It is eventually desirable that in Kosovo all facilities conduct proper exhaust gas measurement and reporting, and their ELVs comply with the law. The enforcement of the law is the biggest issue, as the law is not complied with even though it stipulates that the measurement and reporting is obligatory in Kosovo. Therefore, the first step is for persons in charge to deepen their knowledge on emissions and acquire the capacity to instruct properly the private facilities (This issue is described in 3.7.1). The Project established the system for MESPI/MESP to conduct measurement, and now it is necessary for MESPI/MESP to utilize this system and to disseminate the measurement technology.

3.4 Output 3: Air quality monitoring activities are sustained.

Activities in Output 3 were implemented for the purpose of acquiring accurate air quality data and providing data to the public in a fast manner. These activities are mainly the rehabilitation of analyzers in AQMSs, O&M training for analyzers to be able to supply stable and sustainable data and the installation of air quality data displays to provide data to citizens. Furthermore, the Project studied the optimum placement of AQMSs in the future in Kosovo and transferred air quality measurement technology for emergency cases.

3.4.1 Activities

Activities are divided in four items, which are the rehabilitation and O&M training for analyzers in AQMSs, the study of the optimum placement of AQMSs, transfer of air quality measurement technology for emergency cases and the installation of air quality data displays. In the third period, one activity was added due to the extension of the Project period.

(1) Rehabilitation of analyzers in AQMS and training on O&M of analyzers

Activities related to the soundness of analyzers in AQMS include inspection of AQMSs (nationwide), rehabilitation (AQMSs in the Pristina area: 5 stations), preparation of the maintenance manual and training on calibration of analyzers based on the manual.

1) Inspection of current AQMSs status in Kosovo

Table 3-64 shows AQMSs inspection activities to understand the current status, in order to implement the rehabilitation.

The Project conducted the inspection of eleven AQMSs except Brezovica all over Kosovo mainly on the diagnosis of analyzers for five days beginning from June 4, 2018. The results of this inspection provided the basic data for the rehabilitation of analyzers in five AQMSs in the Pristina area and at the same time, these results were also shared as a reference for rehabilitation of analyzers in other AQMSs by MCC/MFK in the second half of 2019. There was a decrease of abnormalities and mal-functions of analyzers compared with "the detailed planning survey on capacity development project for pollution control for major stationary emission sources" in the Precedent Activity conducted in October and November 2016. The reason for the improvement was largely due to the fact that since June 2017, maintenance budget of 150,000 euros per year was secured.

Table 3-64 Inspection of the current AQMSs status for rehabilitation planning

Date	Activity	Reference
Year 2018, the first period		
Apr. 17 (Tue)	Meeting with MCC/MFK	Discussion on scheduled activities
May 11 (Fri)	Meeting with MCC/MFK	Discussion on the task division and data network
May 25 (Fri)	Meeting with MCC/MFK and EC	Discussion on data network
June 4 (Mon)	Meeting with KHMI and subcontractor Diagnosis of KHMI station.	Ms. Letafete and 4 staff from KHMI attended the meeting. One staff from KHMI attended the diagnosis. PM_{10}/$PM_{2.5}$ analyzer was checked next day.
June 5 (Tue)	Diagnosis of AQMS in Rilindja, Obiliq, Palaj and Dardhishte. Repair of some analyzers.	KHMI :1 In comparison with two years ago, the number of equipment out of order was reduced, calibration (zero and span) was also conducted, etc. However, the motherboard of the CO analyzer at Palaj station was broken, and the SO_2 analyzer at Dardhishte station was not installed yet although it was stolen in November 2015.
June 6 (Wed)	Diagnosis of AQMS in Mitrovica, Drenas and Peja. Repair of some analyzers.	Same as above, Improvement was observed, but the Peja station had only Grimm 180 (the PM_{10} / $PM_{2.5}$) same as two years ago. In AQMS in Mitrovica, the room temperature was 40 degrees and analyzers were not working properly because the air conditioner was broken. Cooling function of NOx analyzer was out of order. After 5 days, a new air conditioner was installed.
June 7 (Thu)	Diagnosis of AQMS in Gjilan, Hani i Elezit and Prizren. Repair of some analyzers. Wrap-up meeting for the result of inspection.	KHMI:1 In AQMS in Hani i Elezit air dryer of Grimm 180 was broken. In AQMS in Prizren, there is no of SO_2 analyzer. Ms. Letafete and 2 staff from KHMI attended the wrap-up meeting.
June 8 (Fri)	In AQMS in KHMI, as a trial SO_2 analyzer was calibrated by using the calibrator (SG741) provided by JICA.	KHMI:1

Photo 3-12 Scheduling meeting and inspection of the AQMS in Obiliq

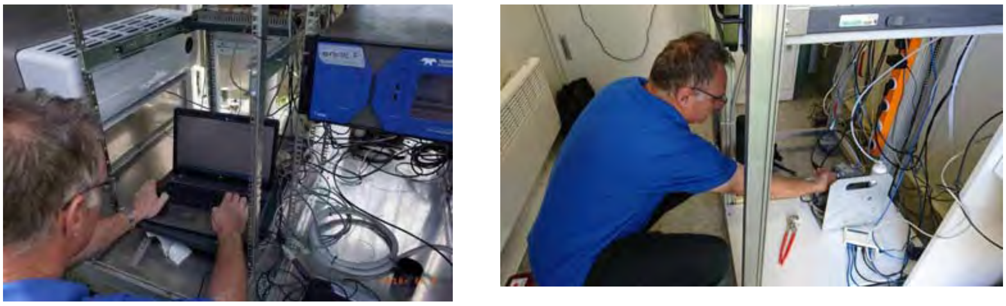


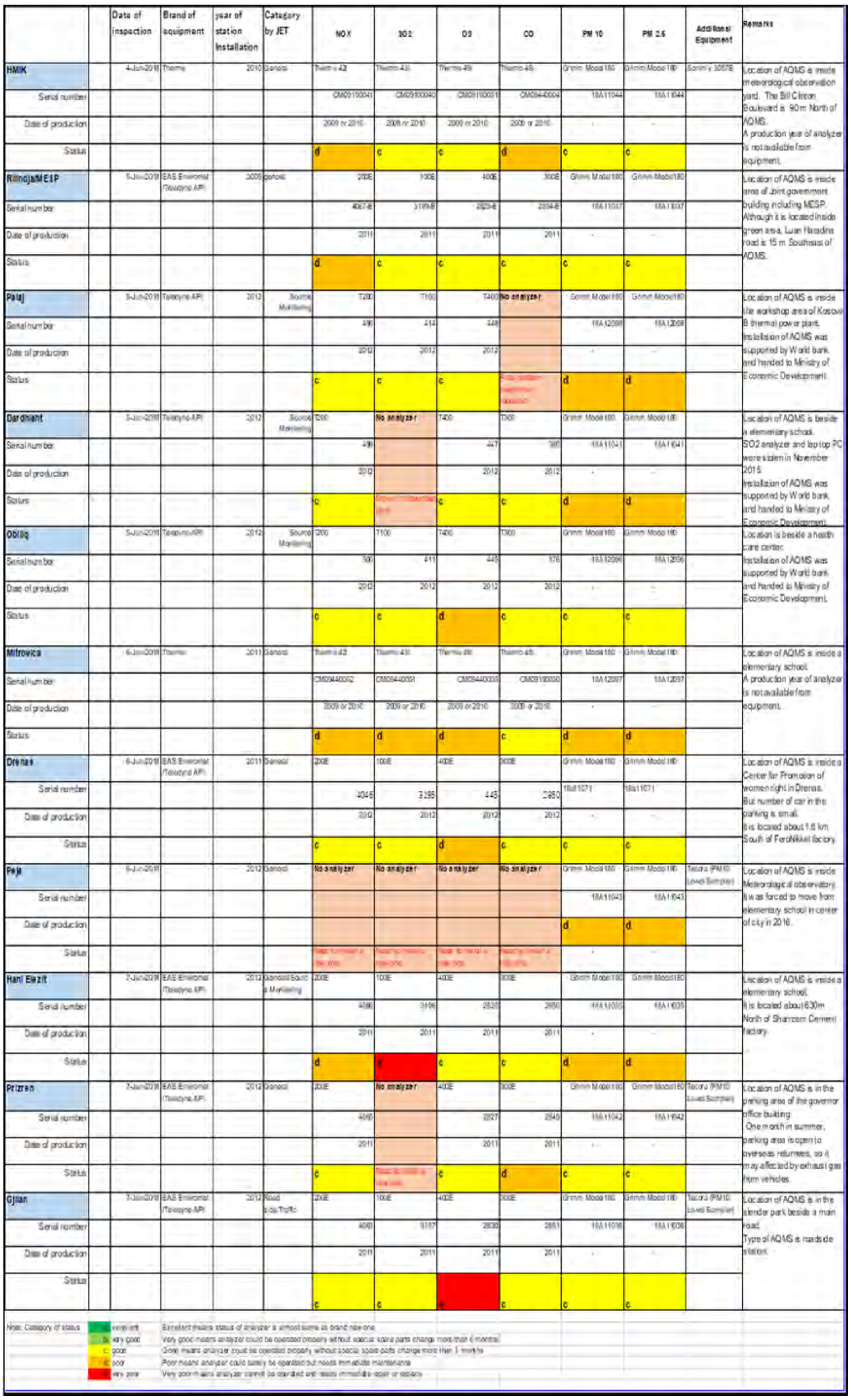
Photo 3-13 Inspection on the current status of AQMS

The result of the inspection of AQMSs is attached in Appendix-1 “Second Period: 3-2)-1 Summary of Air Quality Monitoring Station Inspection all over Kosovo”. The summary is shown in Table 3-65. The state of the analyzers at the time of the inspection was ranked through the evaluation.

2) Rehabilitation of analyzers in five (5) AQMSs in the Pristina area

The Project conducted the rehabilitation of analyzers in five AQMSs in Pristina area in the second period from May to June 2019. All analyzers from five AQMSs were moved to the KHMI laboratory room and overhauled by the procedures of cleaning, disassembly, parts replacement, reassembly and the function confirmation. After reassembling the analyzer, zero/span check was performed at KHMI, analyzers were installed again at AQMSs, warmed up for more than 24 hours, and then multipoint calibration was performed. In addition, out of the five AQMSs in the Pristina area three of them included the work of replacing their small housings with larger ones. Because of the small housings, there was no space for the person in charge to work inside the AQMS, so the maintenance work had to be performed with an open door. During the rainy weather, the rain entered the AQMS and the maintenance work could not be performed. Due to the small space in the housing, there was a serious problem with the temperature rise inside the housing as it became high in summer and the analyzers stopped due to overheating. These defects have been resolved with the installation of large housings with high heat insulation performance and large capacity air conditioners.

Table 3-65 Summary of the AQMSs inspection results



		Date of inspection	Brand of equipment	year of station Installation	Category by JET	NOX	SO2	O3	CO	PM 10	PM 2.5	Additional Equipment	Remarks
HMIK		4-Jun-2018	Thermo	2010	General	Thermo 42	Thermo 43	Thermo 49	Thermo 48	Grimm Model 180	Grimm Model 180	Sonimix 3067B	Location of AQMS is inside meteorological observation yard. The Bill Clinton Boulevard is 90m North of AQMS. A production year of analyzer is not available from equipment.
Serial number						CM09190041	CM09190040	CM09190051	CM09440004	18A11044	18A11044		
Date of production						2009 or 2010	2009 or 2010	2009 or 2010	2009 or 2010	-	-		
Status						d	c	c	d	c	c		
Rilindja/MESP		5-Jun-2018	EAS Enviromet /Teledyne API	2006	General	200E	100E	400E	300E	Grimm Model 180	Grimm Model 180		Location of AQMS is inside area of Joint government building including MESP. Although it is located inside green area, Luan Haradina road is 15 m Southeast of AQMS.
Serial number						4067-E	3199-E	2829-E	2894-E	18A11037	18A11037		
Date of production						2011	2011	2011	2011	-	-		
Status						d	c	c	c	c	c		
Palaj		5-Jun-2018	Teledyne API	2012	Source Monitoring	T200	T100	T400	**No analyzer**	Grimm Model 180	Grimm Model 180		Location of AQMS is inside the workshop area of Kosova B thermal power plant. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Serial number						490	414	448		18A12098	18A12098		
Date of production						2012	2012	2012		-	-		
Status						c	c	c	[illegible]	d	d		
Dardhisht		5-Jun-2018	Teledyne API	2012	Source Monitoring	T200	**No analyzer**	T400	T300	Grimm Model 180	Grimm Model 180		Location of AQMS is beside a elementary school. SO2 analyzer and laptop PC were stolen in November 2015. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Serial number						490		447	380	18A11041	18A11041		
Date of production						2012		2012	2012	-	-		
Status						c	[illegible]	c	c	d	d		
Obiliq		5-Jun-2018	Teledyne API	2012	Source Monitoring	T200	T100	T400	T300	Grimm Model 180	Grimm Model 180		Location is beside a health care center. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Serial number						500	411	445	376	18A12096	18A12096		
Date of production						2012	2012	2012	2012	-	-		
Status						c	c	d	c	c	c		
Mitrovica		6-Jun-2018	Thermo	2011	General	Thermo 42	Thermo 43	Thermo 49	Thermo 48	Grimm Model 180	Grimm Model 180		Location of AQMS is inside a elementary school. A production year of analyzer is not available from equipment.
Serial number						CM09440052	CM09440051	CM09440003	CM09190050	18A12097	18A12097		
Date of production						2009 or 2010	2009 or 2010	2009 or 2010	2009 or 2010	-	-		
Status						d	d	d	c	d	d		
Drenas		6-Jun-2018	EAS Enviromet /Teledyne API	2011	General	200E	100E	400E	300E	Grimm Model 180	Grimm Model 180		Location of AQMS is inside a Center for Promotion of women right in Drenas. But number of car in the parking is small. It is located about 1.6 km South of FeroNikkel factory.
Serial number						4045	3196	445	2850	18A11071	18A11071		
Date of production						2012	2012	2012	2012	-	-		
Status						c	c	d	c	c	c		
Peja		6-Jun-2018		2012	General	**No analyzer**	**No analyzer**	**No analyzer**	**No analyzer**	Grimm Model 180	Grimm Model 180	Tecora (PM10 Lowd Sampler)	Location of AQMS is inside Meteorological observatory. It was forced to move from elementary school in center of city in 2016.
Serial number										18A11043	18A11043		
Date of production										d	d		
Status						[illegible]	[illegible]	[illegible]	[illegible]	-	-		
Hani Elezit		7-Jun-2018	EAS Enviromet /Teledyne API	2012	General/Source Monitoring	200E	100E	400E	300E	Grimm Model 180	Grimm Model 180		Location of AQMS is inside a elementary school. It is located about 630m North of Sharrcem Cement factory.
Serial number						4080	3196	2820	2850	18A11035	18A11035		
Date of production						2011	2011	2011	2011	-	-		
Status						d	e	c	c	d	d		
Prizren		7-Jun-2018	EAS Enviromet /Teledyne API	2012	General	200E	**No analyzer**	400E	300E	Grimm Model 180	Grimm Model 180	Tecora (PM10 Lowd Sampler)	Location of AQMS is in the parking area of the governor office building. One month in summer, parking area is open to overseas returnees, so it may affected by exhaust gas from vehicles.
Serial number						4060		2827	2849	18A11042	18A11042		
Date of production						2011		2011	2011	-	-		
Status						c	[illegible]	c	d	c	c		
Gjilan		7-Jun-2018	EAS Enviromet /Teledyne API	2012	Road side/Traffic	200E	100E	400E	300E	Grimm Model 180	Grimm Model 180	Tecora (PM10 Lowd Sampler)	Location of AQMS is in the slender park beside a main road. Type of AQMS is roadside station.
Serial number						4060	3197	2830	2851	18A11036	18A11036		
Date of production						2011	2011	2011	2011	-	-		
Status						c	c	e	c	c	c		

Note: Category of status

a	excellent	Excellent means status of analyzer is almost same as brand new one
b	very good	Very good means analyzer could be operated properly without special spare parts change more than 6 months
c	good	Good means analyzer could be operated properly without special spare parts change more than 3 months
d	poor	Poor means analyzer could barely be operated but needs immediate maintenance
e	very poor	Very poor means analyzer cannot be operated and needs immediate repair or replace

Rehabilitation is essentially an analyzer overhaul. Two staff from KHMI in charge of air quality management participated in these works all the time, and experienced the procedure of overhaul and acquired the knowledge and skills for repairs, which is also necessary for daily maintenance. Disassembling, cleaning and replacement of deteriorated parts of NO_X, SO_2, O_3 and CO analyzers and cleaning of the cell with solvent were conducted. This was the first experience of a kind for two staff in charge. It was also required to prepare replacement parts, equipment, schedule management etc. for the next overhaul work. It was good opportunity for capacity development.

In addition to the overhaul of the analyzer, KHMI staffs also cleaned the manifold (a device that distributes the sampled air to each analyzer) and the Teflon tubes in the AQMSs. The inner walls of both the manifold and the Teflon tube were extremely dirty and had not been cleaned for a long time. As described in Appendix-1 "Third period: 3-3) -1 AQMS Maintenance Manual ", they have to be cleaned once a year from now on.

Table 3-66 Activities: Rehabilitation of analyzers in 5 AQMS and replacement of 3 housings

Date	Activity	Reference
Year 2019, second period		
April 30 (Tue)	Analyzers in AQMS (Obiliq, Dardhishte, Palaj) were moved to KHMI	JET, C/P was under training of Ion Chromatography
May 2 (Thu)	Removal and movement of three housings to KHMI (Obiliq, Dardhishte, Palaj)	KHMI: 2
May 3 (Fri)	Foundation construction (Obiliq, Dardhishte)	Witnessed by JET
May 6 (Mon)	Foundation construction (Palaj)	Witnessed by JET
May 7 (Tue)	Completion of foundation work (Obiliq, Dardhishte, Palaj)	Witnessed by JET
May 10 (Fri)	Inspection of Spare parts and consumables delivery from Austria	JET
May 13 (Mon)	Rehabilitation work Scheduling of rehabilitation work and OJT	JET
May 15 (Wed)	Starting analyzer rehabilitation and OJT, new housings preparation in warehouse	KHMI: 2
May 16 (Thu)	Analyzer rehabilitation and OJT, new housings preparation in warehouse	KHMI: 2
May 17 (Fri)	Analyzer rehabilitation and OJT, new housing delivery to Dardhishte	KHMI: 2
May 18 (Sat)	Analyzer rehabilitation and OJT, new housing delivery to Obiliq	KHMI: 2
May 20 (Mon)	Analyzer rehabilitation and OJT, Zero calibration for NO_X, O_3, SO_2 and CO analyzers in Obiliq, Dardhishte, MESPI/MESP/Rilindja	KHMI: 2
May 21 (Tue)	Multi points calibration for analyzers in AQMS (KHMI) and OJT, housing delivery to Palaj	KHMI: 2
May 22 (Wed)	Multi points calibration of analyzers in AQMS (Palaj) and OJT	KHMI: 2
May 23 (Thu)	Analyzers rehabilitation of AQMS, O_3 analyzer calibration (KHMI) and OJT	KHMI: 2
May 24 (Fri)	Wrap-up of Analyzer rehabilitation, Q &	KHMI: 2

	A, repair of ventilator for gas sampling (KHMI)	
May 27 (Mon)	Inspection of housing construction and correction request (Obiliq, Dardhishte)	Witnessed by JET
May 28 (Tue)	Fence installation (Palaj)	Witnessed by JET
May 29 (Wed)	Fence installation (Palaj) Inspection of AQMS renewal (Obiliq, Dardhishte)	Witnessed by JET
May 30 (Thu)	Inspection of fence installation (Palaj) Hand-over of keys for three AQMS housings to JET from the contractor	Witnessed by JET
June 3 (Mon)	Hand-over of keys for three AQMS housings to KHMI from JET	KHMI: 2 and Head of Institute

Photo 3-14 Concrete foundation construction and replacement of housings

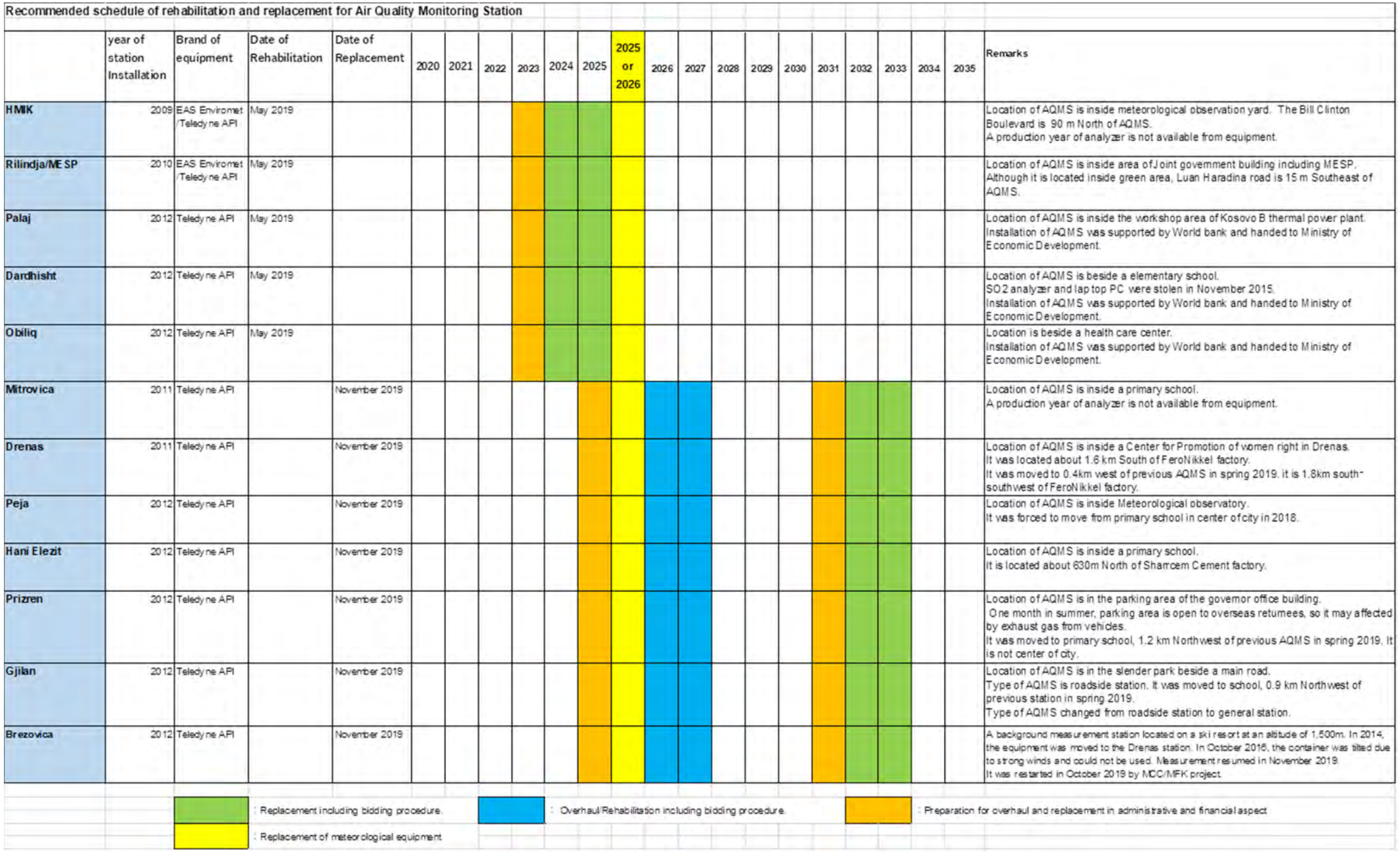
Photo 3-15 Analyzer rehabilitation and sampling tube (Teflon tube) cleaning

Detailed report of the rehabilitation work is attached in Appendix-1 "Second Period: 3-2) -4, Rehabilitation of AQMS in the Prishtina Area" and detailed report of the housing replacement is attached in Appendix-1 " Second Period: 3-2)- 3, Housing replacement for 3 (three) AQMSs in the Prishtina Area”.

Rehabilitation should be conducted in 7 to 8 years after the installation or rehabilitation of the analyzers. It is necessary to replace them within about 12 years after the installation or rehabilitation. In addition, it is desirable to replace the meteorological equipment after five years because the validity period of the certification is usually five years.

The recommended rehabilitation and replacement schedule are shown in Table 3-67.

Table 3-67 Recommended rehabilitation and replacement schedule



Recommended schedule of rehabilitation and replacement for Air Quality Monitoring Station

	year of station Installation	Brand of equipment	Date of Rehabilitation	Date of Replacement	2020	2021	2022	2023	2024	2025	2025 or 2026	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Remarks
HMIK	2009	EAS Environmet /Teledyne API	May 2019					🟧	🟩	🟩	🟨											Location of AQMS is inside meteorological observation yard. The Bill Clinton Boulevard is 90 m North of AQMS. A production year of analyzer is not available from equipment.
Rilindja/MESP	2010	EAS Environmet /Teledyne API	May 2019					🟧	🟩	🟩	🟨											Location of AQMS is inside area of Joint government building including MESP. Although it is located inside green area, Luan Haradina road is 15 m Southeast of AQMS.
Palaj	2012	Teledyne API	May 2019					🟧	🟩	🟩	🟨											Location of AQMS is inside the workshop area of Kosovo B thermal power plant. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Dardhisht	2012	Teledyne API	May 2019					🟧	🟩	🟩	🟨											Location of AQMS is beside a elementary school. SO2 analyzer and lap top PC were stolen in November 2015. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Obiliq	2012	Teledyne API	May 2019					🟧	🟩	🟩	🟨											Location is beside a health care center. Installation of AQMS was supported by World bank and handed to Ministry of Economic Development.
Mitrovica	2011	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is inside a primary school. A production year of analyzer is not available from equipment.
Drenas	2011	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is inside a Center for Promotion of women right in Drenas. It was located about 1.6 km South of FeroNikkel factory. It was moved to 0.4km west of previous AQMS in spring 2019. it is 1.8km south-southwest of FeroNikkel factory.
Peja	2012	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is inside Meteorological observatory. It was forced to move from primary school in center of city in 2018.
Hani Elezit	2012	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is inside a primary school. It is located about 630m North of Sharrcem Cement factory.
Prizren	2012	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is in the parking area of the governor office building. One month in summer, parking area is open to overseas returnees, so it may affected by exhaust gas from vehicles. It was moved to primary school, 1.2 km Northwest of previous AQMS in spring 2019. It is not center of city.
Gjilan	2012	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			Location of AQMS is in the slender park beside a main road. Type of AQMS is roadside station. It was moved to school, 0.9 km Northwest of previous station in spring 2019. Type of AQMS changed from roadside station to general station.
Brezovica	2012	Teledyne API		November 2019						🟧	🟨	🟦	🟦				🟧	🟩	🟩			A background measurement station located on a ski resort at an altitude of 1,500m. In 2014, the equipment was moved to the Drenas station. In October 2016, the container was tilted due to strong winds and could not be used. Measurement resumed in November 2019. It was restarted in October 2019 by MCC/MFK project.

🟩 : Replacement including bidding procedure.
🟦 : Overhaul/Rehabilitation including bidding procedure.
🟧 : Preparation for overhaul and replacement in administrative and financial aspect
🟨 : Replacement of meteorological equipment

3) Calibration of analyzers

Details of calibration are attached in Appendix-1 "Third period: 3-3) -1 AQMS Maintenance Manual". Basically, it follows EU standards.

KHMI is responsible for the maintenance of AQMSs in Kosovo and for O&M of AQMSs in Kosovo. When analyzers and equipment were brought by EU from 2011 to 2012, the standard gas dilutor (with a built-in zero gas generator and O_3 generator) was included, but it has not been used by the KHMI staff. According to the KHMI staff, no training was given on how to use it.

The NO_X analyzer and SO_2 analyzer installed in AQMSs in Kosovo have built-in standard gas generators called permeation tube that can generate NO_2 gas and SO_2 gas, respectively. Previously, KHMI used this method for calibration of analyzers. However, the permeation tube method is not suitable for calibration, but it can be used to check the operation and function of the analyzer because the generated gas concentration fluctuates by about 15%. The O_3 analyzer[21] has never been calibrated since the installation. The CO analyzer had been calibrated by the gas from the CO standard gas cylinder brought in 2012, but it has not been calibrated after the CO gas in the cylinder was exhausted. In the Project, one standard gas calibrator (with built-in zero gas generator and O_3 generator) and five sets of standard gases consisting of NO, SO_2 and CO cylinder were provided for five stations in Pristina area, and the training for calibration was conducted.

O&M of AQMS for all 12 stations is conducted by persons in charge in KHMI and/or contracted private company, which is determined by bidding annually. At present, maintenance companies in Kosovo do not have the ability to properly calibrate NO_X, SO_2, O_3 and CO analyzers. Engineers were called from Austrian or Slovenian agencies to conduct some more advanced repairs and calibrations. As a result of the training conducted for the KHMI staff in the second and third period, the KHMI staff acquired the ability to conduct calibration. From now on, it is necessary for KHMI staff to instruct the contractor and calibrate analyzers together. It is desirable to transfer the technology to the contractor, so that the engineer of the contractor can also conduct the calibration.

The calibration frequency according to the EU standard is once every two weeks for zero-span check and once every three months for multipoint calibration. The time required for four types of analyzers is about 4 hours for zero/span check and about 6 to

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[21] Standard method for calibration of O_3 analyzer is the traceability system which makes Standard Reference Photometer as the first standard method. The second and the third standard method are established domestically, and the calibration is conducted by calibrating O_3 analyzer with the third standard method. In Japan, the standard method is moved from the Gas phase titration (GTP) to the traceability system which makes Standard Reference Photometer by the U.S. National Institute of Standards and Technology as the first standard. In the manual for continuous measurement of air by the Ministry of Environment (the sixth edition), GPT is stipulated in JIS B 7957 Annex-3. The method is described to be able to be used for the confirmation method of the sensitivity of the standard analyzer in municipalities, although it is not used to evaluate the sensitivity of the standard analyzer. The system of traceability for O_3 is has been established in only eighteen countries in the world as of May 2018. Therefore, the Project uses Gas Phase Titration method (GTP) for calibration of O_3 analyzer as the next second best method by using SG-471 provided by the Project.

7 hours for multipoint calibration, and it will take the whole day to calibrate just one station.

In addition, two C/Ps in charge of AQMSs at KHMI are not dedicated only for O&M of AQMSs, but also to perform soil monitoring, etc., attend the workshops, meetings, etc. Considering these conditions, it is not possible to carry out the calibration at the frequency stipulated by the EU standard. For the time being, it has been recommended for the frequency to be cut in half as shown in Table 3-68.

In the near future, it is advisable to switch to the frequency stipulated by the EU standard of the calibration, which requires the addition of at least one dedicated AQMSs maintenance staff.

Table 3-68 Recommended calibration frequency as the first step

Air pollutants	EU Standard	Zero/Span check	Multipoint calibration
NOx	BS EN 14211, 2012	Every four weeks	Every six months
SO_2	BS EN 14212, 2012	Every four weeks	Every six months
O_3	BS EN 14625, 2012	Every four weeks	Every six months
CO	BS EN 14626, 2012	Every four weeks	Every six months

The training for analyzer calibration started in January 2019, prior to the implementation of rehabilitation of analyzers. The training activities for analyzer calibration for O&M are shown in Table 3-69.

The Project made the training as practically as possible in order to meet the needs of C/P, such as checking for failures as well as calibration mainly through OJT. For example, the standard gases for calibration and the calibrator were carried into the AQMS when abnormality appeared in the analyzer, and then the calibration was performed.

During the rehabilitation in May 2019, the overhauled analyzers were taken back to the AQMS. After the reinstallation, they were warmed up, and then zero-point adjustment and multipoint calibration were conducted together with C/P. As a result, C/P has accumulated a lot of experience.

Table 3-69 Activities: Calibration and O&M

Date	Activities	Remarks
Second period		
Jan. 16 (Wed), 2019	NOx analyzer calibration by using calibrator (SG-741)	KHMI: 3
Jan. 18 (Fri), 2019	CO analyzer calibration by using calibrator (SG-741)	KHMI: 1
Jan. 21 (Mon), 2019	NOx analyzer calibration by using calibrator (SG-741) for trouble shooting at calibration laboratory in KHMI.	By JET

Jan. 22 (Tue), 2019	SO_2 analyzer calibration by using calibrator (SG-741)	KHMI: 1
Jan. 30 (Wed), 2019	NOx analyzer calibration OJT by using calibrator (SG-741) at AQMS (Hani i Elezit)	KHMI:2
Apr. 15 (Mon), 2019	Training for cleaning sampling tube (OJT)	KHMI: 2
Apr. 18 (Thu), 2019	On site calibration training by using calibrator and standard gas cylinders at AQMS (Obiliq)	KHMI: 2
Apr. 23 (Tue), 2019	NO_X and O_3 analyzer calibration training by GPT (Gas Phase Titration) at calibration laboratory (KHMI)	KHMI: 2
Apr. 25 (Thu), 2019	On site calibration training for CO, SO_2, NO_X and O_3 analyzers by using calibrator (SG-741) and standard gas cylinders at AQMS (Prizren)	KHMI: 2
Apr. 26 (Fri), 2019	Training on converter efficiency calculation of NO_X analyzer by GPT (KHMI)	KHMI: 2
Jun. 10 (Mon), 2019	Zero calibration of NO_X analyzer for trouble shooting, (MESPI/MESP/Rilindja)	KHMI: 2
Jun. 11 (Tue)	NO_X analyzer calibration and SO_2 analyzer zero calibration, OJT (MESPI/MESP/Rilindja)	KHMI: 1
Jun. 12 (Wed)	NO_X analyzer calibration (GPT), O_3 analyzer calibration and SO_2 analyzer calibration OJT by using calibrator (SG-741) and standard gas cylinders at AQMS (MESPI/MESP/Rilindja)	KHMI: 2
Jun. 14 (Fri)	Trouble shooting for NO_X analyzer (MESPI/MESP/Rilindja)	KHMI: 1
Third period		
Nov. 13(Wed), 2019	Lectures on air quality monitoring activities*1)	KHMI: 2

*1) Lectures conducted were as follows

- It is essential to conduct regular zero-span checks and keep the records. The frequency of zero/span check is recommended, and the recording sheets were shared with KHMI
  Zero/span check: once every four weeks
  Multipoint calibration: once every 6 months
- Data management: Introduction of the Japanese example in regards to the data management was lectured. As checking points necessary for data confirmation, the importance of comparing the measured values with the maintenance records of analyzers in each AQMS was lectured in order to find anomalies such as continuous very low concentration values, continuous zero values, interruption in measurement, zero drift and span drift, and to confirm the relationship with weather, the relationship with nearby stations, etc.

4) O&M for AQMSs

The O&M manual is attached in Appendix-1 "Third period: 3-3) -1 AQMSs Maintenance Manual". Examples are shown as follows.

The role division between KHMI and the contractor and the frequency of each work are described in AQMSs maintenance manual. O&M of AQMSs is jointly conducted by the C/P from KHMI and the maintenance company that has been entrusted with the work each year. The role division is shown in Table 3-70. The workflow and its frequency are shown in Table 3-71.

Table 3-70 Role assignment between KHMI and contractor

KHMI	Contractor	Frequency
Preparation of checking plan for AQMS		Every year
	AQMS inspection, cleaning, filling out checklist	Every 2 weeks
	Replace dust filter	Every 2 weeks or monthly
	Zero/Span check	monthly
	Leak check, flow calibration	Every 2 months
Multi-point calibration	Multi-point calibration	Every 6 months
Checking the remote data Checking for abnormal or invalid data		Every day
Notifying the contractor of the occurrence of abnormal values		As needed
Response to abnormal data occurrence Checking AQMS	Response to abnormal data occurrence, Checking AQMS	As needed with contractor
	Troubleshooting (If necessary, contact EAS Envimet or Altes)	As needed
	Submission of the troubleshooting report	As needed
Preparation, submission of measurement weekly report		Every week
Supervision of contractors		As needed

Table 3-71 Workflow at KHMI and AQMSs

Frequency/Timing of maintenance	Workflow at KHMI	Workflow at AQMSs
Every morning	・ Checking remote data. ・ Checking for abnormal or invalid data. ・ Checking for warning messages from 12 AQMS. ・ Supervision of the contractor.	・ Communication with staff in KHMI.
Every week	・ Preparation, submission of measurement weekly report to MESPI/MESP	
Every two weeks		・ AQMS inspection, cleaning, filling out checklist. ・ Replace dust filter depending on dust level. ・ AQMS inspection, cleaning, filling out checklist.
Every month		・ Replace dust filter depending on dust

		level ・ Zero/Span check ・ Pressure calibration ・ Fan filter cleaning ・ Leakage test (internal pump) ・ Flow calibration ・ Pressure sensor check
Every 6 months		・ Multi-point calibration
Every year	・ Preparation of checking plan for AQMS.	・ Change or cleaning of the sampling lines between manifold and inlet of analyzer. ・ DFU filter replacement
Every service or repair		・ Zero/span calibration ・ Pressure calibration ・ Flow calibration
As needed	・ Notifying the contractor of the occurrence of abnormal values. ・ Troubleshooting If necessary, contact official distributer of manufacturer	・ Response to abnormal data occurrence ・ Checking AQMS

(2) Data management

Table 3-72 shows the list of necessary items for running AQMS sustainably and its existing conditions. The Project, in collaboration with MCC/MFK, carried out the improvement of air quality data monitoring and collection system centering on the rehabilitation of analyzers in AQMSs, and established the system to provide accurate data. It has reached the stage of “3. Establishment of continuous air quality monitoring system”, but it is required to establish “4. Air quality data management” from now onwards.

Table 3-72 Present condition and items for AQMS appropriate and sustainable operation from now onwards

Stage of activities for establishment of air quality management[*1)]	Supporting activities and/or conditions at the end of the Project period	Remarks and/or future activities etc.
1. Optimization of AQMS facility and placement AQMSs are placed in order to efficiently achieve the purposes that are continuous understanding of air pollution condition at designated area, contribution of each emission source to air pollution, identification of high polluted area, evaluation of the effect by air control measures, etc.		
1) Number and placement of AQMSs	Continue the status quo Proposal of appropriate placement of AQMSs	Study of additional placement and/or movement of AQMSs based on the dispersion simulation results
2) Replacement of AQMS housings	Implementation of upsizing of three AQMSs housings in the Pristina area	Improvement of maintenance environment for maintenance of analyzers by upsizing of AQMS housings (Realization of sustainable operation)

2. <u>Air quality analyzers and Operation and maintenance (O&M)</u> In order to implement appropriate continuous air quality monitoring, not only understanding of measurement principles and configurations of analyzers but also technologies such as daily maintenance works, calibration skills for securing measurement precisions, etc. are required. It is necessary to maintain analyzers properly and to keep measurement precisions based on knowledges mentioned above.		
1) Implementation of rehabilitation of analyzers	JICA: Implementation of rehabilitation of analyzers for five AQMSs in the Pristina area. Replacement of analyzers for other seven AQMSs in Kosovo by MCC/MFK. Installation of meteorological instruments for all AQMSs by MCC/MFK	Proper operation and maintenance for all analyzers needs to be sustained.
2) O&M management system	Continue the status quo, KHMI contracts the maintenance company	KHMI requires reinforcement of staff for improvement. Capacity development of maintenance company is required.
3) Organization of management record	Strengthening of management by KHMI Support for drafting O&M management plan and replacement plan	Schedule, O&M records, analyzer maintenance records, analyzer histories, AQMS maintenance reports, etc. are required
4) Maintenance of analyzers	The introduction of the calibration instrument and calibration training. Finalization of SOP for analyzer calibration and manual for O&M of analyzers Starting to use the zero/span check record	Sustaining operation and maintenance work as scheduled. Continuation of analyzer calibration activity using span gas and calibrator is required.
3. <u>Establishment of continuous air quality monitoring system</u> Continuous air quality monitoring system functions efficiently for taking spontaneous necessary measures for emergency situations affecting human health, informing actual air pollution condition to the public through internet, etc. by knowing real time situation of air pollution condition.		
1) Establishment of the system	MCC/MFK constructed AQMS data network and store data in the same server from all AQMSs in Kosovo	Implementation of data check, analysis of data through data stored in the server. Air pollution alarms, etc. should be considered.
4. <u>Air quality data management</u> Continuous air quality monitoring is necessary to secure high quality data storage as well as have continuity. Therefore, analyzers require maintenance. However, measurement data may have abnormality because of analyzer failure etc. and it is necessary to delete these data.		
1) Finalization of measurement data	Continue the status quo (finalized by the person in charge in KHMI)	Daily check, consideration of O&M records into data, data screening, treatment of abnormal

	The Project introduced the finalization procedure in Japan	data and data deleting procedure, data correcting method, etc. (reinforcement of staff is inevitable)
2) Preservation of the measurement data	Preservation of the measurement data through MCC/MFK network (all data including meteorological data)	It is necessary to preserve raw measured data as well as settled data through the procedure of 1) Finalization of measurement data
3) Treatment of measurement data	Continue the status quo (treated by the person in charge in KHMI)	Finalization of hourly, maximum daily 8 hours mean, daily, monthly and annual mean data
4) Provision of data	Continue the status quo	Publishing of reports including statistical data, etc. after finalization of data.

*1) Stage of activities: Preparing the stages referring to chapters of “Continuous air quality monitoring manual (the sixth edition)” (tentative name) from Ministry of Environment in Japan.

1) Examples of data problems

Regarding AQMS data management, specific problems such as data abnormality, inappropriate data processing, etc. are found in the study of the second period. Concrete examples are as follows.

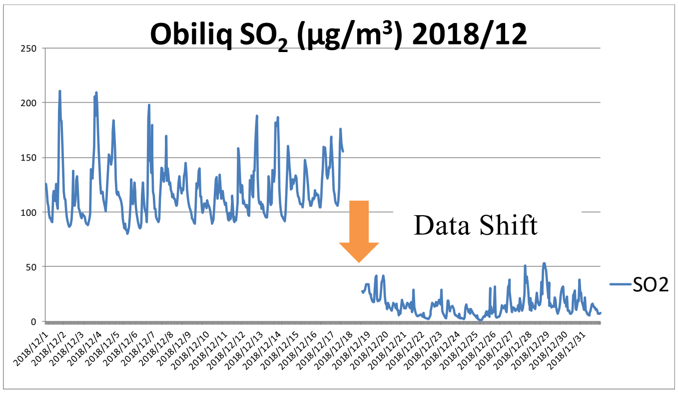
1) Inappropriate treatment of analyzer abnormality

After the analyzer rehabilitation work completed in June 2019, abnormality was found in the data of two analyzers (Pristina/Rilindja NOx analyzer and Pristina/KHMI O_3 analyzer). These analyzers continuously showed negative values, which means that they have problems. The cause of the failure in O_3 analyzer in KHMI AQMS was the filter holder and Project repaired it by changing the parts. The cause of the failure in the NO_X analyzer in Rilindja AQMS, which also had a problem, was the flow passage of the sampling gas line, and this analyzer was sent to the responsible agency in Austria for repair.

Two C/Ps in charge from KHMI participated in these activities which were conducted as one of the training for trouble shooting for analyzers. These problems can be found by the person in charge by checking the measurement data of each AQMS every morning as described in Table 3-72.

i) Zero drift

The inspection of the past air quality monitoring data showed the data shift, shown in Figure 3-13. In the figure, SO_2 data largely shifted in December in 2018. The cause of the data shift was presumed to be caused by analyzer calibration work. However, since there was no record of calibration work, contents of the work and condition of the analyzer before and after calibration were unknown. Therefore, the reliability of the data was greatly damaged.



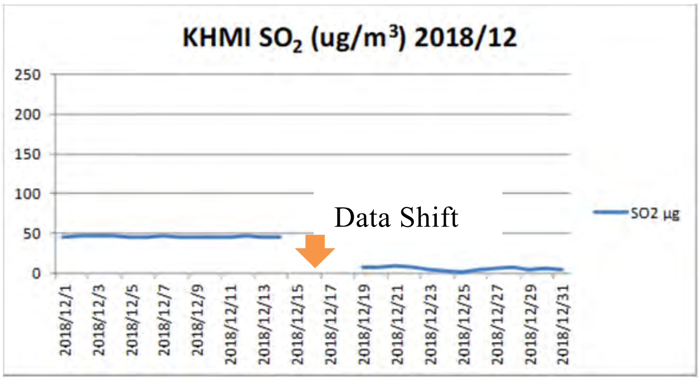


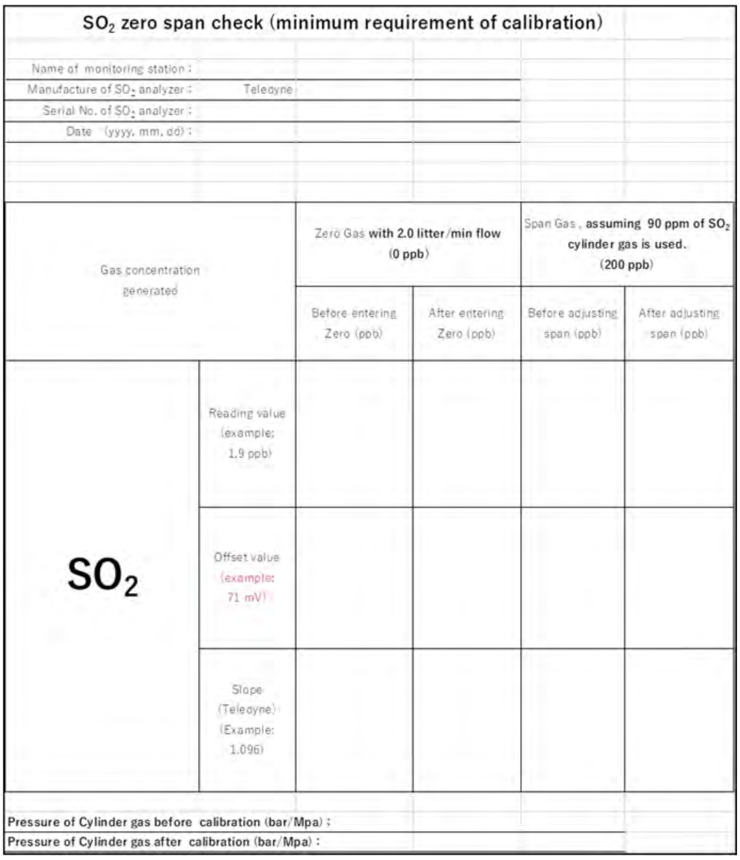
Figure 3-13 Examples of zero drift

In the above example, it is considered that the zero point was adjusted and then the measurement data were lowered. If there is a record of the concentration (ppb or µg/m^3) that was adjusted before and after the zero-point adjustment, the data could be corrected and it is possible to use for calculation of statistical data, analysis and study of the air quality data and validation of air quality simulation results.

The AQMS maintenance manual clearly describes how to keep the record of zero/span check and multipoint calibration. The SO_2 zero/span check sheet is shown in Table 3-73. When conducting a zero-span check about every four weeks, the following items must be completed and recorded in the sheet and be stored.

- Date and time
- AQMS name (location)
- Serial number of analyzer
- Reading value (ppb) of zero gas before and after zero adjustment (plus offset value and slope value)
- Reading value (ppb) of span gas before and after span adjustment (plus offset value and slope value)

Table 3-73 Zero/Span check sheet



SO_2 zero span check (minimum requirement of calibration)

Name of monitoring station :
Manufacture of SO_2 analyzer : Teledyne
Serial No. of SO_2 analyzer :
Date (yyyy. mm. dd) :

Gas concentration generated		Zero Gas **with 2.0 litter/min flow (0 ppb)**		Span Gas , **assuming 90 ppm of SO_2 cylinder gas is used. (200 ppb)**	
		Before entering Zero (ppb)	After entering Zero (ppb)	Before adjusting span (ppb)	After adjusting span (ppb)
SO_2	Reading value (example: 1.9 ppb)				
	Offset value (example: 71 mV)				
	Slope (Teledyne) (Example: 1.096)				

Pressure of Cylinder gas before calibration (bar/Mpa) :
Pressure of Cylinder gas after calibration (bar/Mpa) :

In Figure 3-13 it is estimated that approximately 100 μg/m^3 (38 ppb) was shifted in the SO_2 analyzer in Obiliq and about 50 μg/m^3 (19 ppb) was shifted in the SO_2 analyzer in Pristina/KHMI before and after the service. If the zero/span check sheet is recorded and maintained for the zero/span check, then correction can be applied to the data before the service, and it is possible to restore the reliability of the data before the service.

As an example, the following indicates the method to correct the data in the case of zero point shifts before and after the calibration. It is assumed that zero drift occurs as shown in Figure 3-14 and the full scale is 200 ppb (526 μg /m^3). EU standard (SO_2: BS EN 14212, 2012) stipulates zero drift within ± 4.0 ppb. When the zero drift is within ±4.0 ppb for SO_2, no correction is applied. In the case that the drift occurs as a function of time, correction of the data can be made. Table 3-74 shows how to correct the data when the zero drift occurs as a function of time.

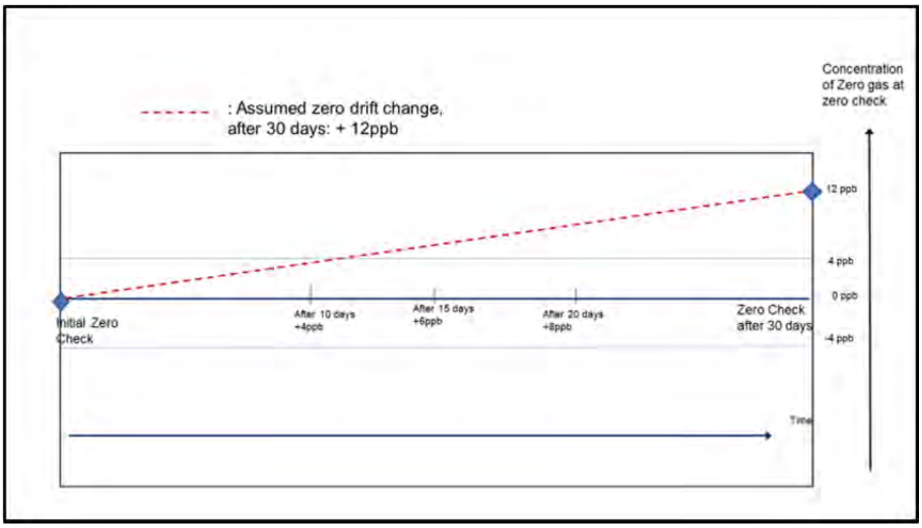


Figure 3-14 Example of zero-drift

Table 3-74 Example of correction method when the drift occurs as a function of time

	Assumed zero level (ppb)	Correction (ppb)	Data after correction
Initial zero check	0	0	Measured value
After 5 days	2	-2	Measured value -2
After 10 days	4	-4	Measured value -4
After 15 days	6	-6	Measured value -6
After 20 days	8	-8	Measured value -8
After 25 days	10	-10	Measured value -10
After 30 days	12	-12	Measured value -12

The problems mentioned above are thought to be caused by the lack of management system for air quality data. Since the procedures such as finalization of the measured data and data processing are inadequate, it is indispensable to establish data management system.

In the activities in the third period, the Project held a lecture on the data management system.

Additional activity in the third period		
Dec. 7, 2020	Seminar on air quality data management	2 C/Ps

Detailed contents are shown in the Appendix-1 other (9) “3)-4 Seminar on Air quality Data management”. In this seminar, the significance and necessity of air quality data management were introduced. Air quality data is the base for all studies related to air quality such as evaluation, analysis, etc., and the accuracy of the data is required. Data management is the system to guarantee the accuracy of the data, and it is a big issue for the Kosovo side. The establishment of the system requires experience, technologies, etc., and it is desirable to have trainings by foreign donors in the future to improve the data accuracy.

(3) Study of optimum distribution of AQMSs

"1. Optimization of AQMS facility and placement" in Table 3-72 was studied. Guideline for proper distribution of AQMSs in Kosovo is attached in Appendix-1 "Third Period: 3-2-2) AQMS Proper Distribution Guideline". The draft guidelines were prepared and according to the meeting shown in Table 3-75, and the opinions from Kosovo side were summarized as follows.

Table 3-75 Activity: Proper distribution of AQMS

Date	Activity	Remarks
Third period		
Nov. 25 (Mon), 2019	The Project heard opinions about "Guideline for proper distribution of AQMS" before the workshop were held. The Project adopted the opinion that the EU Directive 2008/50 / EC (21 May 2008) should be included in the guidelines.	KHMI: Mr. Shkumbin Shala
Nov. 25 (Mon), 2019	The Project heard opinions about "Guideline for proper distribution of AQMS" in advance to the workshop. Increasing the AQMSs number is preferable if possible, but it would be difficult without the financial support from donors.	KHMI: Ms. Letafete Latifi
Nov. 27 (Wed), 2019	The workshop on "Guideline for proper distribution of AQMS" was held, and all attendees from MESPI/MESP agreed with the original draft. Additional possible sites for AQMSs in the future have also been approved.	MESPI/MESP：4 Ministry of Internal Affairs：1 Municipality of Pristina：1
Nov. 29 (Fri), 2019	The Project reported the results of the workshop on "Guideline for proper distribution of AQMS" and listened to the opinions of C/P. The results of the workshop were accepted. The idea of prioritizing the maintenance of the current AQMSs was also accepted.	KHMI: 2: (Mr. Shkumbin Shala and Mr. Mentor Shala)
Nov. 29 (Fri), 2019	The Project reported the results of the workshop on "Guideline for proper distribution of AQMS" and listened to the opinions of C/P. The idea of prioritizing the maintenance of the current AQMSs was also accepted.	KHMI:1 (Ms. Letafete Latifi)

Firstly, EU Directive 2008/50/EC (21 May 2008) contains EU AQMS placement standards, and Kosovo meets the minimum number.

As for the placement of existing AQMSs, five AQMSs are placed for monitoring large emission sources, which are three for TPP Kosovo A and TPP Kosovo B, one for Ferro-Nickel Factory in Drenas and one for Cement factory in Hani i Elezit. The one in Drenas is 1.8km south-southwest from Ferro-Nickel factory and the one in Hani i Elezit is 0.6 km north from the cement factory, and they both work as city background stations at the same time. The AQMS in Brezovica is a back ground station located in Sharri Mountain. There are six city back ground AQMSs, which are: two in the city of Prishtina in the middle and north (the capital, the largest population), one in Prizren in the south (the second largest population), one in Peja in the west (the fourth largest population), one in Gjilan in the west (the sixth largest population) and one in Mitrovica in the north (the eighth largest population, but there is also an industrial waste landfill). These twelve AQMSs are located in good balance, and therefore, the Project did not propose any change for the placement of the existing AQMSs

The Project proposed the placement of additional AQMSs by referring to the guideline of the Ministry of Environment of Japan “Secretary-treatment standard for continuous monitoring of air pollution status”, dated on 30th August 2013.

The Project has proposed the placement of five additional AQMSs, which are: one in Ferizaj (the third largest population), one in Gjakova (the fifth largest population), and one in Fushe Kosovo (next to Prishtina, the population is increasing), and two in Prishtina in order to dissolve deviation of placement inside the Prishtina.

However, the following matters should be prioritized: To be able to secure air quality data from current 12 AQMSs, to be able to take appropriate measures for data abnormality and perform appropriate maintenance management. After these conditions are achieved, the proposed placement should be considered. The Kosovo side accepted this proposal.

Table 3-76 shows the result of the summary of information on the additional locations of AQMSs to be proposed as a plan for the future. It shows the list of the sites for future AQMSs in addition to the information of the existing AQMSs. The locations of AQMSs are shown in Figure 3-15.

Table 3-76 Proposal of Five additional AQMSs for the future

Classification	Number of existing AQMSs	Recommended No. of AQMSs	Proposed additional AQMSs	Remarks
Back ground	1	1	－	Brezovica

City background stations except Prishtina	4	7	Ferizaj Gjakova Fushe Kosovo	Ferizaj: the third largest population Gjakova: the fifth largest population Fushe Kosovo: deemed as a par Prishtina, and population is increasin
Serve as both city back ground and monitoring of specific emission sources	2	2	--	Drenas and Hani i Elezit
City back ground in Prishtina	2	4	Kodra e Trimave Lagjja e Spitalit	Eliminate the deviation of locations inside Prishtina
Monitoring of specific emission sources	3	3	--	In case of not placing additional AQMSs, relocation is possible such as a movement from Dardhishte to Fushe Kosovo, etc.
Total	12	17	5	

Note) There is one mobile station except above mentioned AQMSs.

Table 3-77 Proposal for future addition of AQMSs, with the information of the existing AQMSs

Name	Type of air quality monitoring	Installation year	Population (2011, Census)	Supplier	Analyzer overhaul	Analyzer replacement	Remarks
IHMK	Pristina urban background AQMS But Rilindja AQMS can be urban traffic AQMS due to the effect of emission from road	2009	198,897 (First in Kosovo)	EAS Environment /Teledyne API	May 2019	-	Location of AQMS is inside meteorological observation yard. The Bill Clinton Boulevard is 90m North of AQMS. The production year of analyzer is not available from the equipment.
Rilindja/MMPH		2010		EAS Environment /Teledyne API	May 2019	-	Location of AQMS is inside area of Joint government building including MESP. Although it is located inside green area, Luan Haradinaj road is 15 m Southeast of AQMS.
Kodra e Trimave		-		-	-	-	High concentration of air pollutant could be expected from topography. Elimination of bias in AQMS placement and distribute evenly.
Lagjja e Spitalit		-		-	-	-	High population density is expected. Elimination bias in AQMS placement and distribute evenly.
Palaj	Obiliq Emission source/ TTP Kosovo A &B monitoring	2012	Municipality of Obiliq 21,549	Teledyne Api	May 2019	-	Location of AQMS is inside the workshop yard of TPP Kosovo B. Installation of AQMS was supported by the World Bank and handed to Ministry of Economic Development.
Dardhishtë		2012		Teledyne Api	May 2019	-	Location of AQMS is beside the elementary school. SO_2 analyzer and laptop computer were stolen in November 2015. Installation of AQMS was supported by the World Bank and handed to Ministry of Economic Development.
Obiliq		2012		Teledyne Api	May 2019	-	Location of AQMS is beside the health care center. Installation of AQMS was supported by the World Bank and handed to Ministry of Economic Development.

Mitrovica	Urban background AQMS	2011	71,909 (Eighth in Kosovo)	Teledyne Api	-	November 2019	Location of AQMS is inside the primary school yard. The production year of analyzer is not available from the equipment.
Drenas	Urban background AQMS and emission source monitoring	2011	58,531	Teledyne Api	-	November 2019	Location of AQMS is inside the yard of the Center for Promotion of women right in Drenas. It was located about 1.6km South of Ferro-Nickel factory. It was moved to 0.4 km west from previous AQMS location in spring 2019. It is now 1.8 south-souths west of Ferro-Nickel factory.
Peja	Urban background AQMS	2012	96,450 (Fourth in Kosovo)	Teledyne Api	-	November 2019	Location of AQMS is inside the Meteorological observatory yard. KHMI was forced to move it from the primary school yard to the city center in 2016.
Hani i Elezit	Urban background AQMS and emission source monitoring	2012	9,403	Teledyne Api	-	November 2019	Location of AQMS is inside the primary school yard. It is located about 630m North of Sharrcem Cement factory.
Prizren	Urban background AQMS	2012	177,871 (Second in Kosovo)	Teledyne Api	-	November 2019	Location of AQMS is in the parking area of the Mayor office building. One month during summer, parking area is open to the overseasreturnees, so it may be affected by exhaust gas from vehicles. It was moved to the primary school yard, 1.2 km Northwest of previous AQMS location in spring 2019. It is not in the center of city.
Gjilan	Urban background AQMS	2012	90,178 (Sixth in Kosovo)	Teledyne Api	-	November 2019	Location of AQMS is in the narrow park beside the main road. Type of AQMS is Urban traffic station. It was moved to the school yard, 0.9 km Northwest of previous station location in spring 2019. Type of AQMS changed from Urban traffic to Urban background AQMS.
Brezovica	Background AQMS	2012	68	Teledyne Api	-	November 2019	A back ground measurement station located at the ski resort at an altitude of 1,500m. In 2014, the equipment was moved to the Drenas station. In October 2016, the container was tilted due the strong wind and could not be used. Measurement resumed in November 2019.
Ferizaj	Urban background AQMS	-	108,610 (Third in Kosovo)	-	-	-	It is the third largest municipality by population size. It is recommended to have AQMS.
Gjakovë	Urban background AQMS	-	94,556 (Fifth in Kosovo)	-	-	-	It is the fifth largest municipality by population size. It is recommended to have AQMS.
Fushë Kosovë	Urban background AQMS	-	34,827	-	-	-	It could be considered as a part of pristina. It is recommended to have AQMS.

🟦 ：Recommended additional AQMS

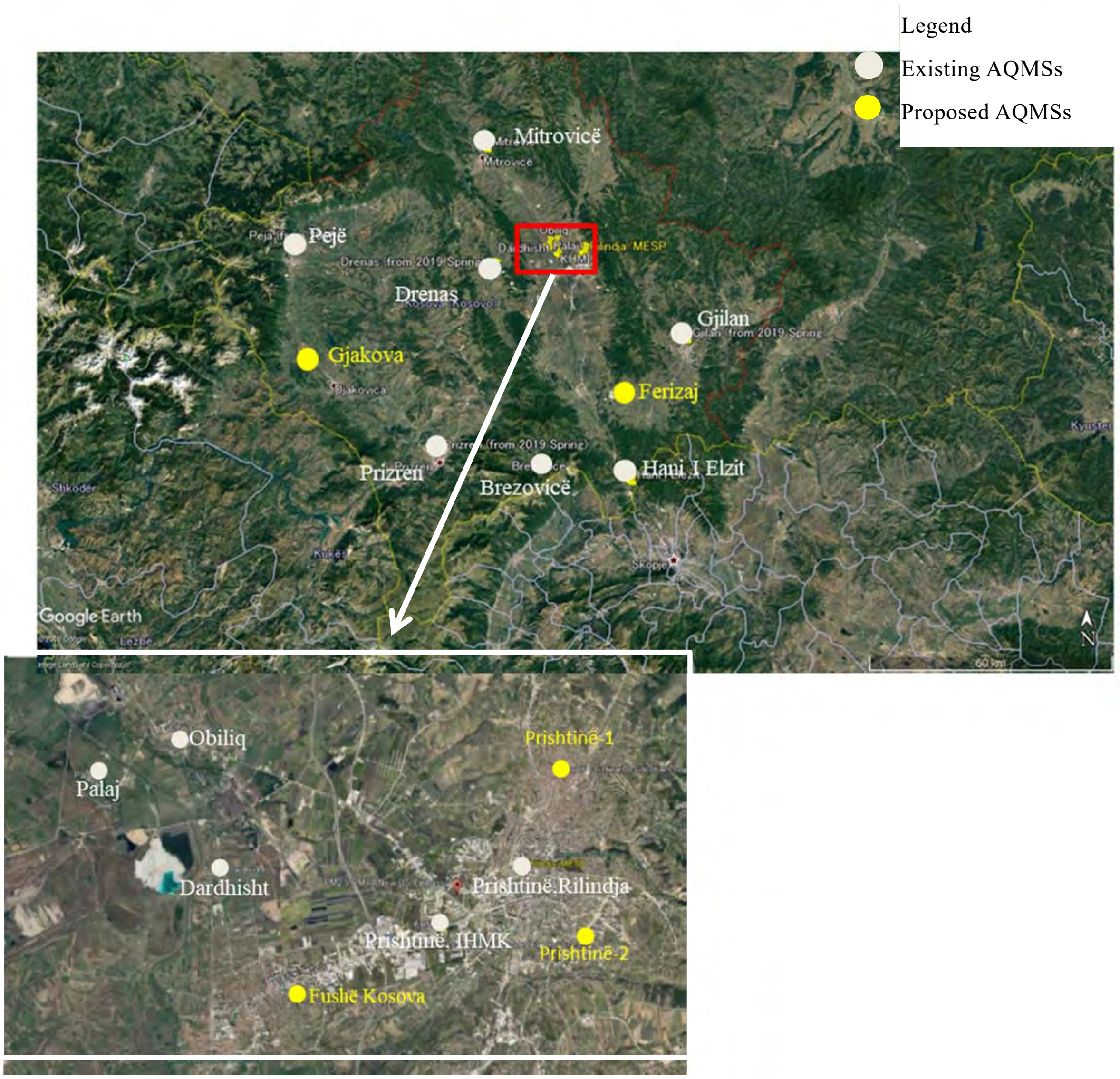


Figure 3-15 Locations of existing and proposed AQMSs

(4) Air quality measurement drill in emergency case

The SOP for measurement of ambient NO_2, SO_2, PM_{10} and $PM_{2.5}$ for emergency cases is shown in Appendix-1 “3rd period: 3-3)-2 SOP Emergency NO_2, SO_2, PM_{10} and $PM_{2.5}$”.

Air quality measurement for emergencies is to respond to accidents such as explosions or fires in factories and fuel storage facilities, forest fire, etc. It is the measurement to respond immediately to an emergency case and to quickly understand the seriousness of the air pollution situation. Therefore, the equipment for emergency measurement is selected with a priority on portability and speed. Since the accuracy and precision are inferior to analyzers installed in AQMS, it is not possible to supplement the air quality monitoring from AQMS.

Table 3-78 shows activities of air quality measurement drill in emergency case.

The first training was conducted in Prizren, and the second and third training was conducted in TPP Kosovo A, where PM concentration in the air was assumed to be relatively high. In the third measurement training, one of the digital dust meters was equipped with a PM_{10} cyclone particle separator, the other was equipped with a $PM_{2.5}$

cyclone particle separator, and two simultaneous measurements were attempted. As result, it was proved that the concentration is PM_{10}> $PM_{2.5}$, and even a simple measuring instrument (digital dust meter) could measure with a certain degree of accuracy. One C/P from KHMI and one C/P from the TPP Kosovo A acquired the knowledge to measure all pollutants by themselves.

Table 3-78 Activity: Air quality measurement drill in emergency case

Date	Activity	Remarks
Year 2019, the second and third period		
April 25 (Thu)	Operation method of digital dust meter for PM_{10}, $PM_{2.5}$ measurement was demonstrated at AQMS (Prizren).	Participants KHMI:2
June 3 (Mon)	Drill for emergency measurement was conducted at TPP Kosovo A by using detection tube (SO_2, NO_2, and NO_X) and PM_{10}, $PM_{2.5}$ digital dust meter.	Participants KEK: 2 KHMI: 2
November 14 (Thu)	Drill for emergency measurement was conducted at TPP Kosovo A by using detection tube (SO_2, NO_2, and NO_X) and PM_{10}, $PM_{2.5}$ digital dust meter. All procedure was performed by C/P.	Participants KEK: 1 KHMI: 1

Photo 3-16 Emergency measurement drill at TPP Kosovo A

(5) Installation of air quality data displays

As stated before, since the Project left the construction of air quality data network in the Pristina area to MCC/MFK, the Project changed the air quality data display installation plan from installing one indoor display in the city of Pristina to installing a larger number of outdoor displays in four locations in the city of Prishtina and one location in the city of Obiliq.

Originally the Project planned to exhibit the data obtained from the network established by MCC/MFK, but because of the delay of the government budget execution in the U.S, at the end of 2017, JET decided to separate the installation work into the ones in the second period and the ones in the third period. In the second period, displays were installed in four locations in the city of Prishtina and started to officially display the data in early part of the third period. In the third period, the Project waited for the establishment of MCC/MFK data network and switched the data sources from EC network to MCC/MFK network in

November, 2019. Furthermore, the Project installed one display in Obiliq, but displaying of the data began in May, 2020 due to COVID-19 effect. The activities regarding the display installation are shown in Table 3-79.

Table 3-79 Activities regarding the display installation

Date	Activities	Remarks
Second Period		
Apr. 23 (Tue), 2019	Open bidding explanation for the second period work	
Apr. 29 (Mon), 2019	Determination of contractor and contract for display installation work	
Jun. 6 (Thu), 2019	Site survey of the locations for displays	MESPI/MESP : 1 KHMI: 1, Municipality: 2、Contractor: 2, JET: 2
Jun. 17 (Mon), 2019	Meeting regarding the method of data update and the design of the screen	KHMI: 2, Contractor: 2, JET: 2
Jun. 28 (Fri), 2019	Meeting regarding the design of the screen	KHMI: 2, Contractor: 2, JET: 2
Aug. 26 (Mon), 2019	Installation of displays in four locations in the city of Prishtina	
Third Period		
Oct. 25 (Fri), 2019	Display handover ceremony	Minister of MESPI/MESP , Chief Representative of JICA Balkan Office, and many others
Nov. 4 (Mon), 2019	Meeting with the Mayor of Obiliq Agreement on display installation	Mayor of Obiliq and two other persons MESPI/MESP : 2, JET: 3
Nov. 11 (Mon), 2019	Agreement on the location for display installation	Obiliq: 2 JET: 2
Nov. 16 (Mon), 2019	Contract for display installation work (same contractor as for the previous work)	
End of November, 2019	Switching data source from EC data network to MCC/MFK network	
Beginning of March, 2020	Installation of the display in Obiliq	
May 10 (Sun), 2020	Started the data displaying	

In the second period, since the MCC/MFK data network was not functional yet, the displays received air quality data from EC data network, and started to display the data. EC network covered the data from eight AQMS in Kosovo, but not from three other AQMSs (Obiliq, Palaj and Dardhishte). Therefore, the Project postponed the installation of the display in Obiliq for the third period. The Project installed displays in four locations in the city of Prishtina, and decided to display the data for Pristina. These displays officially started to display the data on October 25 2019, when the handover ceremony was held, just after the start of the third period.

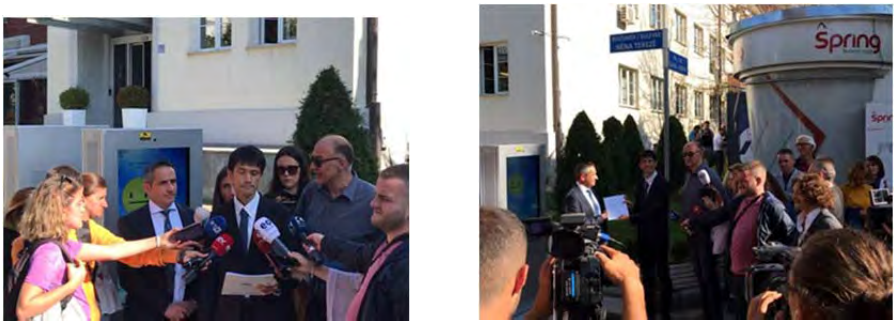


Photo 3-17 Display handover ceremony in the city of Prishtina

All relevant parties such as MESPI/MESP, the municipality of Pristina and KHMI in addition to JET and the contractor, inspected four locations of displays in the city of Prishtina on June 6, 2019. Subsequently, the locations were authorized by MESPI/MESP. Then, the design of the screen was discussed between MESPI/MESP and JET, and after the explanation to the municipality of Pristina it was decided on that.

In the third period, the Project offered the installation of a display to the municipality of Obiliq. The offer was accepted by the Mayor of Obiliq and subsequently it was decided on the location of the display through discussion with officials of the municipality of Obiliq.

In November 2019, MCC/MFK finished the establishment of data network covering all AQMSs in Kosovo, and the Project switched the data source for the display from EC network to MCC/MFK network. At the same time, this change enabled receiving the data from AQMSs in Obiliq. The establishment of MCC/MFK data network was completed, the rehabilitation of all analyzers for seven AQMSs outside the Pristina area, and at the same time, all meteorological instruments for all AQMSs were renewed and installed. The establishment of MCC/MFK data network also made it possible to obtain not only air quality data but also meteorological data. After the establishment, the EC network was replaced by the MCC/MFK network.

Locations and the design of the screen were as follows.

1) Locations of the displays

- Locations in the city of Prishtina

  Number of the locations: four locations (six displays)

  i) In front of the MESPI/MESP: one display
  ii) Inside the park next to the municipality of Prishtina building: one display
  iii) Center of the city (Mother Teresa Square): two displays (for both directions)
  iv) Ministry of Education, Science and Technology: two displays (for both directions)

2) Overview of the display (shown in Figure 3-17)

➢ Upright type monitor

The content of the screen: air quality data from AQMSs (SO_2、NO、NO_2、CO、O_3、$PM_{2.5}$、PM_{10}) and the ambient temperature

Languages: Albanian, Serbian and English

Displays in the city of Prishtina: display of data from the AQMS in front of the MESPI/MESP

Display in the city of Obiliq: display of data from the AQMS in Obiliq

Figure 3-16 Locations of displays in the city of Prishtina

- ➢ Location in the city of Obiliq (one display)

Photo 3-18 Location of the display in the city of Obiliq (along the main street)

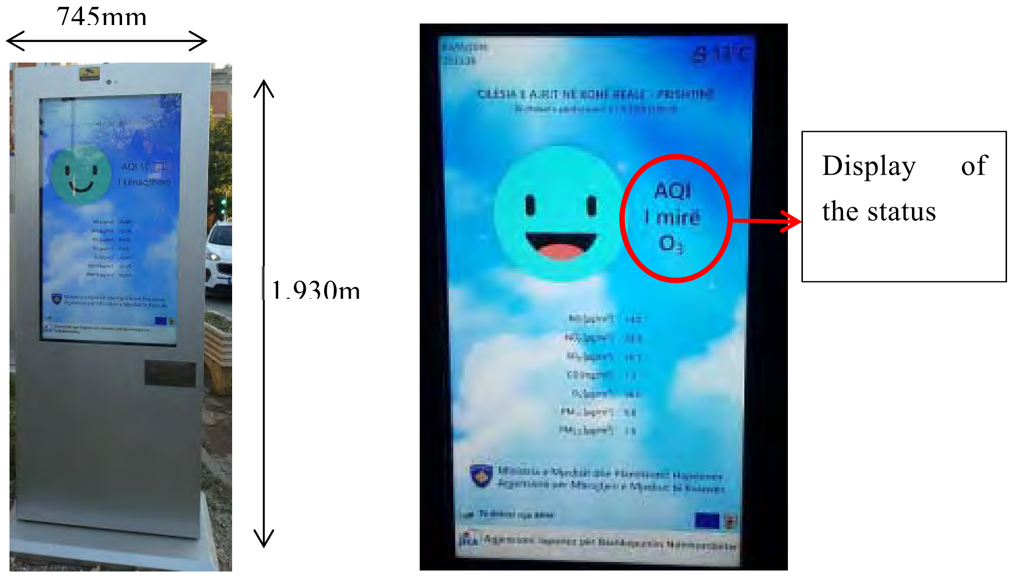
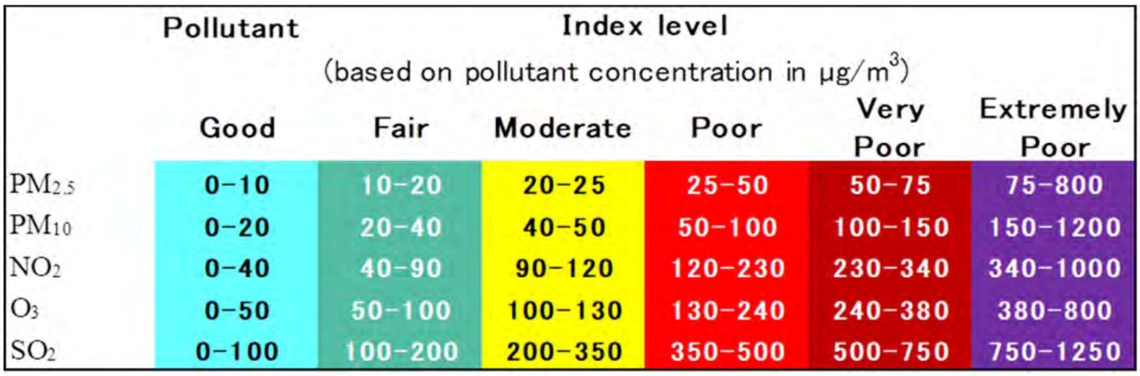


Figure 3-17 Screen of the display

The screen shows the measurement results of seven pollutants and at the same time the Air Quality Index (hereinafter referred to as "AQI") is displayed as an indicator of the air status.

AQI is decided by adopting the worst Index of five components (excluding NO and CO) according to the decision criteria[22] shown in Table 3-80. The AQI is shown in the screen and the description[22] of each AQI level is explained in Table 3-81.

Table 3-80 the decision criteria for AQI stipulated by EU



Pollutant	Index level (based on pollutant concentration in μg/m³)					
	Good	Fair	Moderate	Poor	Very Poor	Extremely Poor
$PM_{2.5}$	0-10	10-20	20-25	25-50	50-75	75-800
PM_{10}	0-20	20-40	40-50	50-100	100-150	150-1200
NO_2	0-40	40-90	90-120	120-230	230-340	340-1000
O_3	0-50	50-100	100-130	130-240	240-380	380-800
SO_2	0-100	100-200	200-350	350-500	500-750	750-1250

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[22] https://airindex.eea.europa.eu : European Air Quality Index

Table 3-81 the description of each AQI level

AQ index	General Population	Sensitive population
Good	The air quality is good. Enjoy your usual outdoor activities.	The air quality is good. Enjoy your usual outdoor activities.
Fair	Enjoy your usual outdoor activities	Enjoy your usual outdoor activities
Moderate	Enjoy your usual outdoor activities	Consider reducing intense outdoor activities, if you experience symptoms.
Poor	Consider reducing intense activities outdoors, if you experience symptoms such as sore eyes, a cough or sore throat	Consider reducing physical activities, particularly outdoors, especially if you experience symptoms.
Very Poor	Consider reducing intense activities outdoors, if you experience symptoms such as sore eyes, a cough or sore throat	Reduce physical activities, particularly outdoors, especially if you experience symptoms.
Extremely Poor	Reduce physical activates outdoors.	Avoid physical activities outdoors.

3.4.2 Evaluation for the Objectively Verifiable Indicators in the PDM

Objectively Verifiable Indicators are: "Five air quality monitoring stations rehabilitated by the Project comply with 6,000 hours effective measurements a year, (8,760 hours) in second and third year in the Project implementation", "Emergency air pollution monitoring drills are implemented at least three times utilizing portable samplers for SO_2, NO_2, $PM_{2.5}$ and PM_{10} measurements" and "Air quality monitoring reports are elaborated at least twice".

The rehabilitation of five stations in the Pristina area was completed at the end of May 2019. Rehabilitation of analyzers for six parameters: NO_X, SO_2, O_3, CO, PM_{10} and $PM_{2.5}$ were conducted at five AQMSs, Pristina/KHMI, Pristina/Rilindja, Obiliq, Dardhishte and Palaj. Until the network reconstruction activity for collecting and storing measurement data by MCC/MFK was completed in November 2019, the storage of measurement data of five AQMS in the Pristina Area was not possible. Therefore, the number of valid data for one year was confirmed during the year from October 1, 2019 (when data has started to be collected) to September 30, 2020. The results are shown in Table 3-82.

Table 3-82 Valid hourly data per year in rehabilitated AQMSs (unit: number of valid hourly data)

	O_3	SO_2	NO	NO_2	CO	PM_{10}	$PM_{2.5}$
KHMI	8083	8025	8181	8181	8174	8547	8547
Rilindja	7711	7956	7573	7572	7857	8278	8278
Obiliq	7896	8387	8353	8353	7588	8706	8707
Dardhishte	8253	8137	8327	8327	8220	8224	8224
Palaj	8294	8374	8388	8389	8294	8698	8698

At the five rehabilitated AQMSs in the Pristina area, the number of valid measurement data exceeded 6,000 hours and the monitoring of 6,000 hours/year was achieved for all measurement items.

Air quality measurement drill in emergency cases was conducted three times: on April 25, 2019, June 3, 2019 and November 14, 2019. In this way, the objectively verifiable indicator was achieved.

Air quality monitoring reports are published on KEPA web site[23] every month. In addition, the "State of the Air" 2018 and 2019, which is equivalent to the white paper on air quality, is published on the KEPA website[24]. In this way, the indicator, "Air quality monitoring reports are elaborated at least twice" was achieved.

3.4.3 Capacity development through the activities

Activities related to the soundness of the analyzer in AQMS can be divided into (a) Inspection of AQMSs (nationwide) and rehabilitation (AQMSs in Pristina area: 5 stations), (b) Maintenance manual preparation and analyzer calibration training based on the manual. C/P experienced and learned the following works through OJT:

- Inspecting to see whether the analyzers in AQMS are operating normally and showing correct measured values,
- Outsourcing of the rehabilitation work including listing of necessary parts based on inspection,
- Overhaul work procedure.

Furthermore, for the first time, C/P conducted cleaning of the manifold (a device for distributing the sample air to analyzers, which is made of glass) and the piping of the gas sample from there to the analyzers. It has not been done for nearly eight years since the installation of AQMSs and the work is very important to secure the data reliability. It is considered that the basic ability has been improved, but it is not at the level at which the next overhaul, including planning, can be implemented independently without outside help. Calibration of the analyzer based on the manual, which is rather complicated process can be performed by one C/P in charge.

The reason the calibration of analyzers became possible is that the capacity of C/P was improved through training, especially OJT, as well as the provision of standard gases and the calibrator with built-in zero gas generator and ozone generator which were prepared and transferred to KHMI by the Project. Calibration became possible by donating five sets of NO standard gas, SO2 standard gas, CO standard gas cylinders, and high purity regulator corresponding to each cylinder to five stations in the Pristina Area. Standard gases and calibrator have not been provided for the remaining 7 stations where MCC/MFK conducted rehabilitation,

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[23] https://www.ammk-rks.net/?page=1,163

[24] https://www.ammk-rks.net/?page=1,21

but it is considered that the KHMI will use them for the maintenance of AQMSs nationwide. However, the two C/Ps who are currently in charge of Output 3 (O&M of AQMSs) are also in charge of preparation of monthly reports, soil pollution, and participation in the conferences, training and workshops held overseas. The private company contracted for the maintenance through bidding does not yet have the capacity to conduct calibration by itself, and it is necessary to transfer the technology to the private company. Sustainable maintenance will be difficult without employing at least one more staff in KHMI.

Regarding establishment of air quality data network, data communication and air quality data displays, C/P have acquired these equipment by donors such as MCC/MFK and JICA. How to use the data network, communication system and air pollution data displays, as well as how to ensure the validity of data and O&M of the equipment are the issues for the future.

3.5 Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

As for the capacity development for laboratory analysis, the Project supported the C/Ps to become able to analyze the exhaust gas from LCPs by Standard Reference Method, and to improve the laboratory analysis technology through the re-functionalization and operation of analyzers necessary for Standard Reference Method. Meanwhile, the Project supported the Kosovo side to monitor heavy metals in the PM in the air and judge the necessity of the continuous monitoring of heavy metals. At the same time, in order to support the monitoring, the Project also assisted with the re-functionalization of ICP-MS in order for C/Ps to analyze heavy metals by themselves.

3.5.1 Activities

(1) The analysis of exhaust gas by Standard Reference Method and measurement of the total mercury in the exhaust gas

EU directive requests the continuous monitoring of Dust, SO_2 and NO_X for LCPs through measurement and reporting, but at the same time, in order to guarantee the measurement results, it also requests once a year the analysis by Standard Reference Method for SO_2 and NO_X, and measurement by iso-kinetic sampling method for Dust. Furthermore, in the case of LCPs using coal as a fuel, it requests the analysis of mercury (Hg) too. Standard Reference Method is the method to be determined as a standard method for SO_2, and NO_X, and EU directive[25] requests this method for exhaust gas analysis. Table 3-83 indicates the standards in EU and Japan for analysis of SO_2, and NO_X. The details are described in Appendix-1: Third Period “4-1)-1 Standard Reference Method for gas measurement”.

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[25] Request for Standard Reference Method is described in PART 3 of ANNEX V in DIRECTIVE 2010/75/EU which stipulates the framework for industrial emissions for Large Combustion Plants.

Table 3-83 Comparison of exhaust gas analysis method between EU and Japan

Method for analysis		EU*1)		Japan*2)	
		SO_2	NO_X	SO_X*3)	NO_X
Ion Chromatograph (IC) method		○		○	○
Titration method	ARSENAZO III method			○	
	Thorin method	○		○	
	Neutralization titration method			○	
chemiluminescence method			○		○
Light scattering method					○
Absorptiometry method (NEDA method, Zn-NEDA method, PDS method)					○

*1) EU: SO_2: EN[11] 14791 NO_X: EN 14792

*2) Japan: SO_X: JIS[11] K 0103 NO_X: JIS K 0104

*3) As for Sulphur oxides, EU standards targets SO_2, but Japanese standards targets SO_X. SO_X usually consists of SO_2 and SO_3. The IC method analyzes SO_X.

EU directive requests the analysis by EN standards or equivalent methods for LCPs where continuous measurement of exhaust gas is conducted. In Kosovo the law, which is planned to be revised, will also request analysis method by EN standards or equivalent methods approved as international standards.

As shown in the table, EN standards stipulate the IC method or titration method for SO_2 analysis and only chemiluminescence method for NO_X analysis. In the Project, the IC method was selected for SO_X and NO_X as a Standard Reference Method adopted by the JIS. The chemiluminescence method was the method already adopted in the automated gas analyzer introduced by the Project, and if it is used, the EN standard can be satisfied for NO_X. The chemiluminescence method detects NO_X directly by the sensor, but the IC method analyzes NO_X in a quantitative manner by absorbing NO_X from the exhaust gas, and the gas sampling method is different from the one by the chemiluminescence method. The Project decided to use the IC method since the IC method is the most common method in Japan, the analysis for NO_X by the IC is conducted in the same way as the one for SO_X and the analysis was conducted in a quantitative manner.

As for the measurement of the total mercury, the AAS method was selected since KHMI possesses the AAS and they are accustomed to operating it.

The followings are the explanation for each analysis method. The details are described in Appendix-1: Third period “4-1)-1 Standard Reference Method for gas measurement”.

1) Exhaust gas analysis by the IC

In order to analyze SO_X and NO_X, it is necessary to go through the process where the exhaust gas is absorbed into the solution and analyzed by the IC.

Figure 3-18 shows the analysis flow. Exhaust gas is absorbed into each solution for SO_X and NO_X. Solutions were brought back to KHMI and analyzed by the IC after being diluted to appropriate concentration. Solutions include the oxidizing agent (hydrogen peroxide solution: H_2O_2), and SO_X and NO_X are oxidized to ions (SO_4^-、 NO_3^-), and then these ions are analyzed. The details of gas samplings are described in Appendix-1: Second period “4-3)-1 SOP for gas sampling for SO_X” and Third period “4-3)-2 SOP for gas sampling for NO_X”. Preparation of standard solutions is described in Appendix-1: Third period “4-2)-1 SOP (IC-Reagents, standard and sample solution)” and the analysis method by the IC is described in Appendix-1: Third period ”4-2)-2 SOP (IC-Operating)”.

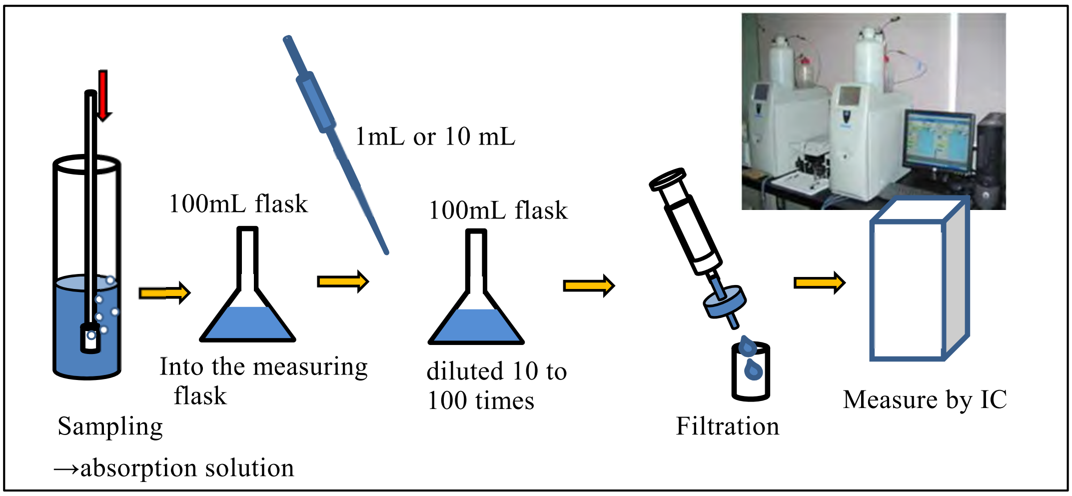


Figure 3-18 Flow of analysis for SO_2 and NO_X by the IC

2) Analysis of total mercury

In order to analyze total mercury in exhaust gas, it is necessary to analyze gaseous mercury and solid mercury. Figure 3-19 shows the analysis flow of total mercury.

Gaseous mercury is absorbed into the solution mixed with potassium permanganate ($KMnO_4$) and sulfuric acid (H_2SO_4) and is converted to mercury ion (Hg^{2+}), and then it is analyzed by the AAS. Meanwhile, solid mercury is collected by the same method as the iso-kinetic dust sampling method. Collected Dust is put into a container and after adding nitric acid (HNO_3) and hydrogen fluoride (HF), Dust is dissolved in the microwave. Solid mercury is extracted and analyzed with the same method as the gaseous mercury. The details for gas sampling are described in Appendix-1: Second period ”4-3)-3 SOP for gas sampling for Hg” and the procedure for dissolution of solid mercury in Appendix-1: Third period” 4-2)-3 SOP (Hg for AAS, Reagents)”.

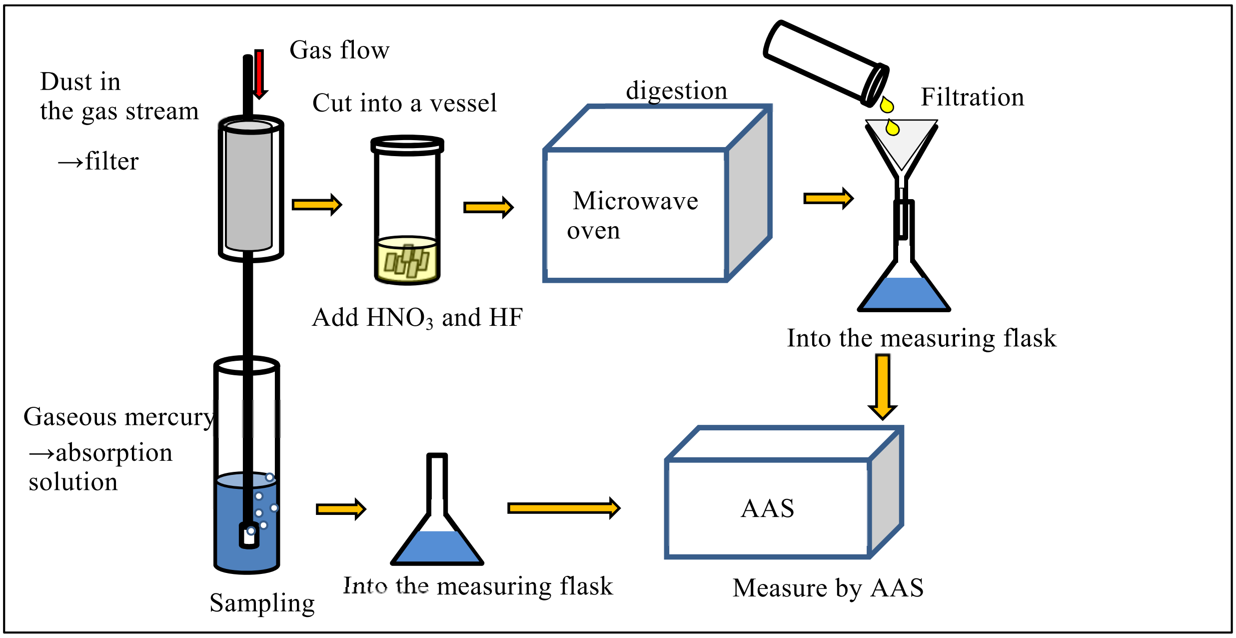


Figure 3-19 Flow of analysis for total mercury by the AAS

(2) Re-functionalization of the IC and ICP-MS and exhaust gas analysis by Standard Reference Method

KHMI possesses the IC and the ICP-MS given as a donation by EU around 2012, but most of them except the AAS have never been operated. Since the Project adopted the IC method for Standard Reference Method, the re-functionalization of the IC was required. Furthermore, as stated in the next section, re-functionalization of the ICP-MS was also required because of the necessity for continuous monitoring of heavy metal in PM. In this section, re-functionalization of the IC and ICP-MS and exhaust gas analysis by Standard Reference Method are described.

1) Re-functionalization of the IC and ICP-MS

Re-functionalization of the IC and ICP-MS are described below.

i) Re-functionalization of the IC

Since the IC had not been operated since it was brought in KHMI around 2012, the Project, in the first period, specified damaged parts and necessary spare parts through the diagnosis. In the second period, the IC was repaired and re-functionalized and the operation training was conducted.

Table 3-84 shows the activities regarding the IC re-functionalization.

Table 3-84 Activities for re-functionalization of the IC

Date	Activities	Remarks
First Period		
Jun. 5 (Tue), 2018	Diagnosis of the IC deterioration state, fluid passage washing, functionality check of sensors for liquid feeding pump, internal check	These activities were carried out with the assistance of engineer from regional agent for the Balkan area.

	of the IC, etc.	Necessary solutions such as washing solution, mobile phase solution and standard solutions for diagnosis were prepared by C/Ps
Jun. 5 (Wed), 2018	Operational check for auto-sampler, detector, etc.	
Jun. 7 (Thu), 2018	Functionality check for auto-sampler and detectors, and soundness check for columns	
Jun. 8 (Fri), 2018	Operational check of valves inside auto-sampler	
Second Period		
Nov. 12 (Mon), 2018	The arrival of the engineer from regional agent for the Balkan area	The arrival of the engineer
Nov. 13 (Tue), 2018	Repair of the IC	Participants from KHMI: 4 The repair work was proceeded while C/Ps were present and asking questions
Nov. 14 (Wed), 2018		
Nov. 15 (Thu), 2018		
Nov. 16 (Fri), 2018	Confirmation of the repair work and explanation of the IC operation	
Nov. 19 (Mon), 2018	Preparation for the IC operation training	The arrival of the engineer from regional agent for the Balkan area
Nov. 20 (Tue), 2018	Operation training on the IC	Participants from KHMI: 3
Nov. 21 (Wed), 2018		
Nov. 22 (Thu), 2018		
Nov. 23 (Fri), 2018		

Photo 3-19 View from IC diagnosis

The Project communicated in advance with the regional agent for the Balkan area about the IC re-functionalization, and procured the necessary parts for the diagnosis. In June 2019, the engineer from the regional agent visited KHMI and made the diagnosis and specified the parts that need to be repaired and necessary spare parts. In the second period, based on the report from the agent, the Project procured necessary spare parts, and the agent repaired and re-functionalized the IC, and then conducted the training on the IC operation. The details are described in Appendix-1: Second Period: ”4-2)-4 Report on Ion Chromatograph” and Second Period: ”4-2)-5 Detailed version of Report on Ion Chromatograph”.

The re-functionalization and training were conducted by the engineers from the agent for a period of two weeks beginning from November 12, 2018. In the first week the IC was repaired. Since the IC had not been operated for a long time and not been kept in good condition, it was not easy to repair the IC. It took time to repair and operate the IC because of the clogging of the liquid passage and the malfunction of some parts, but finally the IC was re-functionalized by using procured spare parts, etc. Training took place in the following week. The engineer from the regional agent explained the principles and the operation of the IC, and under the guidance of the engineer, C/Ps operated the IC by themselves. C/Ps also prepared necessary solutions such as mobile phase solution and calibration solution under the guidance of JET. In spite of the short training time, C/Ps learned the general operation procedure such as start-up, analysis, confirmation of the analysis results, etc. During the training, C/Ps actively participated in the training and they made questions to the engineer, repeated the operation procedure, wrapped up the activities, etc.

After the training, C/Ps requested from JET to give instruction on how to operate the IC by themselves in order to learn more regarding the IC operation and to carry out the analysis of the river water quality. JET gave them an explanation and precautions on the preparation method for solutions, frequency of the IC operation, etc.

Photo 3-20 View from the IC re-functionalization and training

The Project used the IC in May, 2019, and confirmed the normal operation of the IC. As a result, KHMI personnel is thought to have learned how to use the IC.

ii) Re-functionalization of the ICP-MS

Unlike the case of the IC, the Project did not plan to re-functionalize the ICP-MS, but originally planned to decide how to handle it based on the study results of the necessity for the monitoring of heavy metals in PM in the air. However, as described in the next section, the necessity of the monitoring of heavy metals was confirmed, and it became necessary to analyze heavy metals by ICP-MS. On the other hand, MCC/MFK planned the training of the ICP-MS operation in response to the Kosovo side’s request. The Project already confirmed the possibility of the re-functionalization of the ICP-MS in the first period, but the work did not include the adjustment of the ICP-MS for heavy metal analysis since only the diagnosis of the ICP-MS was within the scope of Project works. MCC/MFK found out that the adjustment work was required for the first time when it heard it from the Project, but MCC/MFK did not plan to cover the extension of works for contractor services. Therefore, it was hard to carry out adjustment work.

In this situation, C/P requested for the Japanese side to carry out the adjustment work for the ICP-MS in order to be able to analyze heavy metals in PM in the air. The Project decided to implement this work since the intent matched the purpose of the Project to develop capacities for air quality monitoring.

Table 3-85 shows Activities for re-functionalization of the ICP-MS. The details are described in Appendix-1: Second period: ”4-2)-1 Service report (ICP-MS)” and Second period: ”4-2)-2 Report on ICP-MS”

Table 3-85 Activities for re-functionalization of the ICP-MS

Date	Activities	Remarks
First Period		
May 16 (Wed), 2018	Shipping the ICP-MS to Croatia	
July 16 (Mon), 2018	Arrival of the ICP-MS after repair and inspection	
Second Period		
May 6 (Mon), 2019 ~ May 10 (Fri), 2019	Adjustment work with the engineer from the regional agent for Balkan area	Engineer from the regional agent: 1 KHMI: 1, JET: 1
May 13 (Mon), 2019 ~ May 18 (Sat), 2019	confirmation of the operation by the adjustment work	KHMI: 1, JET: 1
May 20 (Mon), 2019 ~ May 23 (Thu), 2019	confirmation of the operation by the adjustment work	KHMI: 1, JET: 1
Third Period		
Nov. 21 (Thu), 2019	ICP-MS maintenance	KHMI: 1, JET: 1
Nov. 26 (Tue), 2019	ICP-MS operation check	KHMI: 1, JET: 1
Dec. 2 (Mon), 2019	ICP-MS maintenance	KHMI: 1, JET: 1
Dec. 3 (Tue), 2019 ~ Dec. 5 (Thu), 2019	ICP-MS maintenance	KHMI: 1, JET: 1

In February of 2018, the Project made a preliminarily inspection of the internal part of the ICP-MS, and found out that the parts of the wiring inside the ICP-MS were bitten by a mouse and there were many disconnected points as shown in Photo 3-21. The Project consulted the regional agent for the Balkan area certified by the manufacturer to do the diagnosis and the repair of the ICP-MS, including repair of the wiring. As a result, the Project decided to ship the ICP-MS to Croatia where the regional agent is located, since they could deal with problems in a flexible manner as they had many engineers and spare parts there.

After the contract with the regional agent for the Balkan area was concluded, the ICP-MS was shipped to Croatia and the wiring was repaired. Then the ICP-MS was diagnosed and in September 2018, the ICP-MS was send back to KHMI. The results of the diagnosis confirmed that the ICP-MS was in sound condition and ready to be operated.

Photo 3-21 ICP-MS and the internal part of the ICP-MS

In the second period, the Project made a contract again with the regional agent in order to adjust the ICP-MS for analyzing heavy metals. From May 6, 2019, the engineer from the regional agent visited KHMI and together with C/Ps and JET, adjusted the ICP-MS for heavy metal analysis, and completed the work.

Photo 3-22 Adjustment work for the ICP-MS with the engineer from the regional agent

However, an issue remained where plasma in the ICP-MS which is the most important part disappeared in thirty minutes or so after the start-up. Since one of the causes was presumed to be the low detection capacity of the plasma, JET supported the improvement of the detector, and the operation became stable after the improvement. As another issue, the capacity of the induced fan was not sufficient, and JET proposed to KHMI the improvement of this issue. Through these activities the ICP-MS was re-functionalized to be able to analyze heavy metals.

Operation training for the ICP-MS is planned to be conducted by MCC/MFK, and after the training it is expected for KHMI personnel to analyze heavy metals in PM in the air independently. However, the issue that the Kosovo side cannot sample PM_{10} which is requested by the EU Directive to monitor heavy metals still remains. The Project did not prepare SOPs since the operation training is conducted by MCC/MFK.

iii) Support for the analysis of total mercury by the AAS

The AAS which was used for the analysis of total mercury was the instrument already being used in KHMI. However, maintenance condition was not good, and in June 2018, JET instructed C/Ps how to maintain the AAS.

Photo 3-23 View of the AAS and inspection

In order to analyze total mercury, it is necessary to analyze both gaseous mercury and solid mercury in exhaust gas. In order to analyze solid mercury, it is necessary to dissolve filters in which Dust in exhaust gas is collected, extract the solid mercury and convert it to the solution (pre-treatment) by applying microwave pressurized acidolysis and decomposition method. Therefore, JET transferred this method and its treatment condition and the techniques for operating microwave treatment apparatus. JET prepared the SOP for preparation of solutions for analyzing total mercury. This is described Appendix-1 Third period: ”4-2)-3 SOP (Hg for AAS, Reagents)”.

2) Exhaust gas analysis by Standard Reference Method

As a result of the IC re-functionalization, the Project started to apply Standard Reference Method for exhaust gas analysis. From April 2019, the Project sampled the exhaust gas in TPP Kosovo A, TPP Kosovo B and Ferro-Nickel factory, and analyzed the exhaust gas by Standard Reference Method.

This activity was planned to be completed in the second period, but C/P requested additional training regarding the IC operation and the pretreatment and analysis of mercury, and JET accepted the request and gave additional training in the third period.

i) Activities for exhaust gas analysis

As for exhaust gas analysis by Standard Reference Method, the Project conducted gas sampling and analysis in the activities of Output 2. Samples of SO_X and NO_X were analyzed by the IC and mercury by the AAS. For analysis of mercury it is required to analyze the gaseous mercury and solid mercury. Gaseous mercury is absorbed into the solution and analyzed by the AAS, but analysis of solid mercury requires a more complicated process where the mercury in Dust is extracted by strong acid and is analyzed by the AAS.

Table 3-86 shows the activities in KHMI for the analysis by the IC and the one for mercury.

Table 3-86 Activities for analysis by the IC and analysis of mercury

Date	Activities	Remarks
Second Period		
May 2 (Thu), 2019	Lecture on the IC analysis	KHMI: 1
May 3 (Fri), 2019	Support for mercury analysis by the AAS	KHMI: 1
May 7 (Tue), 2019	Preparation of absorption solution for gas sampling	KHMI: 1
May 10 (Fri), 2019	Training on the IC analysis	KHMI: 1
May 13 (Mon), 2019	Training on the IC analysis	KHMI: 1
May 14 (Tue), 2019	Training on the IC analysis	KHMI: 1
May 15 (Wed), 2019	Training on the IC analysis	KHMI: 1
May 16 (Thu), 2019	Training on the IC analysis	KHMI: 1
May 17 (Fri), 2019	Training on the IC analysis, Support of the pretreatment process for mercury analysis	KHMI: 1
May 18 (Sat), 2019	Training on the IC analysis	KHMI: 1
May 20 (Mon), 2019	Training on the IC analysis, Support of the pretreatment process for mercury analysis	KHMI: 1
May 21 (Tue), 2019	Training on the IC analysis, Support for mercury analysis by the AAS	KHMI: 1
May 22 (Wed), 2019	Training on the IC analysis, Support for mercury analysis by the AAS	KHMI: 1
May 23 (Thu), 2019	Training on the IC analysis	KHMI: 1
Third Period		
Nov. 20 (Wed), 2019	Operation check of the IC	KHMI: 1
Nov. 21 (Thu), 2019	Operation check of the IC	KHMI: 1
Nov. 25 (Mon), 2019	Exhaust gas analysis by the IC	KHMI: 1
Nov. 27 (Wed), 2019	Pretreatment of solid mercury (Hg)	KHMI: 1
Nov. 28 (Thu), 2019	Pretreatment of solid mercury (Hg), Operation training of the IC	KHMI: 1
Nov. 29 (Fri), 2019	Pretreatment of solid mercury (Hg), Operation training of the IC, Operation training of the AAS	KHMI: 1
Dec. 2 (Mon), 2019	Operation check of the IC	KHMI: 1
Dec. 3 (Tue), 2019	Operation training of the IC	KHMI: 1
Dec. 4 (Wed), 2019	Operation training of the IC	KHMI: 1
Dec. 5 (Thu), 2019	Operation training of the IC	KHMI: 1
Dec. 6 (Fri), 2019	Organization of the IC operation (drafting the SOP)	KHMI: 1
Dec. 7 (Sat), 2019	Organization of the IC operation (drafting the SOP)	KHMI: 1

Exhaust gas sampling for the IC analysis requires the preparation of absorption solution. However, since the staff in charge were not accustomed to handling reagents inside the laboratory, JET instructed the staff in charge on necessary reagents, concentration, required quantity, etc. and the staff prepared the solutions with the assistance of JET.

In the third period, the staff in KHMI and JET discussed and planned the work every day, and after confirming the technical content of the work of the day such as the preparation of the sample solution for analysis, preparation of solutions, operation of the analyzers, etc. staff in KHMI proceeded with the work with the assistance of JET. As for the operation of the analyzers, since the software operation of analyzers is complicated, staff of KHMI repeated the procedures mainly on the start-up, the analysis procedure, the confirmation of the results, etc. As an organization of the final activity, JET and C/Ps drafted the SOPs together.

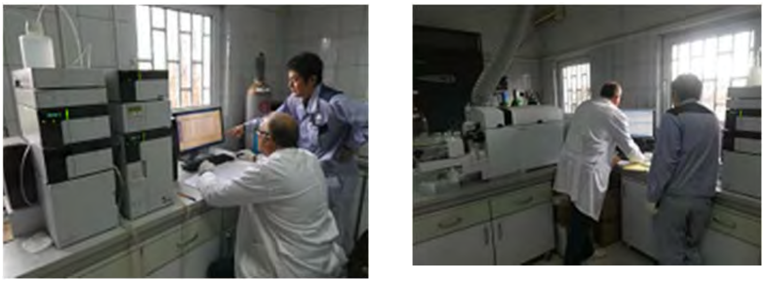


Photo 3-24 Analysis and operation of the IC

Photo 3-25 Operation of the microwave (Hg extraction) and analysis of mercury

ii) Results of the exhaust gas analysis by Standard Reference Method

Table 3-87 shows the results of exhaust gas analysis by Standard Reference Method and mercury analysis. When the gas sampling for Standard Reference Method was conducted, the measurement by the automated gas analyzer was carried in parallel. In the table, both the results of SO_X (or SO_2) and NOx by the IC method and by the automated gas analyzer are shown. At the same time, the results of mercury are shown. It is known that the lignite in Kosovo contains mercury through analysis of lignite, but no mercury was detected in the exhaust gas through all laboratory analysis.

Details are described in Appendix-1: Second period:”4-1)-1 Standard Reference Method for gas measurement”.

Table 3-87 Results of exhaust gas analysis by Standard Reference Method and mercury analysis

Date		April 26,2019	April 30,2019	May 8,2019	May 15,2019	May 16,2019
Facility		TPP Kosovo A	TPP Kosovo A	Ferro-Nickel	TPP Kosovo B	TPP Kosovo B
Duct No.		No.5-C Duct	No.5-C Duct	Rotary kiln furnace	No.1-1	No.1-2
Item	Unit	—	—	—	—	—
SOx (IC)	mg/Nm^3	1,912	1,614	3,155	529	1,244
SO_2 (PG)		1,535	782	1,221	206	580
NOx (IC)	mg/Nm^3	660	771	109	850	819
NOx (PG)		367	396	70	431	483
Hg (Dust)	mg/Nm^3	N.D	N.D	—	N.D	N.D
Hg (Gas)		N.D	N.D	—	N.D	N.D

Date		Nov. 6,2019	Nov. 8,2019	Nov. 11,2019	Nov. 19,2019
Facility		TPP Kosovo A	TPP Kosovo A	TPP Kosovo A	TPP Kosovo A
Duct No.		No.5-C Duct	No.5-C Duct	No.4-C Duct	No.4-C Duct
Item	Unit	—	—	—	—
SOx (IC)	mg/Nm^3	500	6	322	1,983
SO_2 (PG)		125	1	213	897
NOx (IC)	mg/Nm^3	1,048	1,209	1,013	755
NOx (PG)		340	386	354	288
Hg (Dust)	mg/Nm^3	N.D	N.D	N.D	N.D
Hg (Gas)		N.D	N.D	N.D	N.D

The values above are direct values shown by the analysis. They are not converted in reference O_2.

IC: Ion chromatography

PG: Automated Gas analyzer

Hg (Dust): Solid mercury

Hg (Gas): gaseous mercury

N.D. : Not Detected (Detection lower limit : Hg: 0.002mg/Nm^3)

The comparison between the analysis results by Standard Reference Method and the results measured by the automated gas analyzer at the same time is shown in Figure 3-20. As a result, it is obvious that the analysis results by Standard Reference Method are always almost two times larger than the results measured by the automated gas analyzer.

One of the causes of the difference is presumed to be the absorption of SO_2 and NOx by the condensate water in the sampling tube used for the automated gas analyzer.

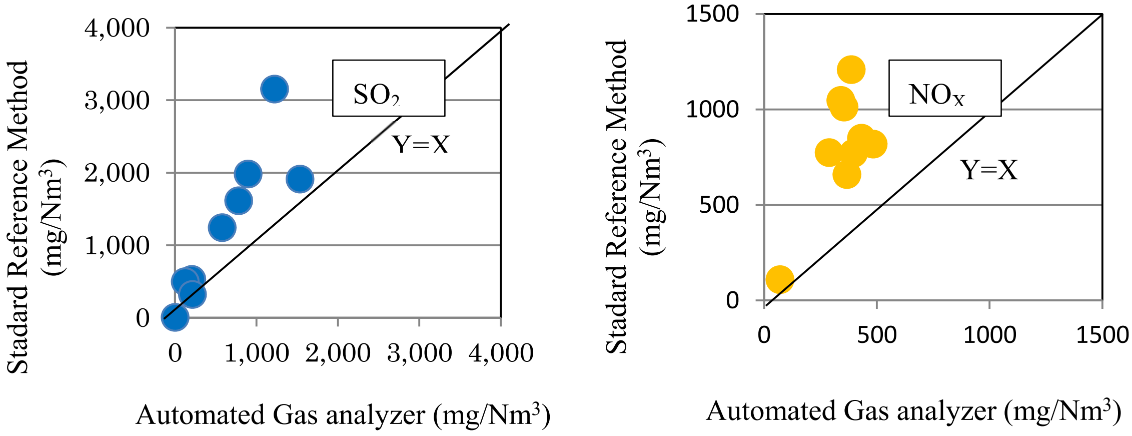


Figure 3-20 Comparison between the analysis results by Standard Reference Method and the results measured by the automated gas analyzer

The View of exhaust gas measurement by the automated gas analyzer is shown in Figure 3-21. In the case where the measurement holes are located at high places such as stacks and ducts at high places, the length of the sampling tube will be 30 to 50m. In three facilities where the Project conducted measurement, the tube length was 30 to 50m. Exhaust gas has high moisture content and the gas was cooled down and moisture in the gas condenses into water on the way from sampling holes to the analyzer. The condensed water may absorb SO_2 and NOx and their content can become lower. Since the amount of condensed water highly depends on the moisture content in the exhaust gas, ambient air temperature, etc. the effect to the measurement results can change in every measurement.

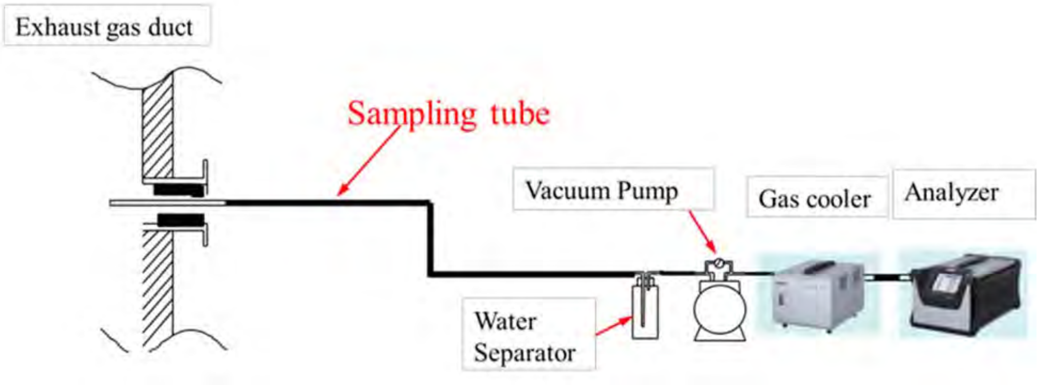


Figure 3-21 View of exhaust gas measurement by the automated gas analyzer

On the other hand, exhaust gas sampling for Standard Reference Method is presumed to be affected very little by condensed water, since the amount of condensed water is very small because of the gas sampling just after the sampling hole, and besides condensed water is all recovered into absorption solution. This can be one of the causes, but at this moment the cause has not been identified.

In the additional activities in the third period, the Project tried to analyze exhaust gas by sampling from different locations in the sampling line in order to compare the effect of the drain in the sampling tube. However, the results varied widely and the number of the results was not sufficient. Therefore, no clear result was obtained. C/Ps seem to understand sampling and analysis by Standard Reference Method, but JET could not follow the actual procedures conducted by C/Ps. Therefore, JET recognized that it was necessary to carry out a little bit more training including the confirmation of those procedures.

Considering the presumption above, attentions should be paid to the following items.

- There is a big difference between the measurement results by the automated gas analyzer and the analysis results by Standard Reference Method. It was recognized at the last moment of the Project, and therefore, the cause was not identified since there was no time to confirm it. In the Project, the measurement results by the automated gas analyzer were used as they were. In order to identify the cause, it is necessary to sample and analyze the same exhaust gas many times for both methods.
- It is thought to be effective to adopt the IC method for Standard Reference Method especially for NO_X, since the gas sampling method is different.
- It is necessary to pay attention to make the length of sampling tube as short as possible, prevent moisture in gas from condensation by keeping the sampling tube warm, etc. However, it is practically hard to keep the long tube of 30 to 50m warm. When the use of a long sampling tube is unavoidable without keeping it warm, it should be considered for both methods (automated gas analyzer and Standard Reference Method) to be conducted and the results to be compared at the same time.
- In case that CEMS is installed, the sampling tubes are generally kept warm. In this case, the aforementioned effect can be avoided. In the TPP Kosovo B the sampling tube is insulated, but whether it works appropriately or not is not confirmed.

The Project supported re-functionalization of the IC and ICP-MS. These two analyzers started the operation and the analysis capacity in KHMI has been improved. At the same time, C/Ps have gained the experience to utilize the IC for the actual duties in exhaust gas analysis by Standard Reference Method. At the same time, the framework for applying Standard Reference Method to TPP Kosovo A and TPP Kosovo B was established.

At present, the facilities which are required to apply the Standard Reference Method in Kosovo are two LCPs, and at the same time, the agency possessing the IC is only KHMI

(TPP Kosovo B has an IC, but it cannot analyze anions which is the target of the Project). Therefore, it is required for KEK and KHMI to collaborate in order to apply the Standard Reference Method. In the future, it is desirable to apply the method to all facilities, but considering the situation where many private facilities do no conduct proper exhaust gas measurement, it is desirable that appropriate exhaust gas measurement including measurement by the automated gas analyzer is carried out.

Furthermore, acquisition of gas sampling method and re-functionalization of two analyzers can be applied not only for Standard Reference Method but also for many other duties such as air quality analysis, water quality analysis, etc. Therefore, it is important to clarify the needs for these technologies and use them effectively.

(3) Heavy metals in PM

As an activity in the first period, sampling of Total Suspended Particulates (hereinafter referred to as “TSP”) of PM in the air sampled by the high volume sampler was conducted in Drenas and Mitrovica, and the sampled filters were brought to Japan. Heavy metal was analyzed in Japan. The EU standard requires the analysis of heavy metals in the air in PM_{10}. Therefore in Drenas and Mitrovica, parallel collection of PM_{10} by the low volume sampler and the collection of TSP by the high volume sampler was conducted at the same time, in total 4 times. These samples were also analyzed in Japan. Based on these analysis results, the importance and urgency of heavy metal monitoring in Kosovo were evaluated, and the results of TSP sampling with a high volume sampler and PM_{10} sampling with a low volume sampler were compared and examined.

Table 3-88 Activities PM sampling in the air in Drenas and Mitrovica

Date	Activity	Reference
Year 2018, the first period		
May 15 (Tue)	Explanation on PM sampling in Drenas and Mitrovica	Preliminary explanation of PM sampling and request for cooperation.
May 28 (Mon)	Meeting with MESPI/MESP/KHMI for planning of PM sampling	Ms. Nezakete informed it to the Mayor of Drenas and chief of environmental sector in Mitrovica. Mr. Shkumbin from KHMI joined the activities.
May 29 (Tue)	Preliminary visit on PM sampling points	Two staffs from KHMI joined the activity. 2 points in Drenas and 6 points in Mitrovica were selected as designated points.
May 30 (Wed)	PM sampling (first sampling in Drenas, start)	Two staffs from KHMI joined the activity. TSP sampling by Hi-Volume Sampler started at 2 points in Drenas.
May 31 (Thu)	PM sampling (the first sampling	Finished sampling in Drenas and

	in Mitrovica, start)	moved to Mitrovica. TSP sampling by Hi-Volume Sampler started at 2 points in Mitrovica.
June 1 (Fri)	PM sampling (the second sampling in Mitrovica, start) Parallel sampling of TSP and PM_{10} at No.4 point.	One staff from KHMI joined the activity. Finished sampling at No.1 and No.2 point, moved to No.3 and No.4 point, and started sampling in Mitrovica.
June 2 (Sat)	PM sampling	Finished sampling at No.3 and No.4 point in Mitrovica.
June 11 (Mon)	PM sampling (the third sampling in Mitrovica, start) Parallel sampling of TSP and PM_{10} at No.5 point.	Started sampling at No.5 and No.6 point in Mitrovica.
June 12 (Tue)	PM sampling (the fourth sampling in Mitrovica, start) Parallel sampling of TSP and PM_{10} at No.1 point.	Two staffs from KHMI joined the activity. Finished sampling at No.5 and No.6, moved to No.1 and No.2, and started sampling in Mitrovica.
June 13 (Wed)	PM sampling (the second sampling in Drenas, start) Parallel sampling of TSP and PM_{10} at No.1 point.	Finished sampling atNo.1 and No.2 point in Mitrovica. Samplers in both points operated only 2 hours due to high temperature, and moved to Drenas. Started TSP sampling by Hi-Volume Sampler started at 2 points in Drenas.
June 14 (Thu)	PM sampling	Finished sampling in Drenas.

Analysis of PM in the air was conducted in accordance with sampling and analysis method stipulated in the “Air pollution Control Technology Manual” in Japan (April 2011, Air Environment Division, Environment Management Bureau, Ministry of the Environment). However, analysis results by using the low volume sampler possessed by KHMI was not adopted, since the results might be affected by the contamination caused by either the laboratory environment or the low volume sampler itself.

1) Result of heavy metal analysis

Analysis results of heavy metals in the first period are shown in Table 3-89 and Table 3-90.

In Mitrovica, the analysis result of Mn (manganese) exceeds the guideline value of Japan (140 ng/m^3 in annual average) in the samples of No.3 and No.4 sampled on June 1 to 2, 2018, while the environmental standard for Mn does not exist in EU standards. At the same time, the analysis result of As (Arsenic) exceeds the guideline value of Japan (6 ng /m^3 in annual average) at the samples of No.3 sampled on June 1 to 2, 2018. In EU the environmental standard for As in PM_{10} is annual average (6ng/m^3) too.

No analysis results in Drenas exceed Japanese guideline value and EU environmental standard.

Table 3-89 Result of heavy metals analysis of PM in the air in Mitrovica

Location	**No.1 Mitrovica**	**No.2 Mitrovica**	**No.3 Mitrovica**	**No.4 Mitrovica**	**No.5 Mitrovica**	**No. 6 Mitrovica**	**Guideline Value in Japan (TSP, Annual average)**	**Environmental Standard in EU (PM$_{10}$, Annual average)**
Sampling (24 hours)	2018/5/31～6/1	2018/5/31～6/1	2018/6/1～6/2	2018/6/1～6/2	2018/6/11～6/12	2018/6/11～6/12		
Sampling location	Business college	House in north	Elementary school	Alba park	House beside a railway	House in west		
TSP (μg/m^3)	**36.1**	**78.3**	**55.4**	**160**	**61.1**	**91.7**	**-**	**-**
Mn(ng/m^3)	47.4	88.1	**169**	**204**	31.5	58.0	**140**	**-**
Ni(ng/m^3)	3.1	<1.4	2.7	18.0	<1.4	3.4	**25**	**20**
As(ng/m^3)	1.5	2.9	**17**	2.1	0.8	0.8	**6**	**6**
Cd(ng/m^3)	0.69	0.60	2.13	0.70	<0.5	<0.5	**-**	**5**
Pb(μg/m^3)	<0.05	0.03	0.25	0.02	<0.05	<0.05	**-**	**0.5**
Zn(μg/m^3)	0.19	0.16	1.40	0.29	0.12	0.08	**-**	**-**

Note: Red highlighted cells show the exceedance of the guideline value of Japan (Annual average)

Table 3-90 Result of heavy metals analysis of PM in the air in Drenas

Location	**No.1 Drenas**	**No.2 Drenas**	**No.1 Drenas**	**No.2 Drenas**	**Guideline Value in Japan (TSP, Annual average)**	**Environmental Standard in EU (PM$_{10}$, Annual average)**
Sampling (24 hours)	2018/5/30～5/31	2018/5/30～5/31	2018/6/13～6/14	2018/6/13～6/14		
Sampling location	1.2 km South of factory	1.5 km Northeast of factory	1.2 km South of factory	1.5 km Northeast of factory		
TSP (μg/m^3)	**43.1**	**58.4**	**52.0**	**46.2**	**-**	**-**
Mn(ng/m^3)	37.3	38.6	21.9	23.7	**140**	**-**
Ni(ng/m^3)	<1.4	3.2	<1.4	7.4	**25**	**20**
As(ng/m^3)	<0.6	<0.6	<0.6	<0.6	**6**	**6**
Cd(ng/m^3)	<0.5	<0.5	<0.5	<0.5	**-**	**5**
Pb(μg/m^3)	<0.05	<0.05	0.05	<0.05	**-**	**0.5**
Zn(μg/m^3)	0.04	0.02	0.03	<0.02	**-**	**-**

Judging from the measurement results, it is recommended that the heavy metals of Mitrovica (at least Mn and As) should be monitored periodically. The sampling time was 24 hours, but environmental standard value (EU) and guideline value (Japan) of heavy metals in the air are set in annual average values. Even if the average 24-hour measurement value exceeds environment standard, it cannot be concluded that there is exceedance of environmental standard values from the annual average point of view. In principle, it is recommended to conduct measurements once every month, or at least 4 to 6 times a year, and then to calculate the average value and to compare with the environment guideline values or standards.

Table 3-91 Activities for evaluation of heavy metal analysis of PM in the air

Date	Activity	Remarks
Second Period		
Oct. 19 (Fri), 2018	Discussion on the analysis results for heavy metals in PM sampled in Drenas and Mitrovica.	Participants KHMI:3
Oct. 22(Mon), 2018	Discussion on the analysis results for heavy metals in PM sampled in Drenas and Mitrovica.	Participants KHMI:2
Jan. 25 (Fri), 2018	The third JCC meeting The Project explained the results of heavy metal analysis in PM in Drenas and Mitrovica. Kosovo side will continue heavy metals monitoring in PM in the air. Acceptance of the re-sampling of PM in the air in Drenas and re- analysis of heavy metals in Japan by Japanese side	Participants JCC member: 7 JICA: 4 Observer: 3 JET: 4 C/P-WG, etc.: 2

In response to these explanations, the monitoring of heavy metals in PM in the air will be continued at least in Mitrovica. However, at the time of the first PM sampling in the air in Drenas, in May and June 2018, the Ferro-nickel plant, which is presumed to be an emission source, was not operating. Since the Ferro-Nickel plant resumed operation, in response to the request by MESPI/MESP, PM sampling in the air in Drenas was conducted again. The sampling was conducted at the end of May 2019.

Table 3-92 Activities Additional PM sampling in the air in Drenas

Date	Activity	Remarks
Second Period		
May 27 (Mon), 2019	Cleaning of High volume air sampler.	Participants KHMI:2
May 28 (Tue), 2019	Start sampling at No.1 point and Np.2 point in Drenas for the first day.	Participants KHMI:2
May 29 (Wed), 2019	Stop sampling. Start sampling at No.1 point and No.2 point in Drenas for the second day.	Participants KHMI:2
May 30 (Thu), 2019	Stop sampling at No.1 point and No.2 point in Drenas.	JET
Jun. 3 (Mon), 2019	Weighing of filters by demonstration and OJT	Participants KHMI:2

Regarding the samples from the Point No. 2 from May 29 to 30, the concentration of Ni (Nickel) showed 35ng/m^3 that exceeds the guideline value of Japan. Guideline value of Japan for Ni is 25ng/m^3 as an annual average. In EU, the environmental standard using PM_{10} for Ni is 20ng/m^3 (annual average).

Photo 3-26 Additional PM sampling in the air in Drenas

Table 3-93 Result of heavy metals concentration in TSP in Drenas (2019)

Location	**No.1 Drenas**	**No.2 Drenas**	**No.1 Drenas**	**No.2 Drenas**	**Guideline Value in Japan (TSP, Annual average)**	**Environmental Standard in EU (PM_{10}, Annual average)**
Sampling (24 hours)	2019/5/28～5/29	2019/5/28～5/29	2019/5/29～5/30	2019/5/29～5/30		
Sampling location	1.2 km South of factory	1.5 km Northeast of factory	1.2 km South of factory	1.5 km Northeast of factory		
TSP (µg/m^3)	**28.2**	**93.2**	**30.1**	**78.3**	**-**	**-**
Mn(ng/m^3)	4.9	9.7	5.6	19.6	**140**	**-**
Ni(ng/m^3)	2.9	14.8	3.5	**35.0**	**25**	**20**
As(ng/m^3)	<0.15	0.6	0.2	0.7	**6**	**6**
Cd(ng/m^3)	<0.06	0.43	0.05	0.41	**-**	**5**
Pb(µg/m^3)	0.001	0.005	0.001	0.004	**-**	**0.5**
Zn(µg/m^3)	0.008	0.090	0.009	0.105	**-**	**-**

Note: Highlighted cell is exceeding the guideline value of Japan (Annual average)

In response to the result of heavy metals concentration in TSP in Drenas, MESPI/MESP decided to continue monitoring the heavy metals in PM in the air in both Mitrovica and Drenas.

2) PM sampling for monitoring heavy metals in PM in the air

In EU, PM sampling for analysis of heavy metals in the air carried out by using the low volume air sampler (hereinafter referred to as “EU method”, where collected particles are PM_{10}) and on the other hand, PM sampling in Japan is carried out by use of the high volume air sampler (hereinafter referred to as “Japanese method”, where collected particles are TSP). Kosovo, which aims at becoming a member of the EU, intends to adopt the EU method. The EU method of sampling and the Japanese method of sampling were conducted in parallel in the first period, May and June 2018, and the following problems were found in the EU method sampler (called “Tecora”, low volume air sampler) owned by KHMI.

- The software is old and cannot communicate with computer because of the different operating system.
- Sampling data such as total suction volume, average temperature, average pressure, suction volume converted to 20 ° C, 1 atm, etc. cannot be collected.
- The sampler itself was very dirty, and an abnormal concentration was detected in the sampling in the first period, May and June 2018. (There is a possibility that the inside of the sampler was contaminated.)

For this reason, the following options can be considered.

a) To purchase a new PM_{10} low volume air sampler, and conduct the sampling by EU method.
b) To repair the problems of Tecora and implement the EU method.
c) To use Japanese method, high volume sampler introduced by the Project and carry out sampling in accordance with the Japanese method.
d) To combine EU method and Japanese method.

The issue is which alternative should be selected. Table 3-94 shows the features of Japanese method and EU method.

Table 3-94 Japanese method and EU method PM sampling in the air (particle size and method)

Name of method	Name of collected particles	Definition	Device for sampling
Japanese Method	TSP (Total Suspended Particulate)	All suspended particulate matter in the air	HV (High volume air sampler: actually up to a diameter of 30 μm)
EU Method	PM_{10} (Particulate Matter 10)	Diameter of 10μm or less (50% efficiency cutoff)	LV (Low volume air sampler) for PM_{10}

Inclusive relationship between TSP and PM_{10} is shown in Figure below.

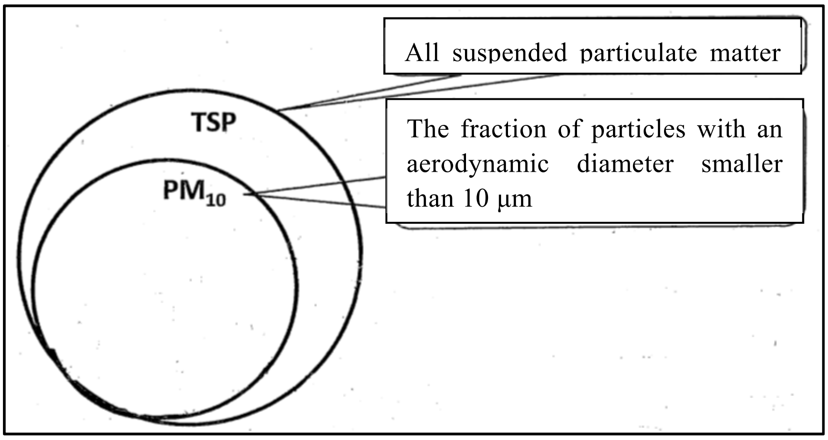


Figure 3-22 Inclusive relationship between TSP and PM_{10}

The high volume air sampler collects TSP, which are actually PM of up to diameter 30 μm, and the low volume sampler collects PM of 10 μm or less. When comparing the weight of heavy metals contained in 1 m^3 of air at 20 ° C and 1 atm (μg /m^3), the amount of heavy metals in TSP is larger than the one in PM_{10} from the principle shown in Figure 3-22. Relationship is expressed by the following equation.

The amount of heavy metal in TSP (μg/m^3) ≧ The amount of heavy metal in PM_{10} (μg/m^3)

Therefore, when sampled at the same place and the same time, the measured value by the Japanese method shows always larger value than the one by the EU method. In other words, Japanese method always evaluates the concentration at the safer side than the EU method, from the view point of the exposure of population to heavy metals.

Considering options in selecting the EU method or Japanese method, b) Repair of the low volume sampler is not feasible because manufacturers and agents did not respond to requests from the KHMI in the past. a) Purchase of a new low volume sampler also requires at least one year for MESPI/MESP's budget allocation, and there can be a shortage in the budget. c) Kosovo side does not prefer adopting Japanese method permanently. The Project recommends conducting measurements using Japanese high volume sampler as a bridge until purchasing an EU method PM_{10} sampler (Option d)). The high volume sampler can be used as a backup after purchasing the EU method equipment, since it evaluates concentration at the safer side.

3.5.2 Evaluation for the Objectively Verifiable Indicators in the PDM

Objectively Verifiable Indicators in the PDM are “Measurements for NO_X, SO_2 and Hg for LCPs as required by the EU Directive based on reference methods are conducted at least twice during the Project implementation”, “The three SOPs for NO_X, SO_2 and Hg in stack gas for LCPs based on reference methods are elaborated” and “Assessment of importance of heavy metal contents in ambient PM is conducted”.

The measurement of NO_X and SO_2 were conducted eight times in LCPs (TPP Kosovo A: six times, TPP Kosovo B: two times) and one time fin Ferro-Nickel factory. The measurement of total mercury was conducted eight times in LCPs the same as the measurement of NO_X and SO_2. The measurement of total mercury was not conducted in the Ferronickel factory. The condition to carry out measurements more than twice was satisfied.

Four SOPs were drawn up for analysis by the IC. One is for NO_X gas sampling and one for SO_2 gas sampling, one for preparing solutions for the IC analysis and one for the IC operation. Two SOPs were drawn up for analysis of mercury. One is for gas sampling and one for preparation of standard solution and reagents. Therefore, six SOPs in total were drafted for the Standard Reference Method.

Objectively Verifiable Indicator for heavy metal monitoring is “Assessment of importance of heavy metal contents in ambient PM is conducted”. In Mitrovica and Drenas, some components in the sampled PM exceeded the Japanese guideline values. Thus, heavy metal content in PM in the air was assessed, and MESPI/MESP decided to monitor PM in the air in the third JCC meeting.

In this way, all Indicators in Output 4 were achieved.

3.5.3 Capacity development through activities

The Project aimed at capacity development for laboratory analysis. C/Ps learned and acquired the operation technology by the IC through the activity of analyzing the exhaust gas by Standard Reference Method. As for analysis, it is important to acquire technology for analysis and at the same time, to learn accurate sampling techniques in order to guarantee the analysis results. C/Ps learned the process of the series of activities which are sampling, pretreatment and analysis regarding exhaust gas analysis by Standard Reference Method. Furthermore, C/P requested additional training in order to deepen understanding of these activities, and C/P acquired the technology and improved the capacity. From now on, it is important how to use the acquired capacity. Same thing can be said on the use of the technology of the ICP-MS operation and analysis.

As for the monitoring of heavy metals in the air, the Project provided high volume sampler, and the Kosovo side has acquired the technology to sample PM in the air. At the same time, the Project found that the low volume sampler brought to KHMI by EU in the past did not function properly. Analyses of heavy metals were conducted in to Japan, but the ICP-MS has been re-functioned through the repair and adjustment by the Project, and is now ready for the analysis of heavy metals. Implementation of the analysis is waiting for the training by MCC/MFK.

As for heavy metal monitoring in PM in the air, it is desirable to perform sampling and analysis once a month because heavy metal in the PM is evaluated using the average annual value, but it is required to be performed at least four times a year.

In KHMI there is only one engineer who can operate ICP-MS, so it is necessary to increase the number of staff for at least one.

As for the PM sampling, it is an option to outsource the work to the private sector, since PM sampling work is less difficult.

3.6 Output 5: Capabilities for air quality simulation modeling are developed.

3.6.1 Activities

Seminars, lectures and on-the-job training (OJT) were conducted in order for the C/P to develop their capacity regarding atmospheric simulation modeling. The simulation based on the first emission inventory developed by the emission inventory group in the second period is called "the first simulation model" and the one based on the second emission inventory is called "the second simulation model". The list of activities carried out is shown in Table 3-95. These activities have improved their ability to construct atmospheric simulation modeling. A list of the materials used is attached in Appendix-1.

Table 3-95 Seminars, lectures and OJT for atmospheric simulation modeling

First period		
Date	Content	Participants
2017/12/11(Mon)	Work plan for Simulation model (Work Breakdown Structure (WBS) for Activity 5), Introduction for Simulation model Necessary meteorological and geographical data	C/P: 5
2017/12/20(Wed)	Availability of necessary meteorological and geographical data in Kosovo Assignment of each data collection among C/P members	C/P: 3
2018/5/14(Mon)	Elevation Data Pre-Processor: Installation of the program, download and arrangement of input data, execution of the program, output check	C/P: 4
2018/5/17(Thu)	Elevation Data Pre-Processor: Review training Land Use Data Pre-Processor: Installation of the program, download and arrangement of input data, execution of the program, output check	C/P: 5
2018/5/18(Fri)	Elevation Data Pre-Processor: Review training Land Use Data Pre-Processor: Review training Geographical Data Pre-Processor: Execution of the program, output check	C/P: 4
2018/5/21(Mon)	Overall: Review training Evaluation of ambient air monitoring data	C/P: 4
Second period		
2018/11/12(Mon)~13 (Tue)	Lectures and Training for Upper air data preparation and its preprocessor	C/P: 5
2018/11/15(Thu) ~ 16(Fri)	Lectures and Training for Surface air data preparation and its preprocessor	C/P: 5
2018/11/21(Wed), 11/23(Fri), 1/30(Fri)	Lectures and Training for Meteorology model	C/P: 5
2019/2/14(Thu) ~ 15(Fri), 2/20(Wed)	Point Source Emission calculation and its preprocessor (time and spatial distribution), and preparation of input file	C/P: 6
2019/2/20(Wed)~2/22(Fri), 2/25(Mon)	Training for implementation of Main program of air dispersion model	C/P: 6
2019/5/24(Fri), 5/29(Wed), 6/6(Thu)~6/7(Fri)	Area Source Emission calculation and its preprocessor, and preparation of input file	C/P: 6
2019/6/10(Mon), 6/13(Thu)~6/14(Fri)	OJT for implantation of air dispersion model using area source emissions	C/P: 6
Third period		
2019/11/7(Thu)	Training for AQMS data checking	C/P: 5
2019/11/19(Tue)	Training for simulation modeling (Waste sector)	C/P: 1
2019/11/21(Thu)	Training for simulation modeling (Waste sector)	C/P: 6
2020/2/12(Wed)	Making line source emission data from Vehicles using GIS data, Training for simulation model calculation	C/P: 3
2020/2/19(Wed)	Making line source emission data from Vehicles using	C/P: 3

	GIS data, Training for simulation model calculation	
2020/2/26(Wed)	Making line source emission data from Vehicles using GIS data, Training for simulation model calculation, Visualization of the simulation result	C/P: 3
2020/3/3(Tue)	Overall seminar of simulation modeling, for other working group members	C/P: 3
Additional activities in the third period		
2020/11/18 (Wed)	Discussion on establishment of the simulation implementation framework	C/P: 8
2020/11/25 (Wed)	Discussion on establishment of the simulation implementation framework	C/P: 6
2020/11/30 (Mon)	Analysis of air quality during the lockdown in Kosovo Lectures on the analysis result of the air quality during the lockdown	C/P: 4
2020/12/2 (Wed)	Calculation of Measures for Households changing to Electric Heater	C/P: 7
2020/12/16 (Wed)	Calculation of Measures for Households changing to Electric Heater	C/P: 6
2021/1/13 (Wed)	Confirmation on Progress of Additional Remote Activities	C/P: 6
2021/1/20 (Wed)	Calculation of Measures for Households changing to Electric Heater	C/P: 5
2021/1/27 (Wed)	Exercise for making Concentration map	C/P: 2
2021/2/4 (Thu)	Calculation of Measures for Households changing to LPG Heater	C/P: 4
2021/2/10 (Wed)	Calculation of Measures for Households changing to LPG Heater	C/P: 5
2021/2/12 (Wed)	Calculation of Measures for Regulation by Vehicle Number	C/P: 4
2021/2/22 (Mon)	Calculation of Measures for Regulation by Vehicle Number	C/P: 4
2021/3/3 (Wed)	Preparation for wrap up seminar for Simulation modeling group	C/P: 5
2021/3/9 (Tue)	Preparation for wrap up seminar for Simulation modeling group	C/P: 5
2021/3/18 (Thu)	Preparation for wrap up seminar for Simulation modeling group	C/P: 5
2021/3/24 (Wed)	Wrap up Seminar with JICA HQ　-Achievements of the Simulation modeling group	C/P: 5. JICA HQ, Balkan office
2021/4/8 (Thu)	Simulation modeling of Brick factory	C/P: 5
2021/4/21 (Wed)	Discussion on Final Report	C/P: 3

(1) Collecting Input data (Activity 5-2)

The data required for the establishment of the atmospheric dispersion simulation model was collected. The progress of data collection was as follows. A summary of the data obtained is shown in Table 3-97.

1) Meteorological Data

Hourly monitoring data at KHMI automatic station was used for meteorological data at ground level in the target area. Figure 3-23 shows the wind rose for the target period of the second simulation model, which is for one year from Jan. 19 2018 to Jan. 18 2019. The manual measurement data of the KHMI and the measurement data at the airport (downloaded from the public database) were not used because of many missing data. Through discussions with the airport's meteorological measurement personnel it was confirmed that no upper-level air data is measured in Kosovo. The data from a neighboring country were used as the closest point among the available data points, assuming that they are situated in the same meteorological system due to their proximity as neighboring countries.

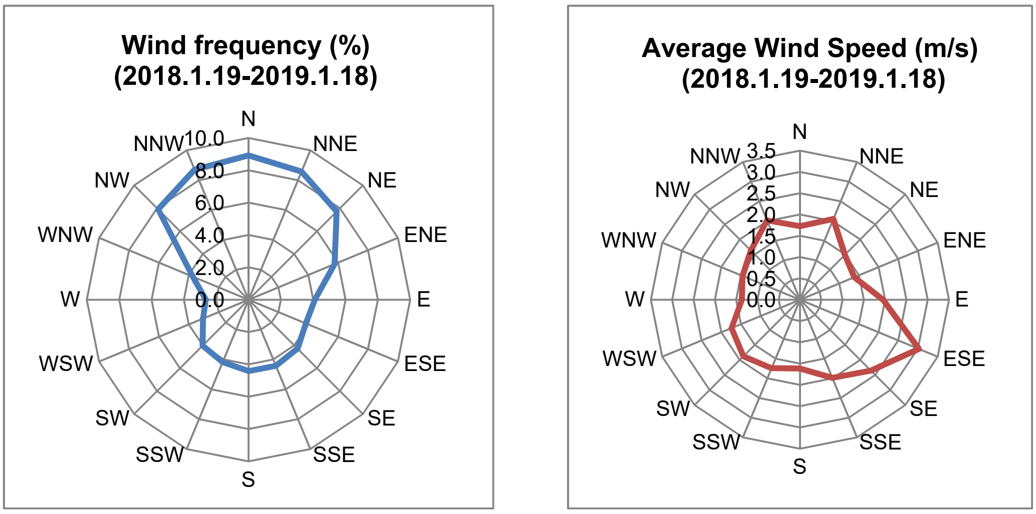


Figure 3-23 Wind rose chart at KHMI for the target period (2018/01/19~2019/1/18)

2) Air quality monitoring data collection

The monitoring data for one year from January 2018 at AQMS in the target area was used for validation of simulation results. The measurement data were obtained from KHMI, and then organized and evaluated. The results of the validation of the air quality measurement data are shown in Table 3-96. The data check was carried out by the following procedure.

Step 1: To exclude missing values or clearly abnormal values such as values that appear to be measured during the process of calibration or maintenance work, consecutive zero values or negative values.

Step 2: To compare concentration values among the five stations in the Pristina Area and exclude unreliable portions based on time variation patterns, orders of absolute values, and characteristics of each pollutant.

Step 3: To select the data for the validation of the simulation, if the hourly data remaining after the above screening are more than 60% of the total number of hours covered by the simulation..

PM_{10} and $PM_{2.5}$ data in the target period of the second simulation model, which is from January 2018 to January 2019, was relatively reliable. Only at Palaj station, valid data did not reach 60%. On the other hand, there was a large difference between the stations in SO_2 monitoring data, and there was an extreme rupture in the time series. Due to the questionable accuracy, SO_2 data was not used for validation of the simulation model results.

Table 3-96 Validation of Air Quality Monitoring Data

PM_{10} µg/m3	Observed Value	Data count	Valid data (%)
Rilindje	32.4	8430	96.2%
IHMK	40.9	8735	99.7%
Palaj	21.2	4709	53.8%
Obiliq	38.1	7245	82.7%
Dardhishte	33.1	6597	75.3%

SO_2 µg/m3	Observed Value	Data count	Observed Value
Rilindje	—	—	—
IHMK	—	—	—
Palaj	15.9	5800	66.2%
Obiliq	64.3	8098	92.4%
Dardhishte	—	—	—

NO_X µg/m3	Observed Value	Data count	Observed Value
Rilindje	—	—	—
IHMK	32.0	2694	30.8%
Palaj	16.1	8519	97.2%
Obiliq	30.0	8491	96.9%
Dardhishte	27.1	8299	94.7%

NO_2 µg/m3	Observed Value	Data count	Observed Value
Rilindje	39.5	8312	94.9%
IHMK	28.5	5182	59.2%
Palaj	9.8	6279	71.7%
Obiliq	17.8	8615	98.3%
Dardhishte	17.6	8307	94.8%

3) Altitude and Land use data

Information on population distribution, road network and land use needed for spatial distribution of emissions was obtained through the GIS staff of the MESPI/MESP, who joined the C/P group members in 2018.

Table 3-97 shows the collected data.

Table 3-97 Collected data for the Simulation Modeling

Necessary items			1st stage Simulation modeling	2nd stage Simulation modeling
Surface Meteorological data	Wind speed	hourly	- One month (2018.01.19-2018.02.18)	- One year (2018.01.19-2019.01.18)
	Wind direction	hourly		
	Temperature	hourly	KHMI automatic weather station data - Hourly data - Start from 2018.01 (working to present) - No Cloud cover, Ceiling height Integrated Surface Database (ISD) - No Cloud Cover, Pressure, Precipitation Existing	
	Cloud cover	hourly		
	Ceiling height	hourly		
	Surface pressure	hourly		
	Relative humidity	hourly		
	Precipitation rates	hourly		
	Precipitation type code	hourly		
Upper air data	Wind speed	at least twice a day	- One month (2018.01.19-2018.02.18)	- One year (2018.01.19-2019.01.18)
	Wind direction	at least twice a day		
	Temperature	at least twice a day	NOAA/ESRL Radiosonde Database - No data in Kosovo	
	Pressure	at least twice a day		
	Elevation	at least twice a day		
Geographical data	Altitude		GMTED2010 - data available	
	Land use categories		Global Land Cover Characterization (GLCC) - data available	
Ambient Air Quality Monitoring Data	NO_X	hourly	KHMI monitoring data - Hourly data	
	SO_2	hourly		
	PM_{10}	hourly		
	$PM_{2.5}$	hourly		
	CO	Hourly		
Temporal and Spatial distribution of Emission Sources	Households		Distributed to each grid as area source, according to the population distribution of each municipality	Emission distribution has been modified, assuming that most households in the area where there is district heating by Termokos do not use fuels for heating in their homes.
	Vehicles		Distributed to each grid as area source, according to the total road length included in each grid	Emission from each road segment was calculated and allocated as line source for major roads, which were studied through traffic counting in this Project. Emission from other roads was allocated as area source for each grid.

(2) Calculation of Simulation model

The calculation flow of the simulation programs is shown in Figure 3-24.

After revising and reviewing the programs executed in the first and second period, training on the preparation of various emission source data, execution of the simulation calculation program, and the making concentration maps using GIS was conducted.

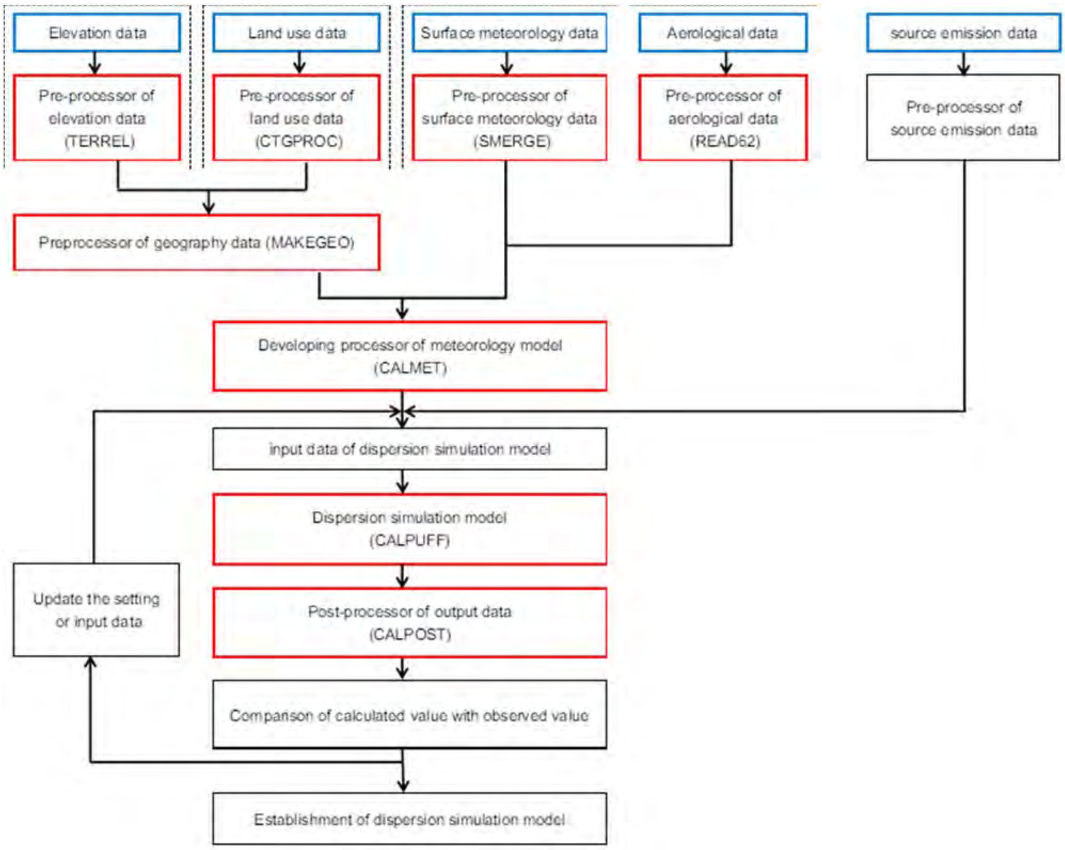
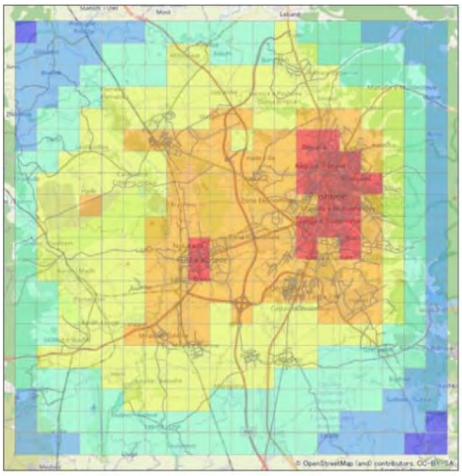


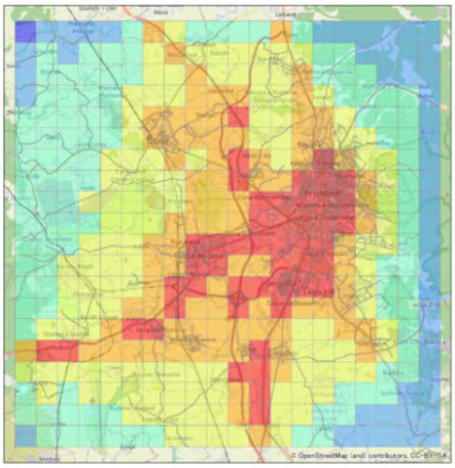
Figure 3-24 Calculation flow of the simulation model programs

Photo 3-27 Training on Simulation modeling

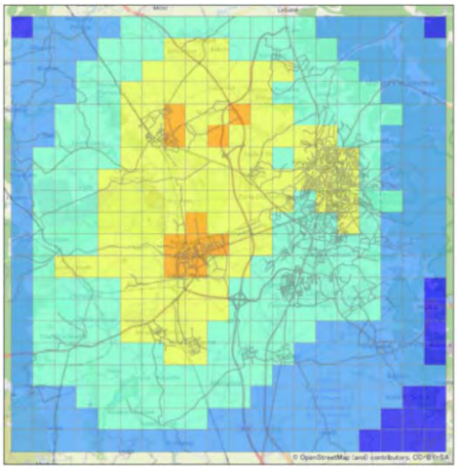
As the second emission inventory was finalized in March 2020, the second simulation calculations were carried out utilizing this inventory. The results of the comparison between calculated values and observed values at the AQMSs are shown in Table 3-98, and the concentration map of the calculated results within the target period of the second simulation model (one year starting from 19th Jan. 2018) is shown in Figure 3-25.



Limit Value for human health
Daily Average: 50µg/m^3, < 35 times/year
Annual Average: 40µg/m^3



Limit Value for human health
Hourly Value: 200µg/m^3, < 18 times /year
Annual Average: 40µg/m^3



Limit Value for human health

Hourly Value：350µg/m^3, 24 times or less

Daily Average : 125µg/m^3, 3 days or less per year

Figure 3-25 Concentration map calculated by Simulation model (including emissions from power plants, vehicles, households, small business, Fugitive dust from coal mining and storage yard)

Limit Value for human health[26]

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[26] DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 May 2008 on ambient air quality and cleaner air for Europe

The following is a summary of the current calculation results.

1) Results

- Most of the pollutant concentrations at the stations in the simulation models were underestimated compared with the actual observed values in AQMSs and the simulation models and emission inventories still need to be improved.
- The largest emission sources of air pollutants in the Pristina Area are coal-fired power plants. However, the largest contributor at the ground level for PM are household emission sources such as heating, and as for NO_X, vehicles contribute quite a lot.
- It should be noted that the above results are still in the trial stage.

2) Issues

- In order to build a simulation model, it is necessary to compare the observed values and calculated values in order to validate the calculation results. However, as shown in 3-6-1(1) 2), the observed monitoring data for the target period were found to be questionable. In order to validate simulation modeling reliability of the monitoring data is necessary.
- As no upper air data was found in Kosovo, observation data from the neighbor country was used.
- The simulation model can be improved by setting more accurate time patterns
- Regarding PM_{10}, Secondary particle is not taken into consideration.

Table 3-98 Comparison between observed values and calculated values
(Second stage simulation model target period, 2018/1/19 – 2019/1/18)

PM_{10} µg/m3	Power plant	Transport	House-holds	Small Business	Fugitive Dust	Waste	Calculated Value	Observed Value
Rilindje	1.0	8.0	36.7	2.8	0.4	0.000	48.9	32.4
IHMK	1.1	2.9	23.5	1.5	0.9	0.000	29.9	40.9
Palaj	1.3	0.4	6.7	0.5	8.6	0.002	17.5	-
Obiliq	2.1	0.7	11.6	1.1	4.3	0.001	19.9	38.1
Dardhishte	1.8	0.7	13.6	1.0	8.5	0.003	25.6	33.1

NOx µg/m3	Power plant	Transport	House-holds	Small Business	Fugitive Dust	Waste	Calculated Value	Observed Value
Rilindje	2.6	125.2	2.8	6.7	0.0	0.001	137.3	-
IHMK	3.0	51.9	1.8	3.4	0.0	0.003	60.2	32.0
Palaj	3.5	6.6	0.8	1.2	0.0	0.040	12.2	16.1
Obiliq	6.5	12.0	1.5	2.7	0.0	0.029	22.7	30.0
Dardhishte	5.2	11.6	1.5	2.3	0.0	0.071	20.6	27.1

SO2 µg/m3	Power plant	Transport	Households	Small Business	Fugitive Dust	Waste	Calculated Value	Observed Value
Rilindje	4.5	0.2	3.1	1.9	0.0	0.000	9.7	—
IHMK	5.2	0.0	2.5	1.0	0.0	0.001	8.6	—
Palaj	5.8	0.0	4.4	0.4	0.0	0.007	10.6	15.95
Obiliq	9.9	0.0	8.4	0.8	0.0	0.005	19.0	—
Dardhishte	8.3	0.0	6.6	0.7	0.0	0.012	15.6	—

(3) Additional activities in the third period

- Analysis of the Air Quality during the Lockdown

As additional activities in the third period, analyses of the air quality data was carried out as the reliability of the data has been improved due to the rehabilitation of the analyzers and meteorological instruments, and the establishment of the data network.

The Project analyzed the air quality condition during COVID-19 lockdown period (March to April 2020) based on the data obtained in this period. Details are shown in Appendix-1, Third period, other (9) “3)-1 Analysis of the Air Quality during the Lockdown”. NO_X was significantly reduced due to the decrease in the traffic volume during the lockdown. However, SO_X did not change, and PM did not change either since the season of heating had already passed.

- Support for analysis and evaluation of air quality data during one year

Accurate air quality data over one year (four seasons) became available because of the completion of the rehabilitation of analyzers in all AQMSs in Kosovo in November 2019 and the extension of the Project period. Therefore, the Project assisted the data analysis and evaluation of air quality status for one year by the Kosovo side.

Table 3-99 shows valid hours of air quality monitoring data and time coverage in 2020 for each AQMS. As for PM_{10}, $PM_{2.5}$ and NO_2, almost all AQMSs cover more than 8,000 hours of valid air quality data and time coverage is higher than 90%. Since the completion of analyzer rehabilitation in November 2019, it is found that O&M for analyzers has been carried out appropriately.

Table 3-99 Valid hours and time coverage of air quality monitoring data in 2020 for each AQMS

Place of AQMS	PM_{10}		$PM_{2.5}$		NO_2		O_3		SO_2		CO	
	Valid hours	Time coverage (%)	Valid hours	Time coverage (%)	Valid hours	Time coverage (%)	Valid hours	Time coverage (%)	Valid hours	Time coverage (%)	Valid hours	Time coverage (%)
Brezovica	7717	87.85	7709	87.76	6675	75.99	6923	78.81	6449	73.42	5827	66.34
Dardhishte	8037	91.50	8124	92.49	8043	91.56	7761	88.35	8034	91.46	7744	88.16
Drenas	8313	94.64	8312	94.63	8002	91.10	8162	92.92	7322	83.36	7122	81.08
Gjilan	7855	89.42	7855	89.42	7217	82.16	7324	83.38	6565	74.74	5585	63.58
Hani i Elezit	7945	90.45	7945	90.45	7335	83.50	7277	82.84	7615	86.69	5483	62.42
Mitrovica	8336	94.90	8336	94.90	7831	89.15	7415	84.41	7976	90.80	6812	77.55
Obiliq	8590	97.79	8590	97.79	8184	93.17	7872	89.62	8172	93.03	8059	91.75

Palaj	8582	97.70	8582	97.70	8247	93.89	8176	93.08	8235	93.75	7194	81.90
Peja	8697	99.01	8697	99.01	8169	93.00	8138	92.65	7300	83.11	7859	89.47
Prishtina, KHMI	8525	97.05	8525	97.05	8287	94.34	8158	92.87	8181	93.14	8248	93.90
Prishtina, Rilindja	8573	97.60	8573	97.60	7970	90.73	8067	91.84	8230	93.69	8146	92.74
Prizren	8660	98.59	8660	98.59	8022	91.33	8154	92.83	8120	92.44	6062	69.01
Mobile	1071	12.19	1071	12.19	909	10.35	2342	26.66	2475	28.18	2440	27.78

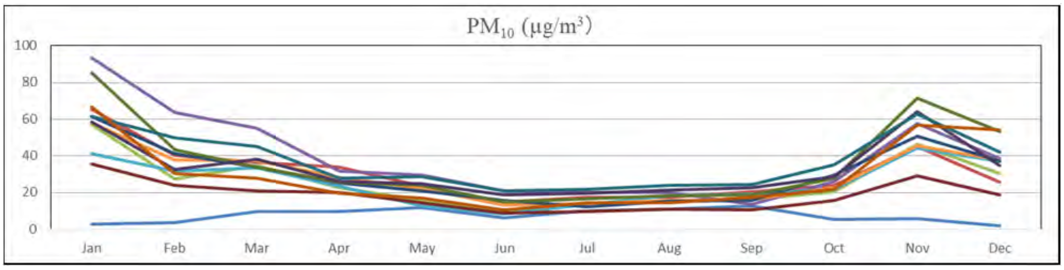
The exceedance hours of PM_{10} daily limit value in 2020 are from 48 hours in Hani i Elezit to 117 hours in Gjilan, excluding the ones in Brezovica that is the background AQMS located in an isolated place. In the case of NO_2, O_3 and SO_2, almost no exceedance of limit values were found.

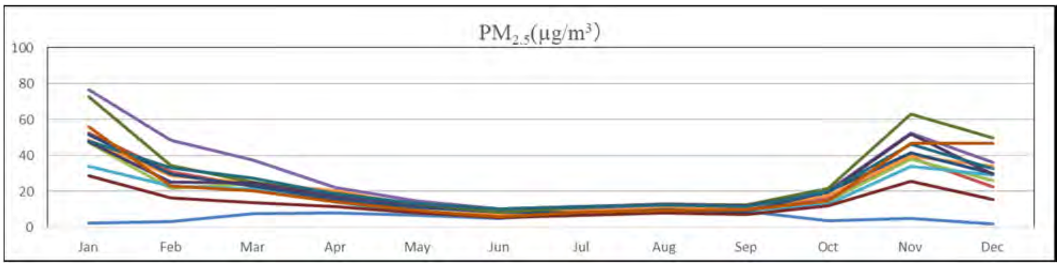
The trend of monthly data in 2020 is shown in Figure 3-26.

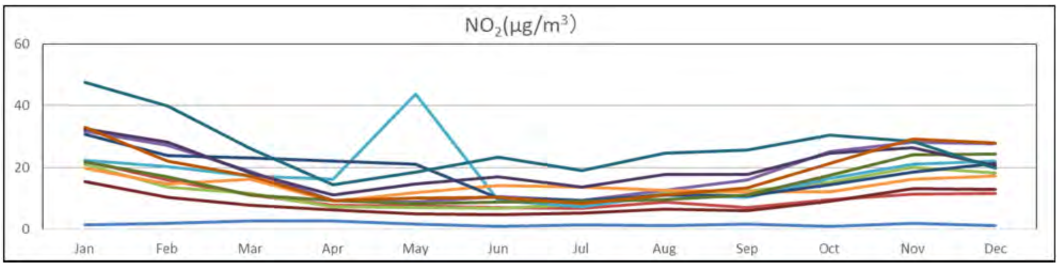
PM_{10} and $PM_{2.5}$ are the highest in January and the second highest in November. In the summer season, they are very low. The average value of PM is high in Gjilan and Peja.

NO_2 is highest in January and relatively low from April to September. Higher NO_2 is observed in Prishtina, Rilindja.

O_3 is highest in April and lowest in November. O_3 is very high in Brezovica which is a back ground AQMS, as there is very little influence of NO_X from vehicles and stationary sources.


PM_{10} ($\mu g/m^3$)


$PM_{2.5}$($\mu g/m^3$)


NO_2($\mu g/m^3$)

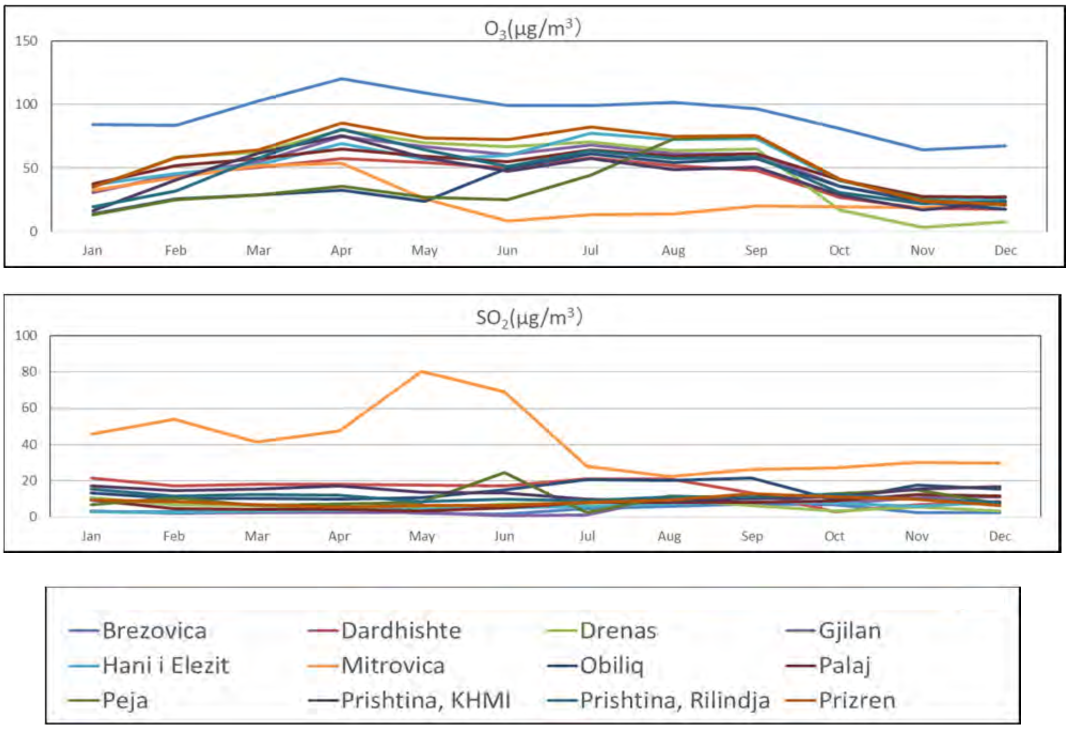
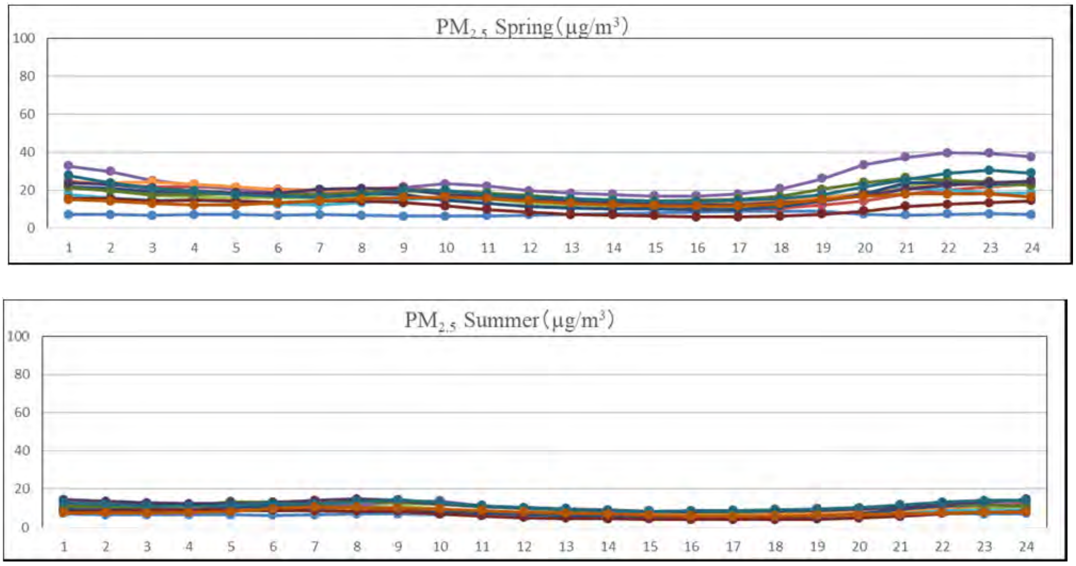


Figure 3-26 Monthly trend of air quality data (2020)

Figure 3-27 shows the trend of the time of the day of $PM_{2.5}$ for seasons of the year. In most AQMSs, $PM_{2.5}$ is high in autumn and winter. In a day, $PM_{2.5}$ is low from 15 to 16 o'clock and high from 20 to 22 o'clock. In Brezovica, $PM_{2.5}$ is a little bit high in summer, but it does not depend on the time of the day all through the year.



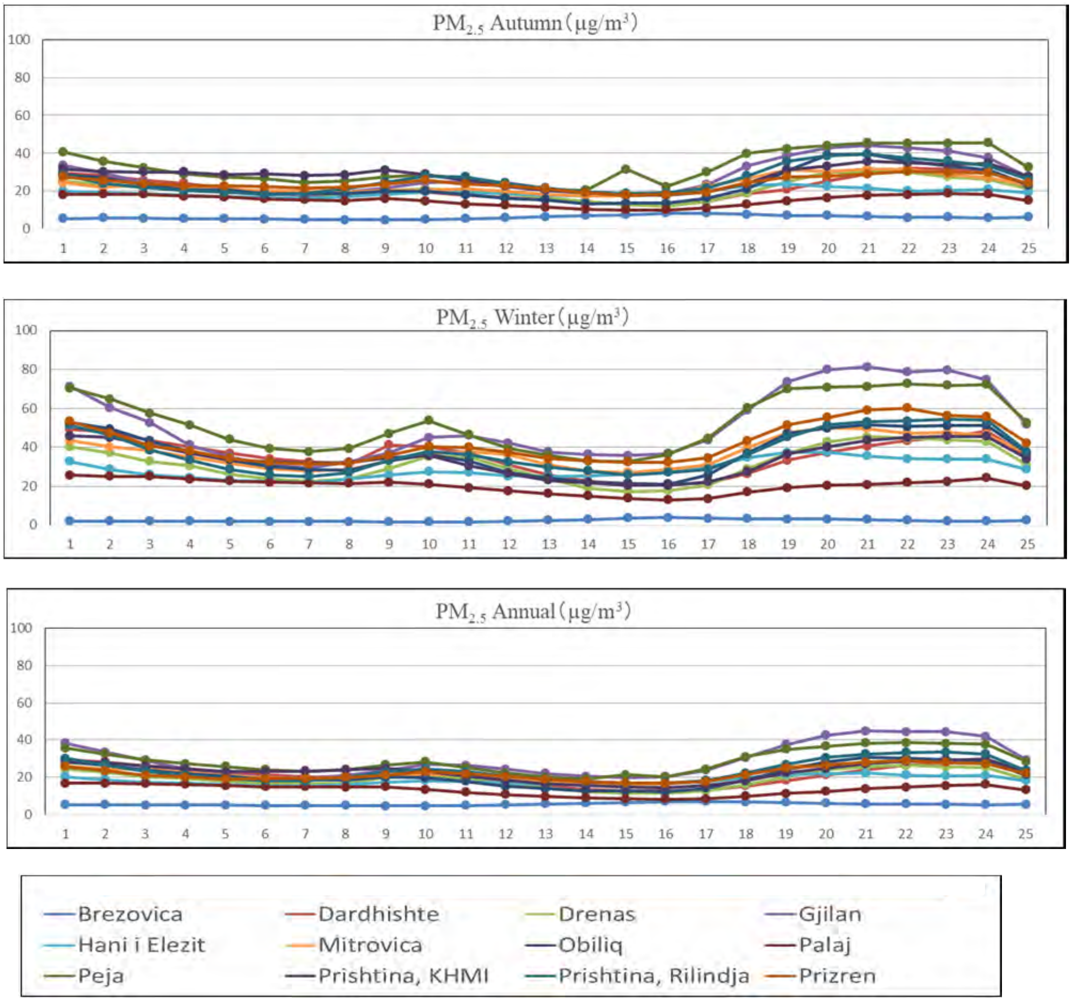


Figure 3-27 Trend of the time of the day of $PM_{2.5}$ for seasons of the year (2020)

- Institutional framework for Simulation Modeling

In order to make simulation modeling activity sustainable after this project, it is necessary to prepare the following.

- Clarification of necessary steps involved in simulation modeling
- Agreement on roles and responsibilities of related organizations
- Stipulation as a government task

The simulation modeling group made a list of necessary steps for simulation modeling, then discussed about the roles and responsibilities for each step with KHMI, KEPA and DEPW.

The roles and responsibilities agreed among three institutions are indicated in Table 3-100.

Table 3-100 Roles and responsibilities for simulation modeling

Activity			Description	Responsible Organization
Collecting Data; Air Quality monitoring Data	NO_X	hourly	KHMI monitoring data - Hourly data	KHMI/Air Monitoring Sector
	SO_2	hourly		
	PM_{10}	hourly		
	$PM_{2.5}$	hourly		
	CO	hourly		
Collecting Data; Surface Meteorological data	Wind speed	hourly	- Target year KHMI automatic weather station data - Hourly data - Started from 2018.01 (working to the present) - No Cloud cover, Ceiling height Integrated Surface Database (ISD) - No Cloud Cover, Pressure, Precipitation Existing	KHMI/ meteorology sector
	Wind direction	hourly		
	Temperature	hourly		
	Cloud cover	hourly		
	Ceiling height	hourly		
	Surface pressure	hourly		
	Relative humidity	hourly		
	Precipitation rates	hourly		
	Precipitation type code	hourly		
Collecting data; Upper air data	Wind speed	at least twice a day	- Target year NOAA/ESRL Radiosonde Database - No data in Kosovo	KHMI/ meteorology sector
	Wind direction	at least twice a day		
	Temperature	at least twice a day		
	Pressure	at least twice a day		
	Elevation	at least twice a day		
Collecting Data; Geographical Data	Altitude		**GMTED2010** - **Provider**: The U.S. Geological Survey (USGS) and the National Geospatial-Intelligence Agency (NGA) - **Resolution** : 30, 15, 7.5 arc-second - **Format:** GEOTIFF - **Geographic Coordinate System:** WGS84	KEPA/Directorate for Environmental Assessment /GIS Sector (Grid data is from Spatial Planning Institute
	Land use categories		**Global Land Cover Characterization (GLCC)** - **Provider;** The U.S. Geological Survey (USGS) - **Resolution:** 30 arc-second (~1 km) - **Date of Data:** 1997 (Version 1), 1999 (Version 2)	KEPA/Directorate for Environmental Assessment /GIS Sector (Grid data is from Spatial Planning Institute)
Collecting Data; Emission Data	Emission Inventory			Directorate for Environmental Assessment / Emission Inventory Group
Collecting Data; Temporal and Spatial distribution of Emission Sources	Power plant		- **Spatial Distribution:** Coordination of the chimney, chimney height, gas speed, etc. - **Temporal Distribution:** Constant	Directorate for Environmental Assessment / Emission Inventory Group
	Households		- **Spatial Distribution:** Distributed to each grid as area source, according to the population distribution of each municipality - **Temporal Distribution:** Constant	Directorate for Environmental Assessment / Emission Inventory Group
	Vehicles		- **Spatial Distribution:** Emission from each road segment was calculated and allocated as **line source for major roads**, which were studied through traffic counting in this Project.	Directorate for Environmental Assessment / Emission Inventory Group

			Emission from **minor roads was allocated as area source** for each grid. - **Temporal Distribution:** 24h Change from traffic volume survey	
Making input files for simulation modeling from the collected data	Air Quality monitoring Data		- Validation of the AQM data: Checking the number of missing data, abnormal data, etc. - Calculation of averaged concentration in the target period	**KHMI /Air monitoring Sector**
	Meteorological Data		- Validation of the meteorology data: Checking the number of missing data, abnormal data etc. - Conversion of original data using: READ62, SMERGE programs	**KHMI /Air monitoring Sector**
	Geographical Data		- Conversion of original data using : TERREL, CTGPROC, MAKEGEO programs	**KHMI /Air monitoring Sector**
	Emission Data		- Conversion of original data using: Excel files into CALPUFF.INP file	**KHMI /Air monitoring Sector**
Simulation Modeling	Calculation of simulation modeling		- Validation of the AQM data Checking the number of missing data, abnormal data etc. - Calculation of averaged concentration of the target period	**KHMI**
	Validation of the result		- Validation of the meteorology data: Checking the number of missing data, abnormal data etc. - Conversion of original data using: READ62, SMERGE programs	**KHMI**
	Making Concentration Map		- Visualization of calculation result using GIS	**KHMI**
Utilization for policymaking, and public communication	Policy making		- Drafting Measures - Evaluation of the effect of measures in the process of drafting the Strategy/Action plan on Air Quality - Decision on Policy	**DPEW**
	Public Communication		-	**Depending on Purpose (under instruction of the Office for communication with the public)**
	Collaboration with the academy		- Quality control of the simulation model	**KHMI**

1) Simulation Modeling for evaluation of the effect of measures

In order to evaluate additional measures, the simulation modeling group carried out the calculation using the simulation modeling. Kosovo side carried out the calculation using the simulation Computer in Kosovo, and JET supported their operation remotely. Through these training, Kosovo side improved their ability to carry out the simulation calculation independently. The result will be shown in the evaluation sheet described in Output 8.

3.6.2 Evaluation for the Objectively Verifiable Indicators in the PDM

The indicators defined in PDM to verify the achievement of Output 5 are "5.1 Dispersion simulation model for the current year is elaborated" and "5.2 Based on the current emission inventory, simulation model is implemented at least twice".

The PDM indicators for Output 5 have been achieved, as the simulation model has been implemented for the year 2018 using the second emission inventory prepared in Output 1, as described in 3-6-1.

3.6.3 Capacity development through the activities

The C/P have learned the purpose of the simulation model, how to operate the program, and how to analyze air pollution conditions by creating concentration distribution maps using GIS. The C/Ps learned the process of executing the programs not only by lectures but by operating program on the computer by themselves through a series of practical exercises.

In addition, the lectures for making the emission inventory, which is closely related to the construction of the simulation model, were held together with the simulation working group, and this has provided a better understanding of the relationship between emission inventories and simulation models, and the basic knowledge necessary to analyze the air pollution situation using these models.

On the other hand, in order for the Kosovo side to implement the simulation model independently in the future, it is necessary to improve knowledge and ability, as only a few of C/Ps seem to have necessary knowledge and ability. In addition, the calculation of simulation model is not specified in the MESPI/MESP's job description. It is essential to settle the simulation modeling calculation as the work of the MESPI/MESP, in order to keep and improve the simulation implementation capacity in Kosovo in a sustainable manner.

3.7 Output 6: Decision making by Kosovo side is improved based on technical evidence for air pollution control.

In Output 6, the Project supported the Kosovo side's decision making on air pollution control measures by studying emission reduction measures for LCPs and other stationary sources.

3.7.1 Activities

The Project supported the Kosovo side's decision making on air pollution control measures by studying emission reduction measures for TPP Kosovo A in line with the NERP and understanding of the actual emissions, as well as studying emission reduction measures for other stationary sources.

The Project, in response to the request from the Kosovo side, has not studied the emission reduction measures for TPP Kosovo B since the rehabilitation work by EU is now on-going, and the Project has limited its study only for TPP Kosovo A. TPP Kosovo A is scheduled to stop its operation in 2023 following the commencement of a new power plant (Kosova e Re), and therefore, the investment is highly restricted.

The new power plant is called "Kosova e Re" of which power generation capacity is 500 MW (other information say 450 MW). The London-based energy investment company "Contour

Global" concluded the Public Private Partnership contract with the Government of Kosovo in 2017. The plant is scheduled to start operation in 2022 to 2023. However, Contour Global withdrew from the construction of the Power plant in March 2020, and at present, the plan of the new power plant is pending and the response of the Kosovo side must be followed closely, including the review of the NERP. On the other hand, in case of making investment on TPP Kosovo A, it is necessary to study comprehensively since the facilities are obsolete and deteriorated and the performance is low, etc. Investment must be considered not only for emission reduction measures but also for measures on equipment renovation, life-extension, increase of power generation efficiency, etc. In this situation, the Project focused the studies on relatively inexpensive and feasible emission reduction measures.

Since the NERP started from the year of 2018, quick response was required, and because of this reason, the activities were placed on the first half of the Project period. As investment is restricted, the Project focused on studying affordable and feasible measures and proposed several measures. Part of the proposals has been actually applied to TPP Kosovo A, and it became one of the big outcomes of the Project.

On the other hand, as for other stationary sources, the Project carried out the study mainly in the last half of the Project after finishing the study for LCPs. Based on the exhaust gas measurement results and inspection results of the process and consumed fuels, the Project understood the real situation of emissions and emission reduction measures, and proposed the items to be improved. The leadership of MESPI/MESP which is the competent authority is the key to the implementation of the proposals.

(1) Activities regarding LCPs

In the Precedent Activity, emission reduction measures for LCPs have been studied in parallel with exhaust gas measurement. The NERP requests for Dust, SO_2 and NO_X from LCPs to meet the ELVs in accordance with EU directive. The purpose of the Precedent Activity was to support the Kosovo side for TPP Kosovo A and TPP Kosovo B, which are the LCPs in Kosovo, to plan concrete emission reduction measure in order to meet the ELVs.

The activities in the Precedent Activity were as follows.

- To support for the Kosovo side to draft the NERP submitted to EnC
- To support the Kosovo side to understand the actual emission condition from TPP Kosovo A and TPP Kosovo B and plan the emission reduction measures
- To give reference for future emission reduction measures through introduction of Japanese emission reduction technologies

The Precedent Activity carried out the study to understand the actual emission conditions and give proposals on emission reduction measures, and support the drafting of the NERP.

After the start of the Project, the study of the emission reduction measures has continued, even though the study was limited only to TPP Kosovo A.

The content of the activities in the Precedent Activity is as follows.

1) Activities regarding drafting of the NERP

Kosovo is a signatory of the Energy Community Treaty (EnCT). Referring to the policy guidelines of the Energy Community Secretariat, Contracting Parties of EnCT are obliged to develop the NERP. This Treaty obliges the implementation of the 'Acquis Communautaire' of EU, in particular on environment, through the implementation of Directives 2001/80/EC and 2010/75/EU on the limitation of certain pollutant emissions into the air from Large Combustion Plants (LCP) by each Contracting Party.[27] The NERP places the importance on the plan to meet the ELVs for SO_2, NO_X and Dust from LCPs by gradual reduction of specific emissions and the quantity of the pollutant emissions mentioned above. Emission reduction targets and the timing to achieve the requirements of Directive 2010/75/EU are as follows.

In the EU directive the target are plants with a heat input of 50MW and higher, and the ELVs are different depending on the type of fuel (solid, liquid and gas), starting time of the operation, scale of the heat input (ELVs change from 50 to 500 MW and are constant for higher than 500MW) and kind of facilities (boiler, gas turbine, etc.).

In Kosovo, only TPP Kosovo A and TPP Kosovo B are the targets of the NERP, and based on the fact that the LCPs in Kosovo are not new and consume lignite as a fuel, ELVs in the year of 2018 are stipulated as in Figure 3-28.

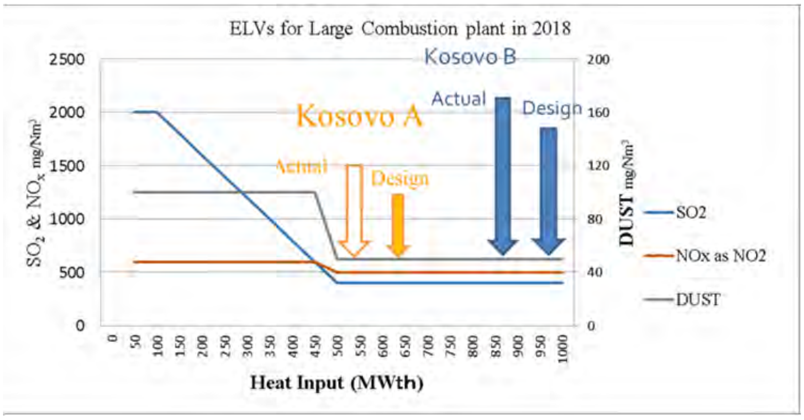


Figure 3-28 ELVs for TPP Kosovo A and TPP Kosovo B for 2018

As shown in the figure above, heat input of both LCPs in Kosovo is higher than 500MW, and based on this, the ELVs change annually as described in Figure 3-29.

As shown in the figure, the values of ELVs are changing and Contracting Parties which chose NERP must comply with the values.

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[27] https://energy-community.org/aboutus/whoweare.html

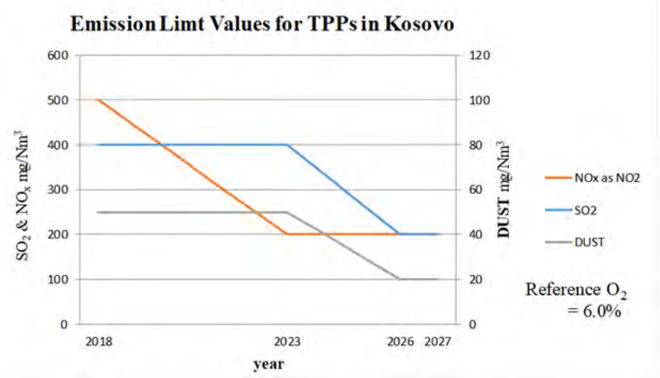
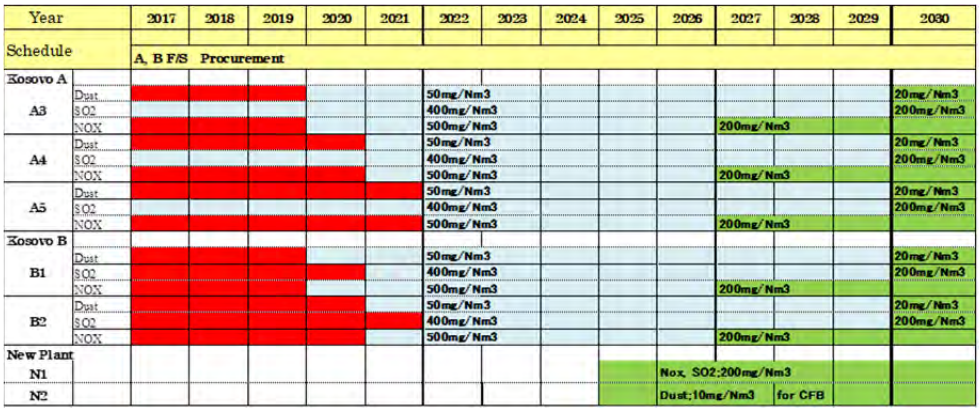


Figure 3-29 Change of ELVs in line with the EU directive

In the Precedent Activity, MESPI/MESP, KEK and Japanese side discussed and reached the conclusion that it was practically impossible to start with the NERP from 2018. Because of this reason, the government of Kosovo decided to negotiate with EnC by explaining that Kosovo will start with the NERP from 2022 with four year delay. Based on this decision, the government revised the NERP implementation plan as shown in Figure 3-30, and replied to EnC.



Year		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Schedule		A, B F/S Procurement													
Kosovo A															
A3	Dust	🟥	🟥	🟥	🟦	🟦	50mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	20mg/Nm3
	SO2	🟦	🟦	🟦	🟦	🟦	400mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	200mg/Nm3
	NOX	🟥	🟥	🟥	🟦	🟦	500mg/Nm3	🟦	🟦	🟦	🟦	200mg/Nm3	🟩	🟩	🟩
A4	Dust	🟥	🟥	🟥	🟥	🟦	50mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	20mg/Nm3
	SO2	🟦	🟦	🟦	🟦	🟦	400mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	200mg/Nm3
	NOX	🟥	🟥	🟥	🟥	🟦	500mg/Nm3	🟦	🟦	🟦	🟦	200mg/Nm3	🟩	🟩	🟩
A5	Dust	🟥	🟥	🟥	🟥	🟥	50mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	20mg/Nm3
	SO2	🟦	🟦	🟦	🟦	🟦	400mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	200mg/Nm3
	NOX	🟥	🟥	🟥	🟥	🟥	500mg/Nm3	🟦	🟦	🟦	🟦	200mg/Nm3	🟩	🟩	🟩
Kosovo B															
B1	Dust	🟥	🟥	🟥	🟦	🟦	50mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	20mg/Nm3
	SO2	🟥	🟥	🟥	🟥	🟦	400mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	200mg/Nm3
	NOX	🟥	🟥	🟥	🟦	🟦	500mg/Nm3	🟦	🟦	🟦	🟦	200mg/Nm3	🟩	🟩	🟩
B2	Dust	🟥	🟥	🟥	🟥	🟦	50mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	20mg/Nm3
	SO2	🟥	🟥	🟥	🟥	🟥	400mg/Nm3	🟦	🟦	🟦	🟦	🟦	🟦	🟦	200mg/Nm3
	NOX	🟥	🟥	🟥	🟥	🟦	500mg/Nm3	🟦	🟦	🟦	🟦	200mg/Nm3	🟩	🟩	🟩
New Plant															
N1										🟩	Nox, SO2;200mg/Nm3	🟩	🟩	🟩	🟩
N2										🟩	Dust;10mg/Nm3	for CFB	🟩	🟩	🟩

Figure 3-30 Revised NERP implementation plan

However, EnC did not accept the plan, and therefore, Kosovo had to revise the plan to start with the NERP from 2018, and after the revision, Kosovo submitted the final NERP to EnC in May 2018.

2) Study on the emission reduction measures for TPP Kosovo A

As a reference, Table 3-101 shows the specification of TPP Kosovo A and TPP Kosovo B. More detailed specification of TPP Kosovo A is shown in Table 3-113 and Table 3-114.

Table 3-101 Specification of TPP Kosovo A and TPP Kosovo B

1/2: TPP Kosovo A

Item	Unit	Description
Year of Operation		A_3 – 1970, A_4 – 1971, A_5 – 1975.
Type of Boiler		Natural Circulation
Firing System		Pulverized Coal assisted by liquid fuel oil and with constant air blow.
Steam Flow	t/h	614 for 200 MW(A-3, A-4) 645 for 210 MW (A-5)
Steam Temperature	℃	535
Steam Pressure	bar.	162（FW）、152(Drum)、138(SH Out)
Output	MW	200 MW (A-3, A-4), 210 MW (A-5)
Type of Precipitator		Electro Static Precipitator Constructed in 2012 3 ESPs per on boiler Each ESP has four fields
Dust Content (Precipitator inlet)	mg/Nm^3	41110
Dust Content (at Stack inlet)	mg/Nm^3	50
Stack Size (Height, Diameter)	m	A_3 and $A_{4,}$ H=100.2 D_{mb} = 8.50/5.20 m A_5, H = 120.0 m D_{mb} = 9.64/6.00 m

2/2: TPP Kosovo B

Item	Unit	Description
Year of Operation		1983/1984
Type of Boiler		Forced Circulation
Firing System		Pulverized Coal assisted by liquid fuel oil and with constant air blow.
Steam Flow	t/h	1000t/ｈ at 339MW
Steam Temperature	℃	540^0C
Steam Pressure	bar.	174bar. (for 339MW)
Output	MW	339MW
Type of Precipitator		Electro Static Precipitator 1983 2 sets per on boiler Each ESP has eight sections
Dust Content (Precipitator inlet)	mg/Nm^3	30,000
Dust Content (at Stack inlet)	mg/Nm^3	150(B-1), 260(B-2)
Stack Size (Height, Diameter)	m	210

Three units in TPP Kosovo A started the operation from 1970 to 1975. As a dust reduction measure, ESP was renovated in 2012, but the plants do not have de-sulfurization unit or de-nitration unit. On the other hand, TPP Kosovo B started the operation from 1983 to 1984. TPP Kosovo B has ESPs from the very beginning of operation as a dust reduction measure, but does not have de-sulfurization unit nor de-nitration unit. The steam turbines were renovated approximately ten year ago. Both TPPs are obsolete.

As stated before, the Project studied and proposed emission reduction measures only for TPP Kosovo A.

Targets of the emission reduction measures are Dust, SO_2 and NO_X. All exhaust gas measurement results the Project conducted are already shown in Figure 3-12 (No equipment has been renovated during the measurement period). NO_X values are rather stable, but Dust and SO_2 values are fluctuating a lot during each measurement. None of the components meet the ELVs for LCP.

The NERP started from 2018, and it was necessary to study measures as early as possible, and therefore, the activities were carried out on a priority basis. TPP Kosovo A is scheduled to stop its operation after the commencement of TPP Kosova e Re. In this situation, it is very hard to have large investments for TPP Kosovo A and therefore, the Project focused on the study of affordable and feasible measures.

The summary of the research and study at TPP Kosovo A is described as follows (details are described in 3.8.1).

i) Dust reduction measures

Dust content varies from 100 to 1,000mg/Nm^3 during each measurement. The specification of the ESPs is 50 g/Nm^3, but Dust content is higher than the specification, and the ESPs do not meet their specification.

Through the activities carried out in Output 2 and Output 7 for exhaust gas measurement and operation inspections, the Project proposed the simultaneous execution of three measures as an emission reduction measure, which are the improvement of the gas flow distribution inside ESPs, the application of the intermittent energization control for ESPs and exhaust gas flow rate reduction through the operation improvement. The improvement of the gas flow distribution and the application of the intermittent energization control need the modification of hardware and software although the budget needed is small, and TPP Kosovo A accepted the proposal. TPP Kosovo A firstly applied the modification for the improvement of the gas flow distribution to one ESP (C-duct of No.5 boiler) in March 2019, and the effectiveness of the modification were evaluated by the Project. Dust content result is shown in Table 3-102. Simultaneous application of the improvement of the gas flow distribution and exhaust gas flow rate reduction made the Dust content almost reach the ELVs for 2018.

Table 3-102 Results of Dust reduction tests

Dust Content (mg/Nm^3) **(C-duct of No.5 boiler)** (ELV 50 mg/Nm^3: 2018)	
Conventional operation	Reduction of exhaust gas flow rate
534, 97, 263, 632 mg/Nm^3	51, 50, 48 mg/Nm^3

As for the improvement of the gas flow distribution inside the ESP, KEK, UP and JET collaborated on the work of measuring the flow distribution inside the ESP, carrying out CFD and studying measures for improvement based on the study results. Finally, the modification of the inlet guide vanes (guide plates to control flow inside the ESP) design was proposed and plan was implemented based on the proposal.

However, as for the intermittent energization control for ESPs, it has not been applied yet because there was no response from the ESP manufacturer in spite of the repeated requests by TPP Kosovo A. However, in the third period, since for the rehabilitation of TPP Kosovo B it was decided to choose the same ESP manufacturer, TPP Kosovo A had the opportunity to meet with the manufacturer, and the negotiation with the manufacturer are on-going.

The effectiveness of the improvement of the gas flow distribution inside the ESP was confirmed and this modification has been applied to other ESPs. At this moment, the ESPs of C-duct in No.5 boiler and all ESPs in No.4 boiler were modified.

The application of the intermittent energization control is now under negotiation and the operation establishment for exhaust gas flow rate reduction remains a future issue. The improvement of the gas flow distribution inside the ESP, the application of the intermittent energization control and the exhaust gas flow rate reduction will contribute to the Dust reduction in the future.

ii) SO_2 reduction measures

SO_2 values fluctuate from 0 to 2,000 mg/Nm^3. For permanent de-sulfurization, it is necessary to install the de-sulfurization unit, but the installation of this unit is impossible for TPP Kosovo A because a large investment is required.

On the other hand, the SO_2 value sometimes dropped to 0 mg/Nm^3, and the Project continued to study this phenomenon. This phenomenon is caused by in-furnace desulfurization, and it depends on the conditions inside furnaces (gas temperature and its distribution, etc.), properties of lignite (Calcium content (hereinafter referred to as "Ca"), Sulfur content (hereinafter referred to as "S")), etc. and when the certain conditions are met, in-furnace desulfurization happens.

However, properties of lignite such as the heating value, water content, S content, Ca content, etc. are always varying, and besides, operation factors such as control of the amount of lignite supply to burners, control of the amount of combustion air supply, etc. are insufficient. Because of this reason, it is hard to control furnace conditions to be suitable for in-furnace desulfurization. It is impossible for TPP Kosovo A to choose lignite and control the quality, as well as to establish suitable conditions for desulfurization because of insufficient control range of boiler operation. However, the Project gave advice on how to control operation factors for the boiler in order to improve desulfurization even a little bit. Details are described in 3.8.1.

iii) NO_X reduction measures

Approximately 15 % of NO_X reduction was confirmed when the combustion air was reduced (decrease of O_2 in exhaust gas). However, it is not sufficient to reach the ELV (200mg/Nm^3) for 2023 in accordance with the EU directive. It is difficult to establish the operation conditions for reduction of combustion air.

These studies for emission reduction measures were carried out through collaboration among DEPW/DIPM, KHMI and KEK, and furthermore, the UP participated in the study on the improvement of the gas flow distribution inside the ESP, which proceeded through industry-academy-government collaboration. TPP Kosovo A is scheduled to stop its operation in the near future and investments are limited. In this situation, it is a good outcome for the Project to be able to propose and implement improvements.

The following outputs have been achieved through these activities.

- C/Ps (especially KEK) learned the procedures for studying the emission reduction measures for which it was necessary to take the steps of measurement and inspection, analysis, studying the measures and their application. So far, operations were left to manufacturers and facilities, but C/Ps learned that they could study emission reduction measures by examining and analyzing operations by themselves. Staff of TPP Kosovo A is willing to study and implement emission reduction measures through inspections by themselves.
- As for the improvement of the gas flow distribution inside the ESP, MESPI/MESP, JET, KEK and the UP collaborated on measurement of actual flow distribution inside the ESP, flow distribution analysis by using CFD, study of measures for improvements and final proposal for improvements. It is expected that this example will become the best practice and same kind of activities will be expected in the future.

(2) Activities regarding other stationary sources

The Project conducted exhaust gas measurement and inspected the processes and consumed fuels in order to understand the actual emission condition from other stationary sources. Based on the measurement and inspection results, actual emission conditions and emission reduction measures were studied.

Facilities that were the target of and where the exhaust gas measurements were conducted are the following four factories.

1) Ferro-Nickel factory
2) Brick factory
3) Asphalt factory
4) Oil Recycling factory

As stated in 3.3.1, ELVs for other stationary sources are regulated by two laws. One is applied to large scale facilities stipulated in the law on IPPC, and in this law the ELVs are given through the IPPC[19] permit for which facilities apply to the government, and then the government conducts a detailed examination of the application. The other one is applied to facilities depending on the kind stipulated by Administrative Instruction No./2007. Out of four facilities, Ferro-Nickel factory and Oil Recycling factory are regulated by the IPPC permit, and Brick factory and Asphalt factory are regulated by the AI.

Inspection results are described as follows.

1) Ferro-Nickel factory

Process flow of Ferro-Nickel factory is shown in Figure 3-31. Facilities consists of i) Rotary kiln, ii) Electrical Furnace and iii) Converter. Since each facility has its own stack, ELVs are stipulated for each facility, and because of this reason, exhaust gas measurement must be conducted to each facility.

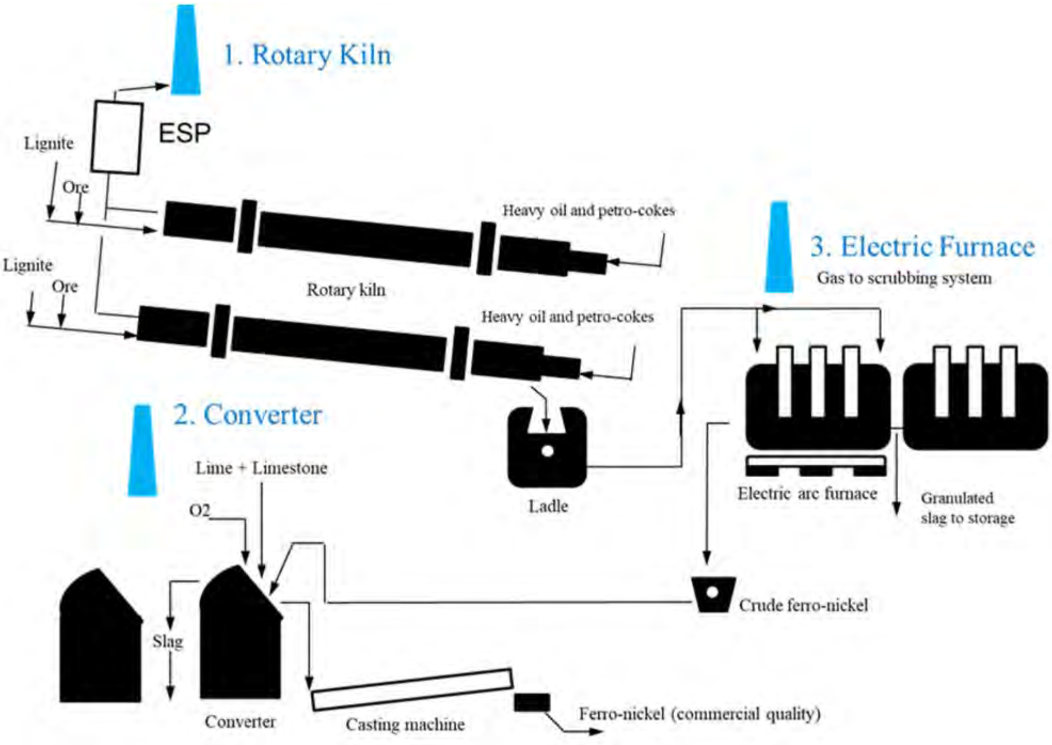


Figure 3-31 Process flow of Ferro-Nickel factory

KHMI, DEPW/DIPM and JET conducted the measurement twice for each facility. The measurement results are already shown in Table 3-61. Measurement results show that SO_2 in the Rotary kiln and Dusts in Electrical Furnace and Converter exceed the ELVs.

Each process is described as follows.

i) Rotary kiln

Nickel ore which is raw material is supplied to the Rotary kiln with lignite and lime stone. In the Rotary kiln, nickel ore is fired at the temperature of approximately 850 ℃ by fuels (heavy oil and/or petroleum coke) and fed to the Electrical Furnace. Dust in exhaust gas is removed by the ESP and exhaust gas is discharged from the stack at a height of 100 m. The facility does not have any de-sulfurization unit and de-nitration unit. Here the volume of the gas is the largest in the Ferro-Nickel factory.

ii) Electrical Furnace

Fired nickel ore in the Rotary kiln is supplied and reduced by the carbon inside the Electrical Furnace and melted by electrical power, and the crude molten Ferro-nickel is produced.

Exhaust gas is washed by the two-stage venturi scrubber and sent to the roof top of the building. Gas is combusted while discharged.

iii) Converter

The converter supplies the oxygen to the crude molten Ferro-nickel and adjusts the nickel concentration in the final product by oxidizing and removing ferrum. Finally, it is casted into casted Ferro-nickel as a product.

Exhaust gas is discharged after being washed by two stage venture scrubber.

The following matters are presumed from the exhaust gas measurement results and the process

i) Rotary kiln

Since the Rotary kiln consumes petroleum coke which has a high S content as a fuel, SO_2 value is very high, which is a big problem. Usually petroleum coke consumed in Kosovo contains 4 to 6 % S. When using combustion calculation, the petroleum coke comprising 6 % S produces approximately 2,050mg/Nm^3 of SO_2 at exhaust gas O_2 =18% (12,320mg/Nm^3 of SO_2 at exhaust gas O_2 =3%), which is a very high value. Estimating from the measurement results, S in the petroleum coke is discharged after combustion as it is. On the other hand, NO_X level is low because the furnace temperature is low, and Dust is sufficiently removed by the ESP.

High SO_2 value is caused by petroleum coke, and it is necessary to convert to low S fuel as soon as possible.

Photo 3-28 Measurement at the Rotary kiln

ii) Electrical Furnace

Dust in the exhaust gas from the Electrical Furnace exceeds the ELV, but SO_2 level is almost 0 mg/Nm^3. The exhaust gas is reducing gas and O_2 shows 0 %. Because of this reason, the gas is combusted after being discharged into the air. In order to evaluate the effect to the air, gas after combustion should be measured, but IPPC permit is given based on the gas before combustion because of the restrictions of the facility. Therefore, ELVs are only given for Dust. However, dust looks blackish in which carbon is presumed to be included, and therefore, Dust content can be lower after combustion.

S in the exhaust gas cannot exist as SO_2 in reduction environment, and presumably exists in the state of hydrogen sulfide (hereinafter referred to as "H_2S"). On the other hand, since in this process most of S can be taken into the slag, low content of S in the gas is expected. As for NO_X, NO_X is not formed in reduction environment, but NO_X formed after combustion is presumed to be still low because of the low combustion temperature. It is reasonable that IPPC permit does not stipulate SO_2 and NO_X, but at least H_2S should be measured. (The gas has the odor of H_2S)

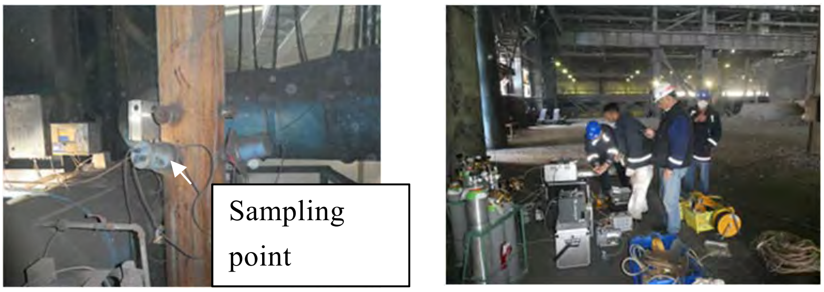


Photo 3-29 Measurement at the Electrical Furnace

As for Dust, the facility adopts Best Available Technology (hereinafter referred to as “BAT”), which is two-stage venturi scrubber, but it is necessary to increase washing capacity for gas cleaning.

iii) Converter

In the Converter, Dust exceeds the ELVs. SO_2 and NO_X levels are sufficiently low. Considering the process, S does not exist in the crude molten nickel and NO_X is also very low, and these values are very reasonable. As for Dust, exhaust gas cleaning system adopts BAT technology so called two-stage venturi scrubber, but it is necessary to increase washing capacity for gas cleaning.

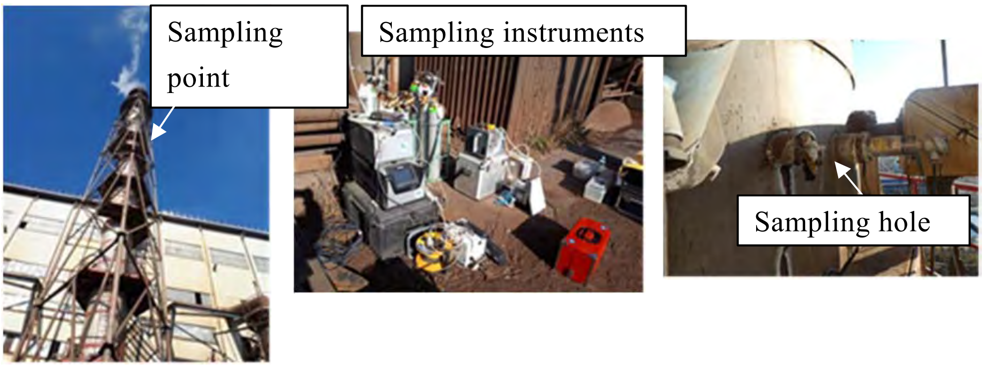


Photo 3-30 Measurement at the converter

The Project conducted measurement and studied emission reduction measures for three facilities in Ferro-Nickel factory. The biggest problem is the high SO_2 in exhaust gas from the Rotary kiln. Immediate conversion to low-S fuel is required. For Dust reduction for Electrical Furnace and Converter, it is necessary to have more pressure drop for the venturi scrubbers and improve dust removal efficiency.

2) Brick factory

Process flow of Brick factory is shown in Figure 3-32. The central facility is the tunnel furnace.

Casted bricks piled up on the trolley are dried and pre-heated by the hot air from the tunnel furnace, and then they are introduced into the tunnel furnace. In the sintering zone in the tunnel furnace, the temperature is kept at the prescribed value by the combustion gas from the burners. Combustion gas flows into the preheating zone, preheats the bricks and is discharged from the stack. Casted bricks enter into the inlet of the furnace, get preheated in the preheating zone, fired at the prescribed temperature during the prescribed time in the sintering zone, cooled in the cooling zone and extracted from the furnace. Cooling used for cooling bricks is used for preheating of the bricks as hot air. Bricks are fired during the move from the inlet to the outlet and come out as a product.

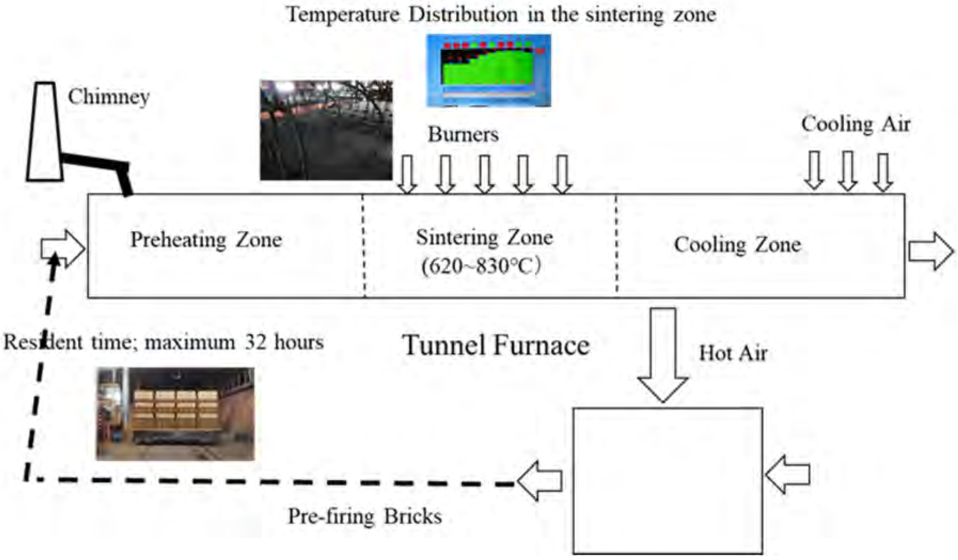


Figure 3-32 Process flow of the Brick factory

KHMI and JET conducted measurement twice. The results are already shown in Table 3-61. The results show that Dust and SO_2 drastically exceed the ELVs.

Photo 3-31 Measurement at Brick factory

This factory consumes petroleum coke same as the fuel used in Ferro-Nickel factory, but at the same time, the factory introduced the supply facility of Liquid Petroleum Gas (hereinafter referred to as “LPG”) as an air pollution control measure. However, the feeding rate of LPG is approximately ten percent, and because of this reason, the exhaust gas has high SO_2 level affected by the petroleum coke. Dust value is also very high, and the Dust is very black as shown in Photo 3-32. This is presumed to be caused by incombustible carbon in petroleum coke.

Since the tunnel furnace in the Brick factory consumes petroleum coke as main fuel, Dust and SO_2 levels are very high, and immediate conversion to low-S fuel is required. It is possible to decrease Dust and SO_2 levels by increasing LPG supply rate.

Table 3-103 shows the calculated value of SO_2 in accordance with the LPG supply ratio increase when keeping the total heat input unchanged.

Photo 3-32 the supply facility of LPG

Photo 3-33 Collected Dust

Table 3-103 Calculated results of SO_2 in the exhaust gas

	Fuel supply rate (kg/hr)		SO_2 concentration in Exhaust gas (mg/Nm^3)	
	Petroleum coke[*1)]	LPG	Exhaust gas O_2=18%[*2)]	Exhaust gas O_2=3%[*2)]
Present condition	450	45.6	1643	9858
In order to meet the present ELVs	147	265	500	3000
In order to meet the future ELVs	43	341	142	850

*1): The assumed S content in petroleum coke for calculation of SO_2 is 6.22 %. LPG does not contain S.

*2) Reference O_2 in exhaust gas is 18 % for present regulation（ELV＝500 mg/Nm^3） and 3% for future regulation (ELV＝850 mg/Nm^3)

As shown it the table, in order to meet the ELV of present regulation, the ratio of LPG must be increased to 65 %, and in order to meet the ELV of future regulation, the ratio of LPG must be increased to 89 %. It is necessary to increase LPG ratio immediately and decrease SO_2 value. As for dust, because of the high combustion performance of LPG, incombustible carbon will decrease and it is presumed that the Dust content will decrease too.

3) Asphalt factory

Process flow of the Asphalt factory is shown in Figure 3-33. Combustion facility is the Rotary kiln used for drying the raw material.

Gravel as a raw material (mainly consists of lime stone ($CaCO_3$)) is fed to the Rotary kiln and is dried at approximately 200 ℃. After drying, the gravel is screened, mixed with asphalt (Bitumen) with temperature control, supplied to the bunker and shipped. Exhaust gas is discharged from the stack after removal of Dust by Bag filters.

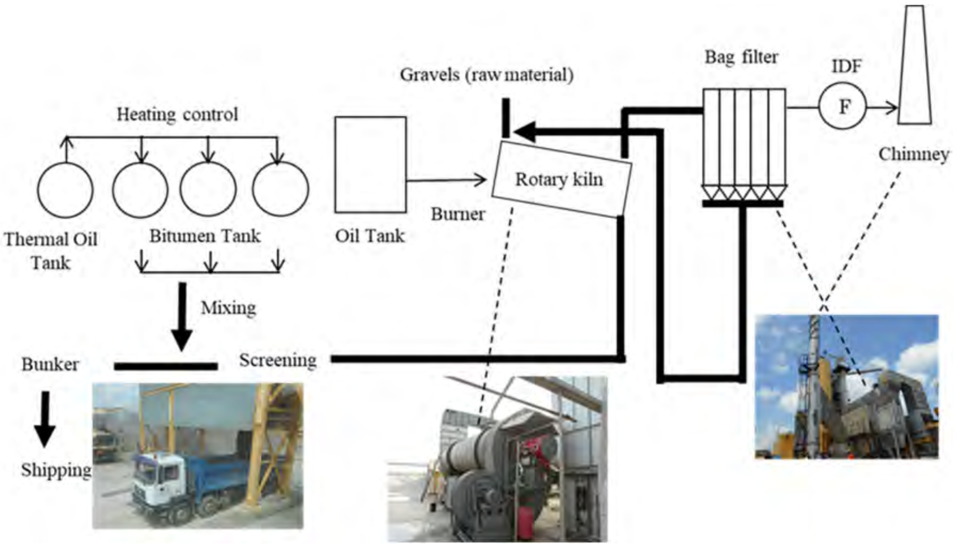


Figure 3-33 Process flow of the Asphalt factory

KHMI and JET conducted the exhaust gas measurement. Measurement results are shown in Table 3-61. Measurement results show that Dust content exceeds the ELV a lot.

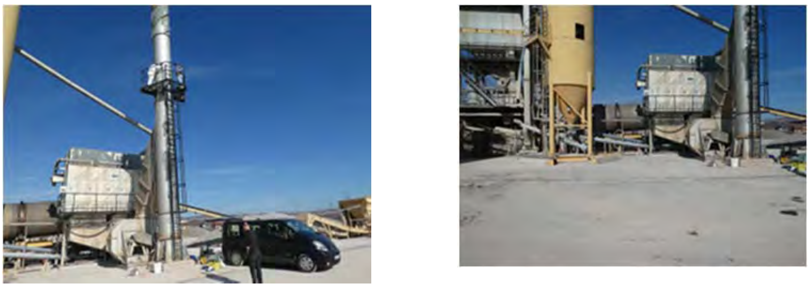


Photo 3-34 Measurement at the Asphalt factory

Although the Asphalt factory uses the oil with S=0.76% that is much lower than the one in petroleum coke, SO_2 content at Reference O_2 =10 % calculated from fuel component is 842 mg/Nm^3, and this value exceeds the ELV. However measurement result is 212 mg/Nm^3 and is sufficiently low compared with the ELV. It is presumed to be caused by the following de-sulfurization reaction.

$CaCO_3 = CaO+CO_2$

$CaO + SO_2 +0.5O_2 = CaSO_4$

In general, one of the methods for removing SO_2 from exhaust gas is that lime hydrate ($Ca(OH)_2$) is injected before the bag filter and SO_2 is removed with the reaction with calcined lime (CaO). In this process, raw material of lime stone is substituted by lime hydrate, and the process is found to have sufficient de-sulfurization capacity.

On the other hand, dust is generally reduced to 20 to 30 mg/Nm^3 in case of treatment with the bag filter, but measurement result show a high value. It is presumed that the bag filters may have possible defects such as holes, etc.

It is common knowledge that Dust is removed sufficiently if the process has bag filters. However, this case shows that operation management is very important such as confirmation of the performance of equipment through exhaust gas measurement, etc. At the same time, de-sulfurization is confirmed to occur through the measurement, and the efficiency of de-sulfurization in this process got known for the first time when the exhaust gas measurement was conducted. As mentioned here, it is very important to confirm emissions through exhaust gas measurement.

4) Oil Recycling factory

Process flow of the Oil Recycling factory is shown in Figure 3-34. This facility separates used oil into components by utilizing the difference of evaporating temperature and condensation temperature. Evaporated oil is condensed and recovered by the condenser, but non-condensed off gas is discharged in the end. Scope of regulation for this factory is applied to this discharged gas. This gas is combusted by the pilot burner, cooled by water spray and discharged to the air through the stack. IPPC permit of this factory regulates components of this discharged gas.

The Project could not analyze these gas components through measurement, and therefore, conducted only Dust, SO_2 and NO_X measurement as usual. The factory staff said that there are complaints by people who live in the vicinity about the odor.

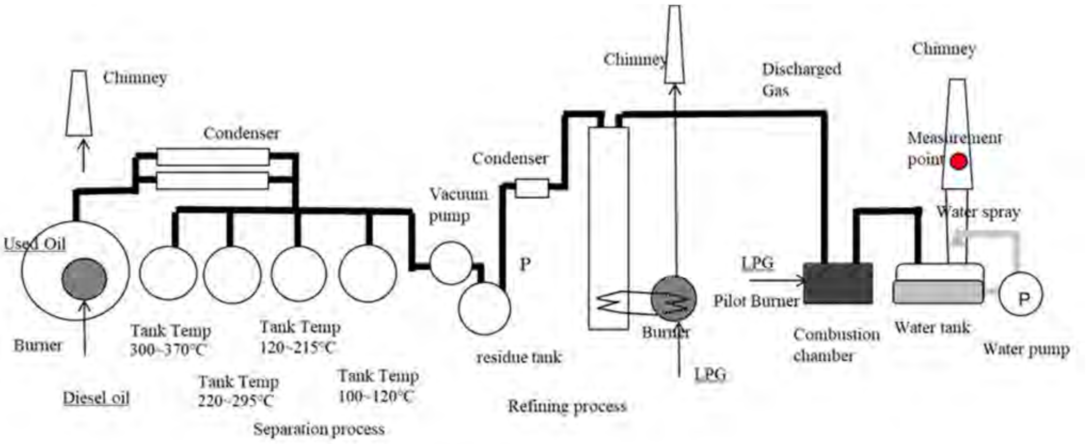


Figure 3-34 Process flow of the Oil Recycling factory

KHMI and JET conducted the exhaust gas measurement. Measurement results are shown in Table 3-61. Measurement results show that almost all exhaust gas is air, and Dust, SO_2 and NO_X were detected very little. According to the factory staff, the oil recycling takes a lot of time, and the generated gas quantity highly depends on the kind of waste oil that is recycled. On the day of the measurement, generated gas quantity was small, and recovered gas was almost all air. Gases generated from the factory are evaporated gas and not contaminated. The problem is whether Volatile Organic Compounds (hereinafter referred to as ”VOC”) and/ or Polycyclic Aromatic Hydrocarbon (hereinafter referred to as ”PAH”) can be combusted for sure or not. This problem is presumed to be the reason why there are complaints from people who live in the vicinity. Odor cannot be removed if VOC, etc. are not combusted (dissolved).Through measurement no SO_2 and NO_X was detected.

Photo 3-36 shows the combustion chamber for the discharged gas. Only the pilot burner with the fuel of LPG is installed, and it is hard to say that discharged gas is combusted for sure.

Photo 3-35 Measurement at Oil Recycling factory

Photo 3-36 Combustion chamber for discharged gas

Based on the experience, JET proposed the installation of the combustion facility in order to combust the gas for sure. The proposal is shown in Figure 3-35.

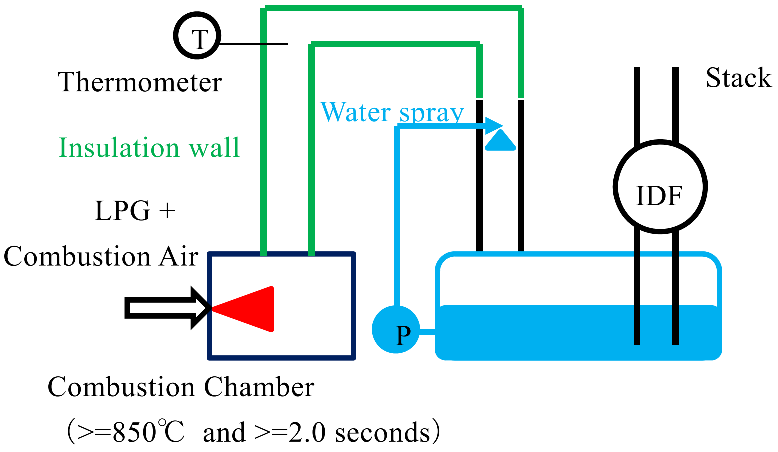


Figure 3-35 System for the combustion facility

The methods to remove VOC and/or PAH are combustion or absorption by activated coke. However, for absorption method, activated carbon must be treated after the use, and therefore combustion method is thought to be more realistic.

It is generally said that condition of the temperature of 850 ℃ or higher and the residence time of 2 seconds or longer is required to combust (decompose) VOC and/or PAH. Therefore, Oil Recycling factory should install a combustion facility as shown in the figure, which has the volume to keep combustion gas for two seconds or longer. At the same time, a thermometer should be installed in the combustion facility, which adjusts the combustion temperature at 850 ℃ or higher by controlling the LPG flow rate, and then combustion gas is cooled by water spray.

Installation of the aforementioned combustion facility will remove the odor and SO_2 and NO_X will become detectable.

The Project conducted exhaust gas measurement for four other stationary sources and at the same time, evaluated emission reduction measures. As a result, the following issues are identified.

- Many private facilities do not conduct proper exhaust gas measurement and submit accurate measurement reports.
- MESPI/MESP (Inspectorate and DEPW/DIPM) does not have sufficient knowledge on emission reduction measures, and cannot give appropriate instructions to private facilities.
- Persons in charge of managing private facilities do not have sufficient knowledge on emission reduction measures, and even the facility that has exhaust gas treatment equipment, they cannot manage it properly.

The measurement results and measures for other stationary sources were passed over to the staff in charge in MESPI/MESP after JET explained the content and had questions and answers, and JET requested them to instruct the facilities.

It is thought to be very important element for MESPI/MESP which is the competent authority to acquire knowledge in order to instruct the private facilities. In order to realize this, it is indispensable to enhance knowledge of persons in charge in MESPI/MESP and to obtain accurate emission measurement results. This will enable persons in charge in MESPI/MESP to judge the situation of emissions from private facilities based on the exhaust gas measurement results and give instructions to these facilities. Since KHMI has developed the capacity for exhaust gas measurement, MESPI/MESP can utilize this capacity. If MESPI/MESP instructs private facilities all the time by using the capacity of KHMI, the exhaust gas measurement has prospective as a business and it is expected to foster the private measurement business.

The final desired goal is for all facilities to conduct proper measurement and report the results to the competent agency.

As another issue, in Kosovo petroleum coke is imported as a cheap fuel, and therefore, it is consumed a lot. Since petroleum coke has high S content, it is for sure that SO_2 exceeds the ELV without a desulfurization unit. Therefore, it is impossible to use petroleum coke as a fuel without a desulfurization unit. However, it is the reality that petroleum coke is still used as a fuel, and it is desirable to strengthen the law enforcement on regulations for exhaust gas from this point of view. If the regulation on the exhaust gas is applied properly, the use of petroleum coke will decrease inevitably. In Japan, in case the petroleum coke is combusted, the supply side pays money to the demand side since the combustion of petroleum coke imposes a large cost on the exhaust gas treatment. When the price of petroleum coke is minus, it is treated as a "waste" in Japan.

(3) Enhancement of knowledge regarding emission reduction measures

The Project found that enhancement of knowledge for MESPI/MESP (Inspectorate and DEPW/DIPM) is required for the study of emission reduction measures for LCP and other stationary sources.

In order for C/Ps to acquire the above mentioned knowledge, along with the knowledge on emission reduction measures the following activities are required: the inspection of process flow, kind of fuel consumed, consumption rate of fuels and the actual operation, and the participation in the actual measurement. Then considering all findings, effective measures must be studied. OJT is thought to be the most effective way for this activity. However, the Project did not carry out this activity. Therefore, the Project held lectures on basic knowledge necessary for the study of emission reduction measures.

The purpose of lectures is to enhance the knowledge. The lectures were held four times and were attended by relevant persons from the Inspectorate, DEPW/DIPM, KHMI, etc. The content is shown in Table 3-104.

Table 3-104 Content of lectures for the enhancement of knowledge

Third Period (2020)		
Date	Activities	Remarks
Jan. 30 (Thu), 2020	Lecture on emission regulation regarding industrial facilities (the effect to the air by pollutants from the stacks and elemental analysis and industrial analysis of fuels)	C/P: 12 JET: 1
Jan. 31 (Fri), 2020	Calculation of exhaust gas volume per unit weight of fuel and estimation of SO_2 content based on the elemental analysis and industrial analysis results	C/P: 6 JET: 1
Feb. 3 (Mon), 2020	Comparison between calculation and actual measurement results for exhaust gas, and measurement method	C/P: 9 JET: 1
Feb. 5 (Wed), 2020	Exhaust gas measurement methods and emission reduction measures	C/P: 9 JET: 1

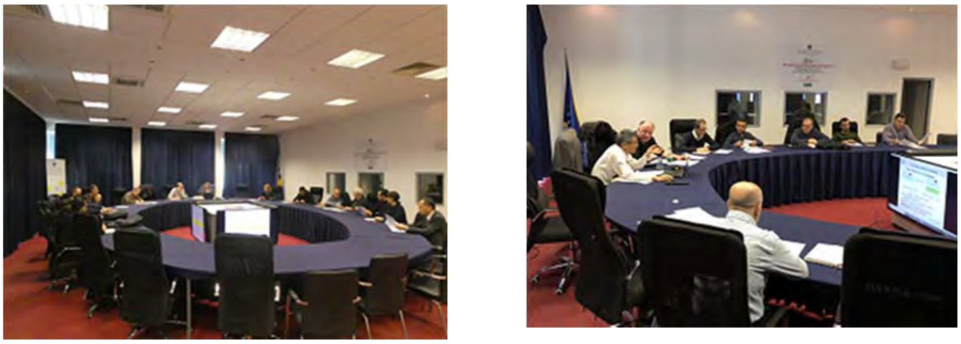


Photo 3-37 Lectures for the enhancement of knowledge

In the first lecture, the effect to the air by pollutants from the stacks (diffusion calculation of pollutants from the stack), and basic knowledge on fuels (elemental analysis and industrial analysis) were lectured. In the second lecture, calculation method for exhaust gas volume per unit weight of fuel, estimation of SO_2 content based on the elemental analysis and industrial analysis results were lectured, and at the same time, the significance of measurement was emphasized. In the third lecture, based on the reports on measurement results and inspection results for consumed fuel and processes, understandings of measurement results and emission reduction measures were lectured. In the fourth lecture, exhaust gas measurement method and common emission reduction measures were lectured.

Through these four lectures, the Project advised as follows. One is that it is possible to estimate SO_2 from fuel component. Another is that in the case when emission reduction equipment is installed, it is necessary to conduct measurement and confirm whether the emission is abated by the emission reduction equipment. The reports on other stationary sources were handed over to MESPI/MESP after explanation and questions. JET requested for MESPI/MESP to instruct these private facilities.

Part of these lectures was carried out as seminar for companies and the University, etc.

C/Ps were very interested in taking these lectures. However, due the lack of knowledge and experiences, it is questionable that C/Ps will be able to use the knowledge they have gained. This will be the key factor on whether MESPI/MESP can enforce the law or not from now onwards.

Enhancement of knowledge and experience of MESPI/MESP is important activity, and is thought to lead to the establishment of institutional framework on exhaust gas measurement.

In the Laws of Kosovo, the exhaust gas measurement and reporting by private facilities are obligatory. However, it is actually hard to say that the law is enforced. There is a situation where it is thought that the exhaust gas measurement has not been sufficiently acknowledged.

In 3.3.1 (3), the steps toward the dissemination of the exhaust gas measurement is shown, but as a premise, the following is required in order to advance the steps.

1) Officials in MESPI/MESP gain sufficient knowledge and experience on the exhaust gas measurement and emission reduction measures.

2) Officials in MESPI/MESP give instructions to private facilities based on their knowledge and experience.

Private factories are obliged to submit the report on exhaust gas measurement by law, but actually, the measurement reports are not submitted or they are not adequate even if submitted. It is expected that the exhaust gas measurement is recognized and disseminated through the instruction to private factories by the officials of MESPI/MESP.

There is only one possible private agency being able to conduct exhaust gas measurement in Kosovo. However, MESPI/MESP believes that it is difficult for MESPI/MESP to back up the specific private company such as with direct technical support and/or supply of measurement equipment. Therefore, it is hard to reach consensus between MESPI/MESP and private agencies. At the same time, the exhaust gas measurement needs to be established as a business considering the continuity of the measurement. At this moment, capacity development of officials in MESPI/MESP and strengthening of the ability to instruct private facilities are necessary. These measures will realize the enforcement of law surer.

3.7.2 Evaluation for the Objectively Verifiable Indicators in the PDM

Objectively Verifiable Indicators in the PDM are “Recommendations for air pollution control are made at least once toward the Kosovo side’s relevant policy making processes” and “Publication and newsletter on air pollution control are disseminated at least four times”.

Emission reduction measures are proposed for LCPs and other stationary sources. Dust reduction measures for TPP Kosovo A are on-going. Although measures for SO_2 and NO_X reduction for TPP Kosovo A have been proposed, they stay as proposals because of the age of facilities and limited investment for improvement. As for other stationary sources, measures have been studied and proposed for four stationary sources.

Many air pollution control measures are also proposed as stated in 3.9.1 (Output 8), and some measures are closely estimated. Newsletters were published four times. They are attached in Appendix-3, and the contents are indicated in 3.12.2.

As mentioned above, Objectively Verifiable Indicators for Output 6 have been satisfied.

3.7.3 Capacity development through the activities

TPP Kosovo A staff has learned the steps where they collected data such as measurement data, operation data, analysis results of lignite and fly ash, etc., analyzed operations and studied measures for improvement. At the same time, TPP Kosovo A staff has also learned the measurement technology and the emission management methods. It is desirable for TPP Kosovo A to utilize this knowledge and these technologies for the operation improvement.

On the other hand, as for other stationary sources, it became obvious that the laws and regulations are not complied with. The Project held lectures for improvement of knowledge, but more knowledge and experience are required. This is a big challenge for the future.

3.8 Output 7: Emission control measures are developed at LCPs.

3.8.1 Activities

Study on emission reduction measures for LCP targeted only TPP Kosovo A. The conducted activity was mainly the study of the In-furnace desulfurization effect through the analysis of SO_2 behavior, improvement of the efficiency of ESP performance and the NOx reduction by improving the operation of boilers.

(1) First Period

In the first period, the activities shown in Table 3-105 were implemented. SO_2, NOx, and Dust were measured and recorded based on "the exhaust gas measurement of Output 2", detailed records of the boiler operation have been maintained, and the lignite and fly ash were sampled and analyzed. These data is used as data for SO_2, NOx and Dust behavior analysis.

Table 3-105 Activities on Emission Control Measures for LCPs

Date	Activity	Participants
Dec. 1, 2017 (Fri)	#1 Regular Meeting Emission Reduction of LCP	C/P: 7
Dec. 4, 2017 (Mon)	Explanation of ESP Investigation	C/P: 5
Dec. 7 (Thu) ～ 8(Fri), 2017	Design data collection of ESP of TPP Kosovo A Inter investigation of ESP of A-5 Boiler	C/P: 12
Dec. 13,2017 (Wed)	Data collection of continuous measurement result of SO_2	C/P: 8
Dec. 15, 2017 (Fri)	#2 Regular Meeting Lecture on basic knowledge of ESP	C/P: 12
Dec. 18, 2017 (Mon)	Discussion with KEK regarding next activity implementation policy and plan	C/P: 3
Apr. 6, 2108 (Sat)	Boiler Group Meeting (Description of implementation plan)	C/P: 7
Apr. 11, 2018 (Wed)	Seminar on–site stack gas measurement	C/P: 13
Apr. 12, 2018 (Thu)	Discussion on Test Procedure of ESP	C/P: 10
Apr. 13, 2018 (Fri)	Meeting on ESP gas flow simulation with the UP	C/P: 3
Apr. 16,2018 (Mon) to 17(Tue)	Internal survey of ESP of TPP Kosovo A (A-5 boiler)	C/P: 5
Apr. 18,2018 (Wed) to 19(Thu)	Preparation of Flow distribution measurement in ESP of TPP Kosovo A (A-5 Boiler)	C/P: 5
Apr. 18, 2018 (Wed)	Start on-site stack gas measurement at TPP Kosovo A (A-4 Boiler)	C/P: 6
Apr. 20,2018(Fri) to 24(Tue)	Flow distribution measurement in ESP of TPP Kosovo A (A-5 Boiler)	C/P: 8
Apr. 25, 2018 (Wed)	ESP gas flow rate / temperature change test Procedure	C/P: 5
Apr. 27, 2018 (Fri)	Flow distribution measurement in ESP of TPP Kosovo A (A-5 Boiler) (Additional measurement)	C/P: 8
Apr. 30, 2018 (Mon)	ESP gas flow rate change test Monitoring of Electric energization of ESP control	C/P: 8
May 2,2018(Wed)	On-site stack gas measurement at TPP Kosovo A (A-3 Boiler)	C/P: 5

to 7(Mon)		
May 2, 2018 (Wed)	Test of SO_2 behavior through boiler O_2 change at TPP Kosovo A (A-3 Boiler)	C/P: 2
May 3, 2018 (Thu)	Test of behavior of SO_2 by the change of mill outlet temperature at TPP Kosovo A (A-3 Boiler)	C/P: 4
May 7, 2018 (Mon)	Test of behavior of SO_2 by changing the number of mills operation at TPP Kosovo A (A-3 Boiler)	C/P: 4
May 7, 2018 (Mon)	Meeting on ESP flow simulation with the UP	C/P: 5
May 8, 2018 (Tue)	Seminar (About ESP survey results and performance improvement measures)	C/P: 7
May 17,2018 (Thu)	Investigation of Lignite analysis method（at INKOS） TPP Kosovo A boiler facility survey	INKOS: 1 C/P: 4
May 18, 2018 (Fri)	Meeting on ESP flow simulation with the UP	C/P: 3
May 25, 2018 (Fri)	Report meeting to boiler group	C/P: 7
May 28, 2018 (Mon)	Meeting for ESP flow simulation with the UP	C/P: 2
May 29, 2018 (Tue)	Seminar (Environmental measures for LCP)	C/P: 10

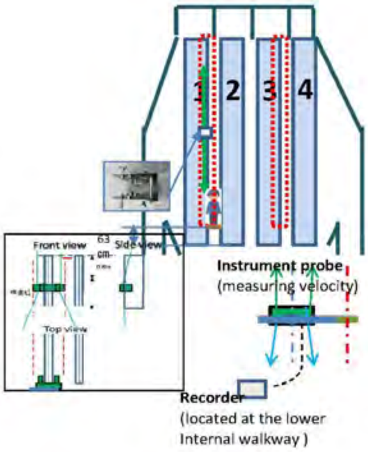
1) Reduction measures for Dust

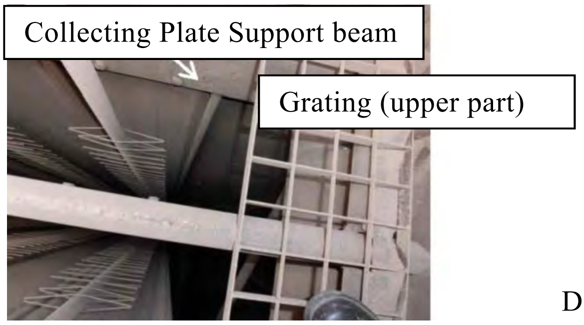
ESPs at TPP Kosovo A (A-3, A-4 and A-5), which are designed to have a Dust content at the outlet not more than 50 mg/Nm^3, were refurbished in 2012 (manufactured by Hamon Thermal Germany GmbH in Germany). Although the Dust meters installed at the outlet of the ESPs indicated the value less than 50 mg/Nm^3, based on the color of the smoke from the stacks it was obviously higher than 50 mg/Nm^3, and the measured values at the Precedent Activities showed high values of 200~600mg/Nm^3. For this reason, these ESPs have the possibility to meet the ELV (50mg/Nm^3) if causes of poor performance are clarified and solved.

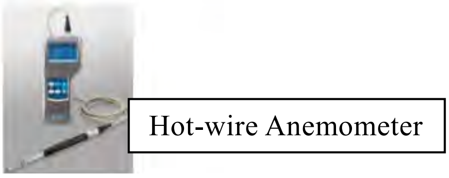
JET inspected the ESPs at TPP Kosovo A in December 2017. Decrease of performance is presumed to be caused by inappropriate setting of the electric energization control of the ESP, inappropriate maintenance of the electrodes, and non-uniformity of the gas flow distribution inside ESP.

Based on this fact finding, in April 2018, the Project focused on the improvement of gas flow uniformity, and as shown in Figure 3-36, conducted the measurement of air flow distribution inside ESP of the A-5 boiler and as shown in Figure 3-37, it is found that there was very little flow at the bottom of the ESP, and the measurement confirmed the necessity of improving gas flow distribution.

ESP Test Procedure Meeting







Down view from the top of ESP

Velocity measuring instrument hanging tool　　Operation check at ESP lower floor

Figure 3-36　Outline of the inside of ESP and activity situation

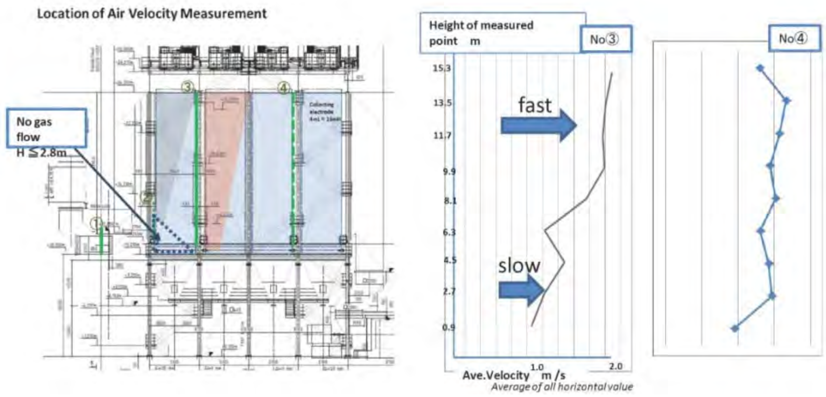


Figure 3-37　Velocity distribution measurement result inside ESP

From May 2018, the studies on establishment of a uniform gas flow inside the ESP by using the computer model CFD by reflecting the measurement result, started in collaboration with the UP.

In addition, through monitoring the electric charging state in the control device of ESP at the A-4 boiler, it was confirmed that the phenomenon of so called “Back Corona (reverse ionization)” caused by the properties of the lignite's ash was happening frequently, which aggravates the ESP performance, and the Project recommended the introduction of the “Intermittent Energization Control” in order to reduce this phenomenon. This is the most economical way without large investment, but in order to apply this improved control system, it is necessary to confirm whether this control system is applicable in the existing system or not. If it is confirmed that it is applicable, it is feasible to be programed by the engineer of the manufacturer. The Project requested that TPP Kosovo A asks the manufacturer on the possibility of the application of this control, and the cost estimate if it is applicable.

On the other hand, as a result of various tests through changing the operating conditions of the boiler, it was confirmed that the combustion with the low excess air ratio (low exhaust gas O_2 operation) contributed not only to the reduction of NO_X emissions but also to the improvement of the Dust collecting efficiency of ESP. However, it was found that SO_2 increased.

2) Reduction measures for SO_2

In the Precedent Activities, SO_2 in the exhaust gas usually showed relatively high value of 600-800 mg/Nm^3, but sometimes SO_2 level was observed to drop at almost 0 mg/Nm^3. This phenomenon is presumed to be caused by In-furnace desulfurization reaction due to the existence of Ca in the lignite. If the factors generating the phenomenon become clear, it is thought to be possible to keep SO_2 low by improving the boiler operations and/or controlling the property of supplied lignite.

As for the investigation of SO_2 behavior in the exhaust gas in the TPP Kosovo A, the exhaust gas measurement results at the A-4 boiler that were conducted in April are shown in Figure 3-38. The trends of SO_2 show a low value affected by In-furnace desulfurization same as in the Precedent Activities. In May, the tests were planned to clarify what kind of the boiler operation parameter would contribute to the reduction of SO_2 by changing the combustion state in the furnace of the A-4 boiler.

Since the A-4 boiler stopped due to the boiler tube leakage, the tests were conducted at the A-3 boiler. However, in the A-3 boiler, SO_2 never showed a low value and high SO_2 level continued to be generated, which had never been measured before, as shown in Figure 3-39.

This high SO_2 was almost equivalent to conversion of all the sulfur (Total sulfur) in the lignite to SO_2 during the combustion process. This is contradictory to the view that KEK engineer had that only the combustible (organic) sulfur in the lignite is converted to SO_2.

In order to investigate the cause of this phenomenon, JET confirmed the structure of the combustion system of the boiler from the technical department of the power plant. At the boiler group meeting on May 25, 2018, JET explained about the presumptive causes that are currently being considered. Since it is necessary to clarify whether this phenomenon is specific to the A-3 boiler or possible to other boilers under certain conditions, JET requested for KEK to measure the exhaust gas themselves and to compare the results when the A-4 boiler started the operation.

Measurement results of this time showed continuously a high SO_2 value. The phenomenon of SO_2 close to zero is presumed to require specific condition and reasons. In order to find the conditions, it is necessary to identify the condition and study the feasibility of their establishment. The conditions have not been specified yet, but it is presumed that it is not easy to create the conditions all the time. Because of this, it is difficult to satisfy the ELVs of 400 mg/Nm^3 only through the In-furnace desulfurization by 2023.

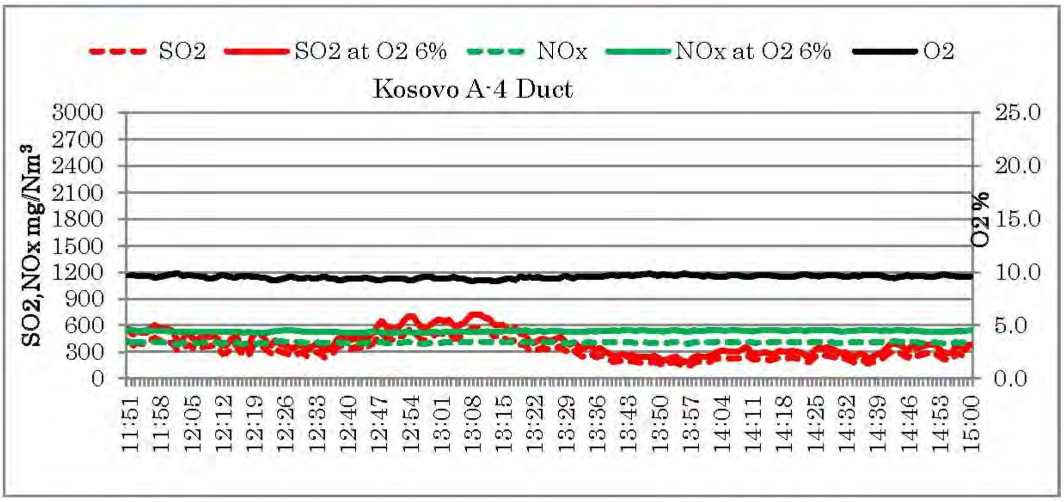


Figure 3-38 Exhaust gas measurement result of TPP Kosovo A A-4 Boiler

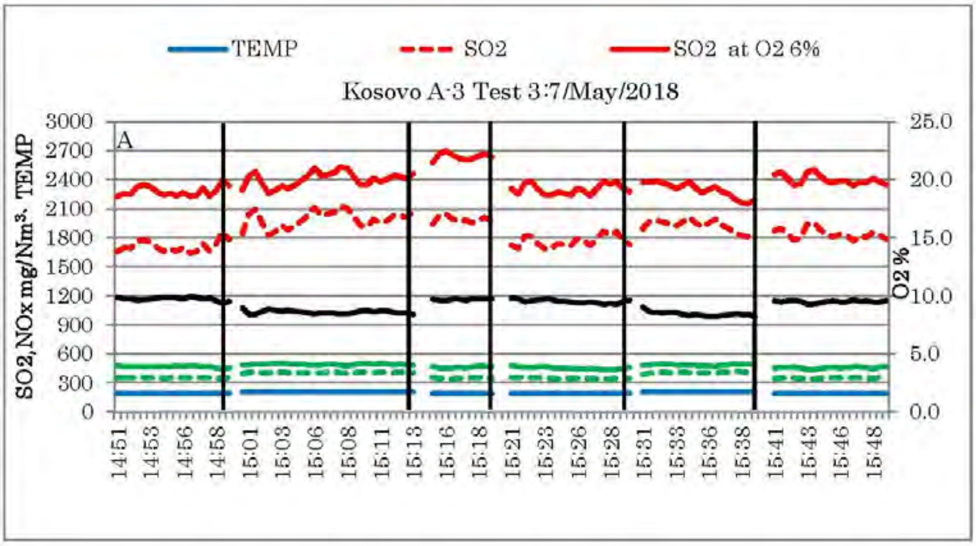


Figure 3-39 Exhaust gas measurement result of TPP Kosovo A A-3 Boiler

3) Reduction measures for NO_X

In the Precedent Activities and the Project period, NO_X in the exhaust gas usually stayed at 400~800 mg/Nm^3 affected by nitrogen content in the lignite, and almost the same value is expected as far as nitrogen content in the lignite does not change much. ELV of 500 mg/Nm^3 in 2018 can be achievable by applying restriction of nitrogen in the lignite or improvement of boiler burner operation. However, in order to achieve ELV of 200 mg/Nm^3 in 2023, at least installation of low NO_X burner is required. Even in the case of the installation of low NO_X burner, it is still required to study the effect of the air supplied not from the burners but from other parts of the boiler.

(2) Second Period and additional activities in the third period

Study on emission reduction measures for LCPs targeted only TPP Kosovo A. In TPP Kosovo A, no pollutants are in compliance with ELVs, and thus the conducted activity was mainly the study on the improvement of the ESP performance and the In-furnace desulfurization effect through analysis of SO_2 behavior.

In the second period, as for improvement of ESP performance to reduce Dust emission, JET explained to C/P-WG concrete measures (the improvement of gas flow distribution inside the ESP, the application of the intermittent energization control and the reduction of exhaust gas flow rate) , and then, proposed them to TPP Kosovo A personnel including the KEK executives. As a result, TPP Kosovo A accepted the proposal and will actively promote these improvements by themselves. As for the issue of the improvement of gas flow distribution inside the ESP, the concrete measure that JET and the UP studied and finalized based on the calculation results conducted in the first period was proposed. The improvement of the gas flow distribution in the ESP will be implemented by the staff of TPP Kosovo A.

As for the introduction of Intermittent Energization control, the possibility of application was confirmed by the manufacturer. However, it was necessary to call the engineer from the manufacturer, and therefore, TPP Kosovo A provided the necessary explanations to the upper management of KEK including the request for allocation of the budget. As TPP Kosovo A was planning to learn not only the introduction of Intermittent Energization control but also the acquisition of the knowledge on the whole control system, JET made a draft specification request for the ESP manufacturer and submitted it to KEK. Regarding the modification work for the improvement of the gas flow distribution inside the ESP, JET made the working manual which was prepared based on the detailed drawings of the ESP and explained it to the staff of TPP Kosovo A.

The study on the improvement of the gas flow distribution was conducted through industrial-academic collaboration by involving the UP, KEK and JET, and this is the first case of this kind of collaboration in Kosovo, which is considered to be one of the major achievements of this project.

Meanwhile, in the extended period of the third period, the Project studied the effect of the load reduction. In parallel, the Project carried out a test on the difference of the measurement results between the automated gas analyzer and analysis by Standard Reference Method, and this was described in 3-5-1 (2) 2).

The modification work at the ESP inlet including the guide vanes (plates for adjusting the flow direction inside ESP), was carried out at the C-duct of the No.5 boiler in TPP Kosovo A on March 2019. JET checked the modification result and measured the flow velocity distribution inside the ESP before starting the boiler and the improvement of the gas flow distribution was confirmed. After starting the boiler, the Project measured the Dust content as a performance test, and confirmed the improved performance through modification for the improvement of the gas flow distribution and the reduction of the exhaust gas flow rate.

On the other hand, with regard to the Intermittent Energization control for ESPs, the ESP manufacturer had been requested to dispatch an engineer, but there was no response to countless requests by KEK. The workshop was held in order for engineers at TPP Kosovo to improve their knowledge so that they can understand the Intermittent Energization control and to get prepared for the future, when the engineer from the manufacturer is dispatched.

As for $SO_{2,}$ in the beginning a low value close to zero was often measured, but as the measurement was repeated, very high SO_2 was also often observed. In the past, KEK thought that only combustible sulfur[28] (organic sulfur) in the lignite was converted to SO_2, and the In-furnace desulfurization reaction would occasionally lead to values close to zero. However, by this assumption it is hard to explain why such a high SO_2 was often observed. In addition, even though the boiler operating condition is the same, SO_2 greatly fluctuates even during the same day. The phenomenon cannot help but be affected by the fluctuation of the lignite properties.

Therefore, in order to investigate the causes, the analysis was conducted based on the measurement data for the past four years, including the data in the precedent activity, and the factors that influence In-furnace desulfurization have been analyzed. As a result, it has been revealed that three elements (Gas temperature, Oxygen concentration in the exhaust gas and the Residence time in the range of desulfurization reaction zone) are important. In order to confirm these hypotheses, and through discussions with C/P regarding the possible measures that could be implemented in the current boiler operation, the following tests were conducted.

- Low exhaust gas O_2 operation to reduce the amount of combustion air
- Increase of the setting value of the mill (Pulverizer) outlet temperature within the allowable range
- Change of the amount of air supplied to the stoker (a caterpillar shape grate for burning a large size unburned lignite falling to the bottom) which is installed at the bottom of the furnace

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[28] Sulfur subtracted from total sulfur the sulfur remained after heating for two hours in the electrical furnace at the temperature of 815±10℃ It is also called "Organic Sulfur"

It should be noted that the test to confirm SO_2 behavior by changing the opening of the burner damper during combustion and the test at lowered boiler load could not be implemented as they were very inconvenient for the staff of TPP.

When the low excess O_2 combustion (reducing the amount of air for combustion) was applied, NOx could be reduced but SO_2 greatly increased.

In the operation of increasing the set value of the mill outlet temperature and changing the amount of air flow supplied to the stoker at the bottom of the furnace, it has been confirmed that NOx does not change much, but SO_2 changes significantly.

It is also conceivable to apply the simulated two-stage combustion[29] and the fuel bias[30] as NO_X reduction measures, which can be applied to the existing boilers. However, inspecting the current boiler damper openings (upper damper is fully open and lower damper is 50%), as they are set close to the simulated two-stage combustion, NO_X reduction cannot be expected. There is also a method to increase the amount of fuel input from the lower burner to achieve a slow combustion, but in order to increase the fuel input from the lower burner, a complicated operation is required and unburned particles that fall to the bottom of the furnace also increase. Therefore, it seems difficult to change the currently set distribution of fuel input.

Table 3-106 Activities on emission reduction measure for TTP Kosovo A (Second period and additional activities in the third period)

Date	Activity	Participants
Oct. 19,2018 (Fri)	UP Meeting on gas flow simulation results in ESP	C/P & UP: 5
Oct.22,2018 (Mon)	Discussions on issues and Work Plan in Second period	C/P: 7
Oct.22,2018 (Mon)	UP, Confirmation of the presentation materials about the simulation	C/P & UP: 4
Oct.23,2018 (Tue)	TPP Kosovo A ESP Performance Improvement Presentation	C/P & KEK: 13
Oct.24,2018 (wed)	Meeting on implementation of ESP performance improvement	C/P & KEK: 6
Oct.25,2018 (Thu)	ESP Performance Improvement Presentation to KEK Executive	C/P & KEK: 5
Oct.30,2018 (Tue)	Black smoke reduction of TPP Kosovo A in boiler startup Improvement of ESP electric energization control	C/P & KEK: 6
Oct.31,2018 (Wed)	TPP Kosovo A NOx reduction test plan	C/P & KEK: 3
Nov. 1,2018 (Thu)	Workshop on ESP	C/P & KEK: 8
Nov.5,2018 (Mon)	TPP Kosovo A NOx reduction test procedure	C/P & KEK: 8
Nov.6,2018 (Tue)	TPP Kosovo A NOx reduction test	C/P & KEK: 5

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[29] Combustion air is supplied at two stages. First stage air is supplied from a burner together with fuel, and second stage air is supplied from the upper part of the burner. NOx is reduced by making the combustion slower.

[30] When burners are placed along height direction, different amount of fuel are supplied along height direction. In this case, burners with insufficient combustion air form reducing environment where NOx is hardly produced.

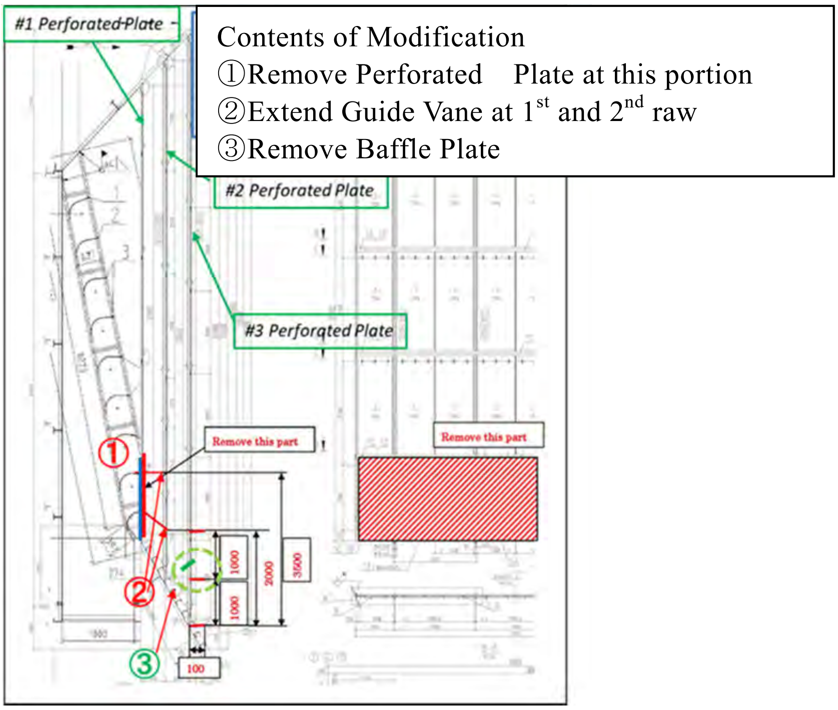
Nov.6,2018 (Tue)	ESP remodeling instructions	C/P & KEK: 6
Nov.8,2018 (Thu)	Discussion about NERP	C/P & KEK: 3
Nov.9 ,2018 (Fri)	Workshop on LCP environmental measures	C/P & KEK: 7
Mar.21,2019 (Thu)	Confirmation of KEK situation on improvement of ESP	C/P & KEK: 2
Mar.22,2019 (Fri)	Air flow distribution measurement procedure in TPP Kosovo A	C/P & KEK: 2
Mar.25,2019 (Mon)	Air flow distribution measurement in TPP Kosovo A	C/P & KEK: 4
Mar.28,2019 (Thu)	Workshop on SO_2 Reduction of TPP Kosovo A	C/P & KEK: 8
Mar.29,2019 (Fri)	Workshop on ESP electric energization control of TPP Kosovo A	C/P & KEK: 5
Apr.1,2019 (Mon) to Apr.4 (Thu)	Exhaust gas measurement on ESP performance improvement verification at TPP Kosovo A (Dust, SO_2, NOx)	C/P & KEK: 4
Apr.8 ,2019 (Mon)	Workshop on SO_2 and NO_X reduction by improvement of boiler operation	C/P & KEK: 3
Apr.10,2019 (Wed) to Apr.11 (Thu)	SO_2 and NO_X reduction test of TPP Kosovo A	C/P & KEK: 4
Apr.12,2019 (Fri)	Workshop on ESP Performance Improvement	C/P & KEK: 9
Apr.15,2019 (Mon) to Apr.18 (Thu)	SO_2 and NO_X reduction test of TPP Kosovo A	C/P & KEK: 3
Apr.24,2019 (Wed)	Workshop on Emissions reduction of LCP	C/P & KEK: 10
Additional activities in the third period		
Nov. 19 2020 (Fri)	Discussion on the results of exhaust gas measurement at TPP Kosovo A	C/P: 2
Nov.19, 2020 (Thu)	Discussion on measurement result of TPP Kosovo A	C/P: 2
Mar.19, 2021 (Fri)	Discussion on measurement result of TPP Kosovo A	C/P: 3

1) Dust Reduction measures

The following three points were proposed as ESP performance improvement measures for Dust reduction, and the implementation and the verification was carried out.

i) Equalizing Gas Flow Distribution

Based on the results of the flow distribution calculation by using computational analysis, the shape change of a part of the guide vane and partial removal of a baffle plate at the ESP inlet of the C-duct of No. 5 boiler were implemented. As shown in the comparison of the analysis results, this modification is intended to introduce gas into the bottom of the ESP where no flow is observed, and to create a uniform flow over the entire ESP cross section. This was carried out based on the modification plan shown in Figure 3-40.

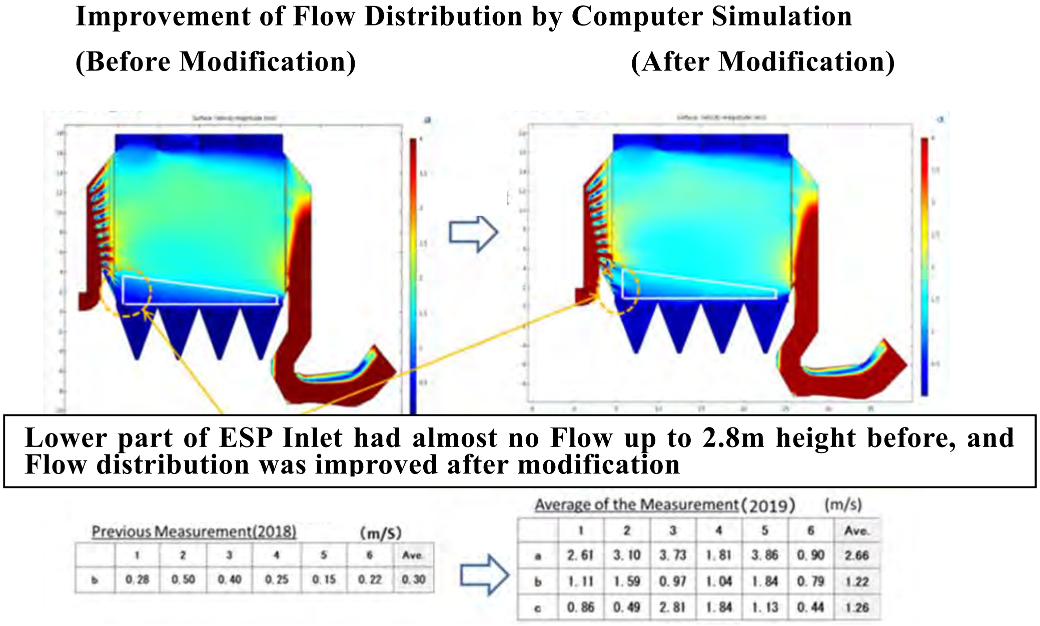


Contents of Modification
①Remove Perforated Plate at this portion
②Extend Guide Vane at 1st and 2nd raw
③Remove Baffle Plate

Figure 3-40 Modification work plan for ESP inlet

The flow velocity distribution measurement in the ESP after the modification was carried out in a very restricted time frame as the boiler had to be started quickly, and therefore, only the lower part of the ESP inlet could be measured.

As shown in Figure 3-41, the gas flow in this part was improved as expected.


Improvement of Flow Distribution by Computer Simulation
(Before Modification) **(After Modification)**

Lower part of ESP Inlet had almost no Flow up to 2.8m height before, and Flow distribution was improved after modification

Previous Measurement(2018) (m/S)

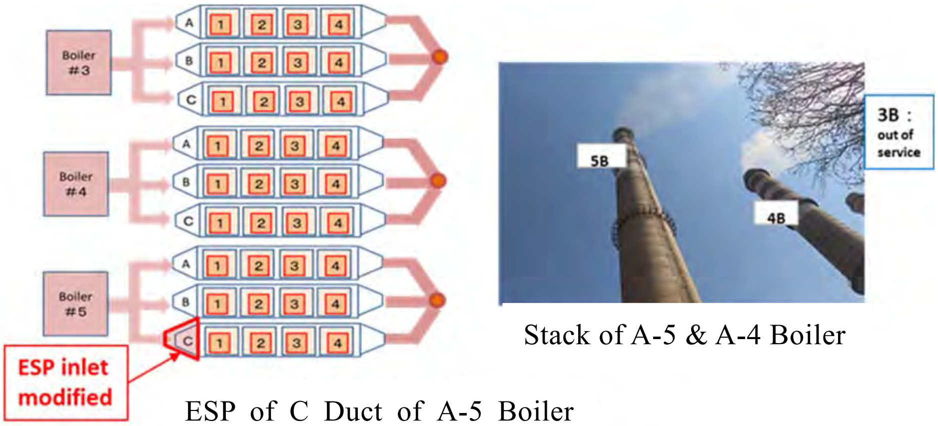
	1	2	3	4	5	6	Ave.
b	0.28	0.50	0.40	0.25	0.15	0.22	0.30

Average of the Measurement(2019) (m/s)

	1	2	3	4	5	6	Ave.
a	2.61	3.10	3.73	1.81	3.86	0.90	2.66
b	1.11	1.59	0.97	1.04	1.84	0.79	1.22
c	0.86	0.49	2.81	1.84	1.13	0.44	1.26

Figure 3-41 ESP inlets Flow Measurement Result (Before and after modification)

In order to evaluate the ESP performance after the modification, Dust content was compared during the boiler operation between the one at the ESP of the C-duct and the one at the A-duct in the A-5 boiler.



Stack of A-5 & A-4 Boiler

ESP of C Duct of A-5 Boiler was modified

Figure 3-42 Layouts of Boiler and ESP in TPP Kosovo A

The performance evaluation test was conducted together with the gas flow rate change test.

According to the test results on April 2, 2019, when it was considered that the properties of the combusted lignite were stable during the test period, it was confirmed that the ESP of the C duct which has been modified had better performance than the ESP of the A duct which had not been modified.

In addition, the performance of the ESP is affected by the properties of the ash of the lignite, and it was also observed in this test the performance of the ESP changed over time. The performance change was presumed to be affected by the "Back corona phenomenon" due to the high electrical resistivity of the Dust. Intermittent Energization control is effective for this kind of phenomenon, but the Project could not evaluate its effectiveness since the Intermittent Energization Control was not introduced yet.

ii) Gas Flow Reduction

The boilers of TPP Kosovo A are operating under the high amount of gas flow in comparison with the boilers of the same output, and at the same time, the ESP inlet gas temperature is higher than the design value. Therefore, the ESP is operating under the higher gas flow rate than the designed value.

For this reason, the reduction of the amount of gas flow rate will be advantageous in terms of the ESP performance, and therefore, the aforementioned performance test was carried out by reducing the gas flow rate together with the confirmation of the above-mentioned ESP inlet modification. As a result, the performance of the ESP was confirmed to be improved by the reduction of gas flow rate, and the result almost satisfied the present ELVs for 2018. In addition to the gas amount reduction effect, this was considered to be due to the fact that the operating temperature was also lowered, and the electric energization condition of the ESP was improved.

The following methods can be mentioned as methods to reduce the amount of the exhaust gas flow rate from the boiler.

(a) Reduce the combustion air flow rate by low exhaust gas O_2 combustion
(b) Reduce the air leakage from air side to gas side in the air pre-heater
(c) Reduce the air flow rate to Stoker at the furnace bottom
(d) Reduce the cooling air to burner nozzles, which are not in operation
(e) Reduce the air infiltration into the boiler through clearance between boiler wall and piping into the furnace, etc.

As a result of the tests conducted on (a), the improvement of the Dust collection performance of the ESP was confirmed, and CO did not increase due to incomplete combustion, but SO_2 increased sharply. Therefore, it is difficult to apply this method to the current facilities.

The amount of the air leakage in the air pre-heater was calculated based on the O_2 content in the exhaust gas at the inlet and outlet of the air pre-heater. As a result, it was found that approximately an amount of 50% of the theoretical air for combustion was leaking. The air leakage in the air pre-heater may be caused by the improper adjustment or deterioration of the seal mechanism that separates the air side from the gas side of the air pre-heater. JET explained the adjustment procedure of the seal mechanism, and recommended to carry out the adjustment.

As for (c), (d) and (e), it is thought that the implementation is difficult because it is necessary to change the structure of the boiler and/or to fully renovate the old boiler.

2) SO_2 Reduction measures

When SO_2 was initially measured in the Precedent Activities, a low value was observed, and it sometimes showed a value close to zero. Therefore, it was thought that in the lignite firing boiler, only the combustible (organic) sulfur in the lignite is converted to SO_2. However, as the measurement was repeated it has been found that it often exceeded 1,000 mg/Nm^3, and sometimes rose to 2,000 mg/Nm^3 or more. In addition, it was also revealed that SO_2 fluctuated largely without changes in the boiler operating conditions, and it is also very unlikely to show stable and constant value within one day as shown in Figure 3-43. It is thought that the effect of the In-furnace desulfurization fluctuates due to the change of the combustion condition caused by the change of the lignite properties.

Since lignite is fed directly from the coal mine, it is difficult to always supply lignite with stable properties. Therefore, it is necessary to investigate factors for achieving high efficiency of the In-furnace desulfurization and to consider the possibility of coping during the operation of the boiler.

Therefore, the analysis of the accumulated data in the project was carried out, and based on the results, possible measures by changing boiler operation method was examined.

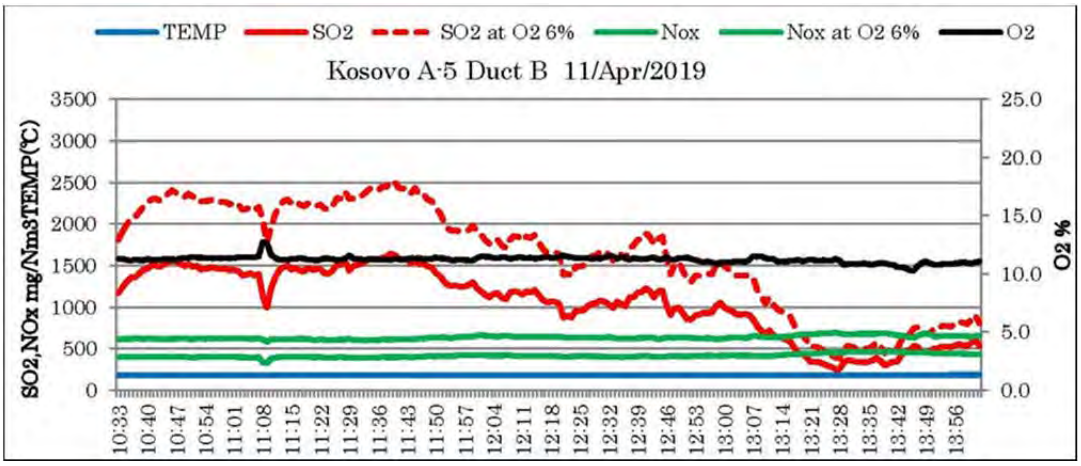


Figure 3-43 Behavior of SO$_2$ Concentration

i) SO$_2$ behavior analysis results

With regard to the data collected from 2017 to 2018 shown in Table 3-107, the analysis was performed regarding the relationship between the operating condition of the boiler and the exhaust gas properties. The analysis of the lignite was available only for dates marked with green in the table, but data without lignite analysis were also analyzed from the viewpoint of the In-furnace desulfurization.

Table 3-107 Recorded data

No.	Date	Boiler		Duct	No.	Date	Boiler	Duct
1	Mar. 20, 2017	A-4		A, B	8	May 2, 2018	A-3	B
2	Apr. 11, 2017	A-4		B	9	May 3, 7, 2018	A-3	B
3	Apr. 11, 2017	A-4		A	10	Sep. 21, 2018	A-4	A, B
4	Apr. 12, 2017	A-4		B	11	Sep. 25, 2018	A-3	B, C
5	Apr. 13, 2017	A-4		B, C	12	Sep. 26, 2018	A-5	B
6	Apr. 18, 19, 20, 23, 2018	A-4		B	13	Nov. 5, 2018	A-3	B
7	Apr. 30, 2018	A-3		A	14	Nov. 6, 2018	A-3	B

🟩 ; Lignite analysis results exist

In the analysis, the boiler operation data, the exhaust gas measurement data and the analysis of the lignite were compared along the time, and the analyses were conducted on the relationship between elements (Ca/S, O_2, Gas temperature and Boiler load) and SO_2 in order for the In-furnace desulfurization to be performed efficiently. The analysis results are shown in Figure 3-44~Figure 3-49.

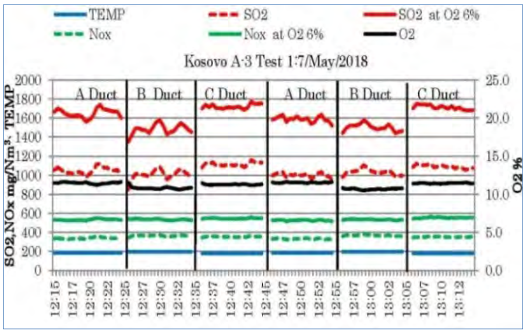


Figure 3-44 Variation of SO_2 per duct

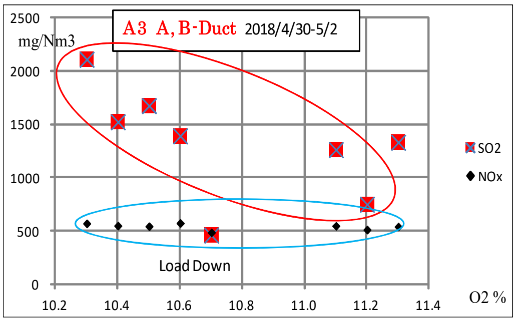


Figure 3-45 O_2 vs. SO_2, NOx

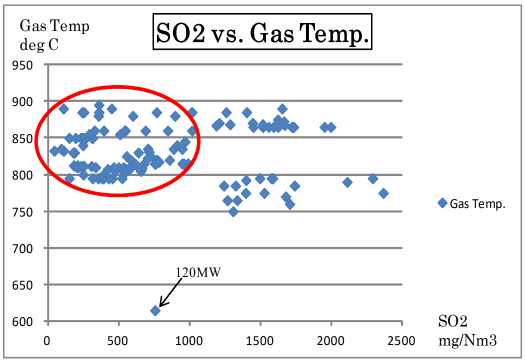


Figure 3-46 Gas temperature vs. SO_2

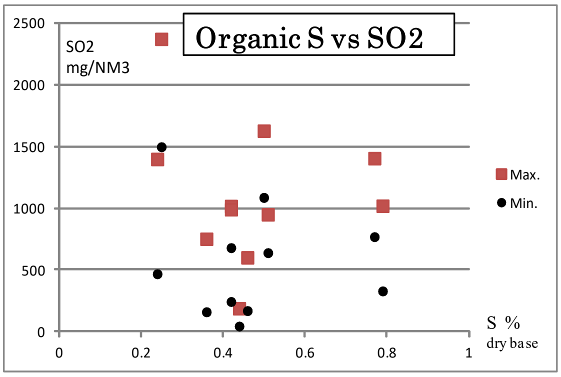


Figure 3-47 Organic S vs. SO_2

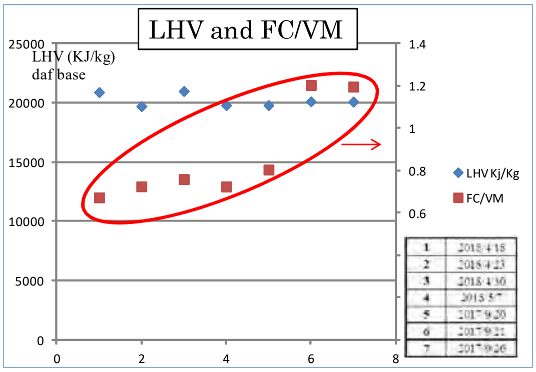


Figure 3-48 Volatile matter vs. SO_2

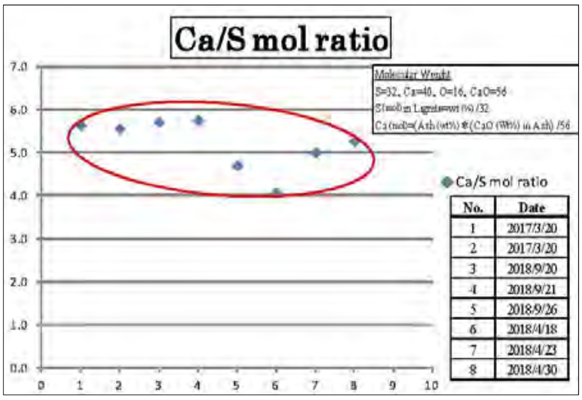


Figure 3-49 Ca, S in Lignite

The analysis results are summarized in Table 3-108

Table 3-108 Summary of Analysis result

	Item	Analysis Result of Data
1	SO_2, NO_X concentration	· SO_2 fluctuates greatly throughout the day. (0 to 2500 mg / Nm3) · Although NOx does not fluctuate much during one day, it changes in a certain range. · There is a difference in SO_2, NOx concentration between the Ducts.
2	Influence of O_2	· When O_2 is low, decreasing O_2 increases SO_2. · When O_2 is high, increasing O_2 increases SO_2.
3	Furnace gas Temperature	· The temperature difference between the left and right is often large. · It does not necessarily indicate the temperature of the desulfurization reaction zone. · There are high/low desulfurization rates for each flame from the burner. · When the temperature is less than 800 ℃ or more than 900 ℃, the concentration of SO_2 is high. · However, when the load is low, the SO_2 concentration below 700 ℃ is low.
4	Lignite Analysis	· Although there are variations in calorific value, S component, etc., the relationship with SO_2 concentration cannot be specified. · If all S becomes SO_2 when S in Lignite is 1% (Dry Base), it is 3000 mg / Nm^3 that means desulfurization reaction always takes place. · The higher the FC/VM ratio, the higher the SO_2 concentration appears. · Ca content in Lignite is 4 or more of Ca / S.
5	Location of not Operating Mill	· It seems that there is no relationship between SO_2 concentration and which mill has stopped. · However, there is a relationship between the furnace outlet gas temperature and the unbalance of the boiler outlet O_2.
6	Boiler Load	· As the boiler load decreases, the SO_2 and NOx concentrations both decrease. · In small load change, it is not clear due to the influence of other factors such as O_2.

FC/VM: Fixed carbon/Volatile matter

In the desulfurization reaction in the furnace, Calcium (Ca) contained in the lignite and Ca in the limestone ($CaCO_3$) are oxidized or dissolved at high temperature to become CaO in the furnace and the desulfurization is performed through the reaction of the generated CaO and SO_2 in the combustion gas as shown below. The performance of the In-furnace desulfurization reaction varies with the molar ratio of Ca/S and the gas temperature as shown in Figure 3-50 and Figure 3-51.

$CaCO_3 \rightarrow CaO + CO_2$; Formation of Quicklime

$CaO + SO_2 + 1/2O_2 = CaSO_4$; Desulfurization reaction

The conditions shown in Table 3-109 need to be satisfied in order for the In-furnace desulfurization reaction to be performed efficiently.

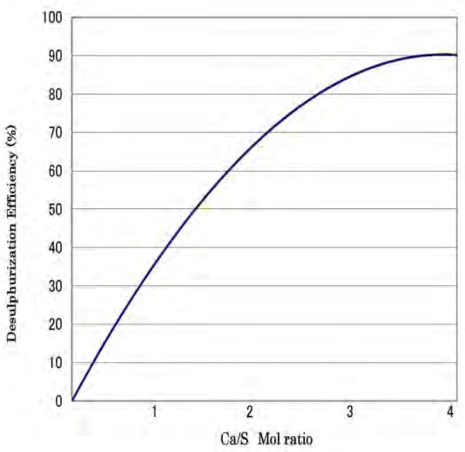


Figure 3-50 Ca/S vs. de-SO$_2$ Efficiency

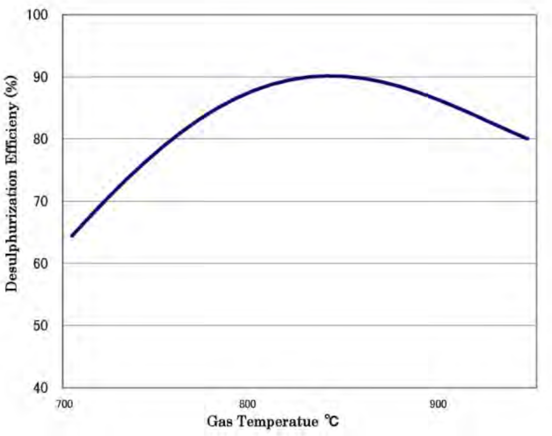


Figure 3-51 Gas temperature vs. de-SO$_2$ Efficiency

Table 3-109 Necessary Condition for In–furnace desulfurization

Item	Impact on desulfurization	Comment
1. Ca/S Ratio	Effect on De-SO$_2$ Efficiency	Ca / S can be secured by Lignite analysis results
2. Temperature	Appropriate Temperature is 825℃±25℃	Necessary to secure a temperature range in the reaction zone.
3. O$_2$ Density	De-SO$_2$ Reaction occurs with Oxidative Atmosphere	Necessary to secure O$_2$ in the reaction zone.
4. Limestone and Combustion Gas Mixing	Good Mixing is necessary	Mixing seems to be good as Ca is contained in Lignite
5. Size of Circulation Particle	Necessary to react to the center of the CaO particle	Good as SO$_2$ sometimes becoming Zero
6. Residence Time for Reaction	Enough time in suitable Gas Temperature zone is required	Combustion needs to be complete in the reaction zone.

From the above results, since the lignite used in TPP Kosovo A contains a large amount of Ca, additional injection of limestone is not necessary, and in order to efficiently carry out the In-furnace desulfurization, it is important to create the following conditions.

a) To create a temperature suitable for the In-furnace desulfurization reaction
b) To ensure O$_2$ concentration in the In-furnace desulfurization reaction zone
c) To secure residence time in the furnace desulfurization reaction zone

ii) Examination of improvement measures for the in-furnace desulfurization by changing boiler operation method

As a method of adjusting the gas temperature at the furnace outlet, methods as shown in Table 3-110 are considered.

However, the equipment of TPP Kosovo A is old and deteriorated, and their adjustment is difficult at this moment and therefore, investment on improvement of equipment is the pre-condition.

As the Lignite is directly supplied from the mine and it is difficult to store it at the power plant for a long time due to its easy ignition properties, it is not possible to apply means such as the quality adjustment by mixing low-quality Lignite with a high-quality Lignite. There is also the problem that the quality of the Lignite supplied to TPP Kosovo A is not stable, as the relatively good quality Lignite is preferentially supplied to TPP Kosovo B

When the property of the Lignite changes, it is ideal to quickly respond through the operation of the boiler. However, the application is very difficult due to the large investment needed, such as for the introduction of automatic control.

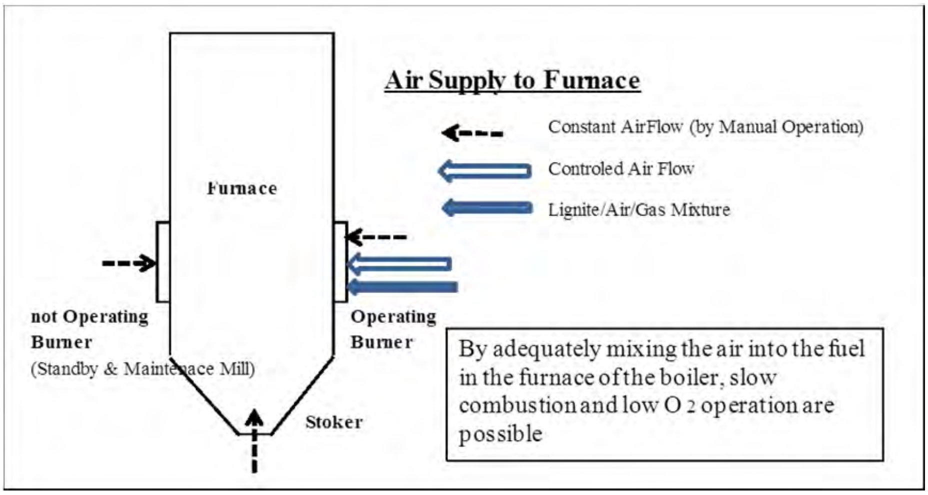
Table 3-110 Furnace outlet gas temperature Adjustment Method

Parameter		Effect	Measures
1	Heat Absorption in the Furnace	The gas temperature fluctuates periodically as Slag deposits and drops off. After the furnace cleaning, the amount of heat absorbed by the furnace wall increases and the furnace outlet gas temperature decreases.	Regular cleaning
2	Excess O_2	When the excess O_2 is increased, the combustion rate is increased and the furnace outlet gas temperature is decreased, but the NOx is increased. In addition, the amount of combustion gas also increases.	Air Flow adjustment
3	Lignite Property	The furnace gas temperature fluctuates due to the influence of the combustion speed and the brightness of the flame.	Lignite Property selection (implementation difficulties)
4	Air from the Burning Burner	The furnace outlet gas temperature changes with the distribution of 2ry and 3ry air at the upper, middle and lower stages of the burner. The furnace outlet gas temperature rises if the amount of air from the lower stage is reduced.	Damper opening adjustment
5	Air from Burners Off	The amount of air leaking for cooling of the burner not operating does not contribute much to the combustion, resulting in an increase in the amount of combustion gas.	Reduction of Cooling Air (Difficult due to burner burnout)
6	Air from Furnace Bottom	The air from the furnace bottom increases the amount of air to the lower level of the burner. As a result, the flame moves down and the furnace outlet gas temperature drops.	Reduction of Stoker Air (Difficult due to Stoker burnout)
7	Boiler Load	When the boiler load is lowered, the amount of heat input into the furnace is reduced and the amount of combustion gas is also reduced. Dust, SO_2, NOx reduction effect is large.	Derating of Boiler load (difficulty?)
8	Set Value of Mill outlet Temperature	When the set temperature is raised, the amount of gas from the furnace brought into the mill increases, the inert atmosphere increases at the burner zone, the combustion speed becomes slow, and the gas temperature at the furnace outlet rises.	Increase setting temperature

9	Number of Operating Mill	When the mill load increases, the amount of gas brought from the furnace into the mill increases for drying the moisture in Lignite. The result is same as for item 8.	With few number of operating Mills (limited by mill capacity)
10	Soot Blower	The furnace outlet gas temperature can be maintained stable by suppressing the amount of Slag adhering to the furnace wall and stabilizing the heat absorption of the furnace wall.	Capital investment required

Figure 3-52 shows the air introduced into the furnace of the boiler. The opening of the burner dampers that are operated manually are kept in the same position, whereas only the motor operated dampers can open and close as the mill is operated or stopped.

Figure 3-53 shows the cross section of the furnace and the arrangement of the mill. Since the air for the burner nozzle cooling is supplied to non-operating burner, it causes the gas temperature and O_2 unbalance inside the furnace.



By adequately mixing the air into the fuel in the furnace of the boiler, slow combustion and low O_2 operation are possible

Figure 3-52 Air supply to furnace

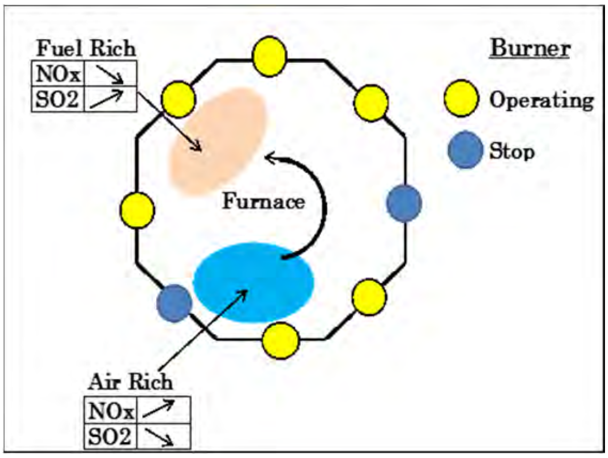


Figure 3-53 Mill layout and furnace atmosphere

iii) Impact confirmation Test on the In-furnace Desulfurization

The following tests were conducted in order to confirm SO_2 behavior by changing the boiler operation method.

- Low exhaust gas O_2 combustion
- Changing the setting value of the mill outlet temperature
- Air flow change from the furnace bottom

The test at lowered boiler load was implemented separately in the additional activities in the third period.

(Test results)

In the operation with low exhaust gas O_2, it was observed that SO_2 increased along with the reduction in exhaust gas O_2. This is likely to be due to the lack of O_2 in the desulfurization reaction zone.

As a result of changing the set value of the mill outlet temperature, it was confirmed that the furnace outlet gas temperature rose when the set value was increased. It is thought that when the set value is increased, the exhaust gas mixing ratio to the primary air increases and the ratio of the air contained in the primary air decreases, so that the combustion in the vicinity of the burner ignition part becomes slow and the position of the flame moves upward.

When the furnace outlet gas temperature is lower than the temperature suitable for the In-furnace desulfurization, the desulfurization efficiency is improved and SO_2 is reduced due to the increase in gas temperature, but the desulfurization efficiency decreases if the temperature rises further and exceeds the temperature suitable for desulfurization and SO_2 increases.

When the furnace outlet gas temperature is higher than the temperature appropriate for the In-furnace desulfurization, the SO_2 rapidly increases as the gas temperature further increases.

When the furnace outlet gas temperature is high, if the amount of air from the furnace bottom[31] is increased, the amount of air supplied to the lower stage of the burner increases. Then the position of the flame moves downward and the furnace outlet gas temperature decreases. It was confirmed that when the furnace outlet gas temperature was higher than the temperature suitable for desulfurization, the reduction of the gas temperature causes a decrease in SO_2.

It was also confirmed that the SO_2 changes sensitively even if the furnace outlet gas temperature change is slight.

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[31] Cold air directly from combustion air fan and hot air after the heat exchanger is supplied to the stoker at the bottom of the boiler. Since the amount of cold air is constant, the amount of hot air to the stoker increases when total amount of air is increase. Thus the supplied air temperature to the stoker increases, and therefore, this temperature becomes the index of total amount of supplied air to the boiler.

If the properties of the lignite are stable, the changing range in SO_2 is small, and it may be possible to control SO_2 by adjusting the operating parameters of the boiler manually according to the SO_2 and the operating condition of the boiler at that time.

However, when the property of the lignite is not stable and changes greatly over time, it is difficult to follow it by changing the boiler operation method.

In order to be able to cope with such a case, it is necessary to install a monitoring device for the boiler operating condition, the emission data in the exhaust gas and the remote control of the burner damper, which usually an integrated part of modern boilers, and then, an advanced control system should be introduced, which uses a computer system that can automatically adjust the boiler operating parameters to achieve the In-furnace desulfurization effectively based on monitoring of the data.

3) NO_X Reduction measures

Although it was confirmed that NO_X can be reduced by approximately15% by low exhaust gas O_2 combustion, SO_2 rose rapidly.

This is considered to be due to the lack of O_2 in the In-furnace desulfurization reaction zone. The desulfurization efficiency decreases when the low exhaust gas O_2 combustion is carried out. Therefore, it is difficult to achieve both SO_2 reduction and NO_X reduction at the same time in the existing boiler.

Besides, although the method using the simulated two-stage combustion and the fuel bias can be considered as NO_X reduction measures, but considering the current boiler damper opening, the setting is already similar to the simulated two-stage combustion, so further NO_X reduction cannot be expected

There is also the method to increase the amount of the fuel input from the lower level burner to achieve slow combustion, but increasing the amount of the fuel input from the lower burner also increases unburned particles falling to the bottom of the furnace. It seems difficult to change the currently set fuel input allocation.

As a peculiarity of the boiler of TPP Kosovo A, there is air introduced from the Stoker installed at the furnace bottom and from the non-operating burner for cooling the burner nozzle.

The air introduced from the operating burner can be adjusted so that the fuel can be properly mixed with the air and good combustion can be obtained, but the air introduced from places other than the burners does not necessarily contribute to the combustion.

Even when trying to carry out low exhaust gas O_2 combustion, the air from places other than the burners interferes or brings O_2 unbalance in the furnace and this air hinders NO_X reduction in improvement of combustion method. The air interferes with the NO_X reduction operation, and it is almost the limit for reduction of NO_X by the existing facilities, and the introduction of the two-stage combustion + low NO_X burner is essential.

4) Effect of the boiler load on pollutants

In the third period, as one of the additional activities, the Project inspected the effect of the boiler load reduction on dust, SO_2 and NO_X, although the time at a low load operation was short. In parallel, the Project studied the difference between the results by the automated gas analyzer and the analysis results by Standard Reference Method, and this is described in 3-5-1 (2) 2).

The effect of the boiler load reduction is as follows.

Reducing the boiler load has the effects as shown in the table, which are thought to affect the SO_2 and NO_X values.

Table 3-111 Effect of reduced boiler load on SO_2 and NO_X

Parameter			Effects	
1	Heat Input	⬇	Furnace Gas Temperature	⬇
2	Gas Flow	⬇	Residence Time	⬆
3	Buner Load	⬇	Primary Air／Lignite	⬆

The test was conducted by C/P on November 4, 2020, with the method of temporary reduction of the boiler load from 137 MW to 118 MW (14% load reduction). The test results are shown below.

SO_2 was reduced significantly as the Boiler Load decreased. On the other hand, NO_X did not change much even when the boiler load was reduced.

The reasons for this are considered to be that lowering the mill load increases the amount of O_2 in the primary air in the burner, promotes combustion and increases NO_X, while NO_X decreases due to the decreased heat input in the furnace. It is probable that the effects canceled each other and NO_X did not change much.

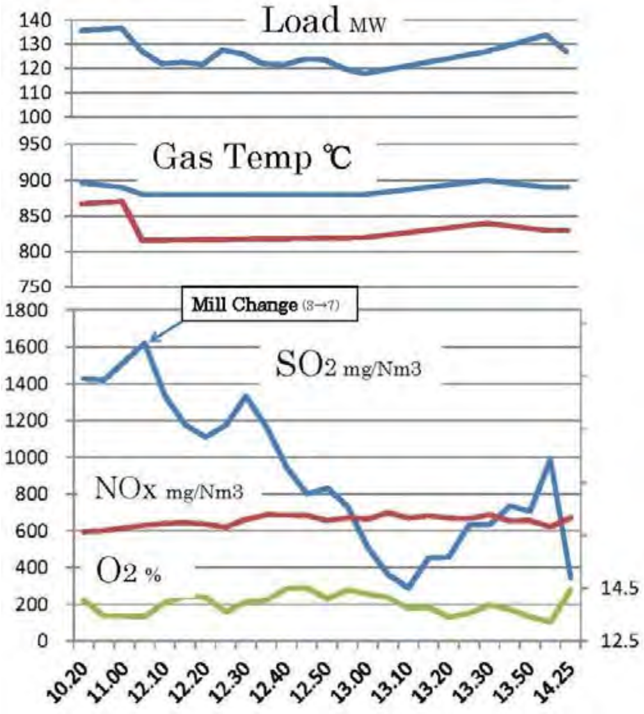

Figure 3-54 Boiler load reduction test result

(For details, see Appendix-1 Output materials: "7-2)-4 Kosovo A-5 Boiler Load Change "," 7-2)-5 Fuel Flow Control of Drum Type Boiler " and "7-2)-6 Impact of Boiler Load down on NO_X ")

The phenomenon where NO_X does not decrease even if the boiler load is reduced is highly likely to be caused by no change in the number of mills in operation when the boiler load was reduced. In the case of the boiler load reduction, if the number of mills in operation is decreased, the amount of O_2 in the primary air at the burner is reduced. In this condition, NO_X is expected to be reduced.

Moreover, since the effect of reducing SO_2 is large, if low excess O_2 combustion is applied, SO_2 may increase slightly, but NOx can be reduced.

In order to make clear the reason why SO_2 and NO_X are reduced by the boiler load reduction in a detailed way, JET recommended that C/Ps need to confirm the following points.

a. As in the previous tests, it has been found that there was not much difference in NO_X between each duct, but the difference in SO_2 was large, and therefore, it is necessary to measure and confirm SO_2 in each duct in order to clarify the effects.
b. It is also necessary to collect one hour data before and after lowering the boiler load in order to confirm the stability of the boiler. All the data of the boiler load, gas temperature, SO_2, NO_X, and O_2 should be collected every 15 to 20 minutes during the test.
c. It is also necessary to confirm the effect of the low excess O_2 combustion in order to confirm the effect to the exhaust gas when the boiler load is reduced,
d. It is considered that to keep the furnace outlet gas temperature suitable for the desulfurization reaction is the most important factor for effective in-furnace desulfurization in the boiler. There is a difference in furnace outlet gas temperature between the ducts, and it is unclear which factor influences the SO_2 reduction as a result of in-furnace desulfurization. Therefore, it is proposed to adjust the damper openings of each burner or to adjust the amount of lignite input through each mill so that there is no difference in furnace outlet gas temperature between the ducts.
e. In order to make the distribution of the furnace outlet gas temperature uniform, it is recommended to install two more thermometers for checking the temperatures, and then based on these temperatures, to control the combustion manually through either lignite flow adjustment or damper opening adjustment.

5) Emission Reduction Measures for LCPs

Kosovo has formulated the NERP based on the NERP submitted to EnC in May 2018 in accordance with the EU Directive on Large Combustion Plants (LCPs). It is necessary to achieve ELVs in accordance with EU directive for LCPs shown in Table 3-112 for Dust, SO_2 and NO_X.

Table 3-112　Emission Limit Values for LCP

Pollutant　／ Year	2018	2023	2026
SO_2 (mg/Nm^3)	400	400	200
NOx (mg/Nm^3) as NO_2	500	200	200
Dust　(mg/Nm^3)	50	50	20

At TPP Kosovo A, three boilers: A-3, A-4 and A-5 are in operation. The specifications of the boiler and ESP are as shown in Table 3-113 and Table 3-114. The A-3 and A-4 boilers are boilers of the same design and the A-5 boiler has a slightly different capacity than these boilers, but it can be considered the same capacity.

Table 3-113　Specifications of TPP Kosovo A-3, 4, 5 boilers

	Item	**Unit**	**Description**
1	Manufacturer Type		“RAFAKO” Poland OP – 650 –b
2	Year of Operation		A-3; 1970、A-4; 1971、　A-5; 1975.
3	Boiler Height	m	60
4	Furnace Size (Width x Depth)	m	12.5 x 15.24
5	Type of Boiler		Natural Circulation Boiler with free semi-suspended construction, with two drums, with a natural circulation of water-steam scheme and with the removal of the bottom ash in the solid state.
6	Firing System		Pulverized Coal assisted by liquid fuel oil
7	Draft System		Balance Draft
8	Furnace Wall		Membrane
9	Furnace Bottom		Scraper Conveyer with water seal
10	Evaporation	T/h	650
11	Steam Temperature	℃	540
12	Steam Pressure	bar.	162（FW）、152(Drum)、138(SH Out)
13	Boiler Design Coal		Lignite
14	Coal Consumption	T/h	316
15	Burner		3 Levels x 8 Corners
16	Excess Air Ratio	%	30 - 50
17	Combustion Air Flow Rate	Nm^3/h	855 000 Nm^3/h
18	Burner Inlet Air Temperature	℃	270
19	Furnace Pressure	mmH2O	-3 to -5
20	Boiler Outlet Gas Temperature	℃	160 - 200

Table 3-114　Specifications of TPP Kosovo A-3, 4, 5 ESP

	Item	**Unit**	**Description**
1	Manufacturer		HAMON ENVIRONMENTAL

	Type		GmBH “KOMPAKT PLUS”
2	Year of Operation		2012
3	Number per Boiler		3 ESPs/Boiler
4	Number of Fields		4 Fields
5	Surface for cumulative electrodes	m2	9728/ESP（1F : 2816　2～4F : 6912）
6	Height	m	16
7	ESP Inlet Gas Flow	m^3/h	716,784/ESP
8	ESP Inlet Gas Temperature	℃	150 - 210
9	Gas Velocity	m/s	1.41
10	ESP Draft Loss	mbar	(-30)
11	ESP Inlet Dust Content	g/Nm^3	41.110
12	ESP Outlet Gas Content	mg/Nm^3	50
13	Dust Collecting Efficiency	%	99.88

Figure 3-55 and Figure 3-56 summarize all data on NO_X and SO_2 content (mg/Nm^3; O_2=6% base) measured at TPP Kosovo A from 2017 to the present, and the Values are very widely distributed.

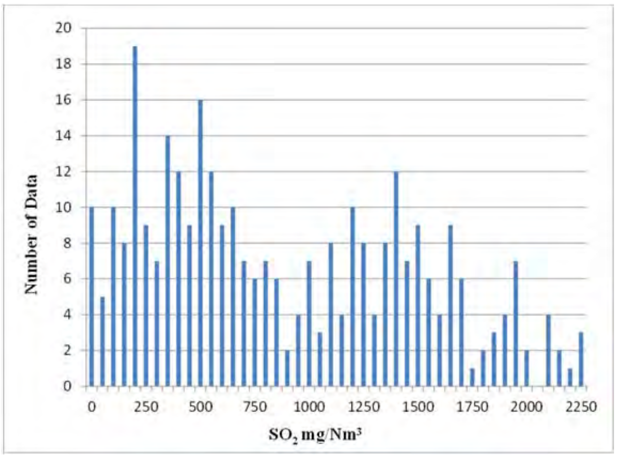

Figure 3-55　Distribution of S02 value

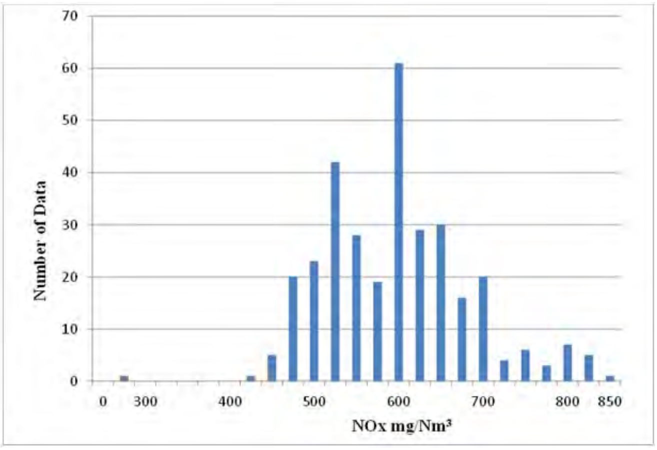

Figure 3-56　Distribution of NOx value

These data include data that no improvement was applied to by the boiler operation method, so when considering equipment improvement to satisfy ELVs, the use of the maximum value in order to satisfy ELVs is not appropriate to consider measures.

Therefore, it is practical to study measures based on the maximum value of the data that cut the top 20% from all data (Table 3-115). If a case that exceeds the value of these values occurs in actual operation, it is considered that it can be dealt with by the boiler operation conducted in the previous tests and by the boiler load reduction.

Table 3-115 Boundary of the top 20% of all data

SO_2	More than 1500 mg/Nm^3
NOx	More than 670 mg/Nm^3

i) Dust Reduction Measures

As stated in the activities, the current ESP is designed with an exhaust Dust concentration of 50mg/ Nm^3, and if the measures shown in Table 3-116 are applied based on the test results conducted so far, it is considered that ELVs in 2023 can be cleared. In order to clear the ELVs in 2026, it is necessary to further enhance the Dust collection capacity, but it may be possible to achieve this by installing a desulfurization unit (* 1) because the Dust is also removed by the desulfurization unit.

Table 3-116 Dust reduction measures

	Measures	What to do
1	ESP gas flow Homogenization	Guide vane improvement in ESP inlet duct for uniform gas flow based on ESP flow analysis results (partially implemented)
2	Change of ESP energization control method	Under discussion with ESP manufacturer for improvement of ESP energization control
3	Reduction of exhaust gas volume	It is necessary to implement on the boiler side. (* 2)
4	Reduction of exhaust gas temperature	It is necessary to implement on the boiler side. (* 2)

* 1: In addition to the Dust removal effect of the desulfurization unit, if a Gas-Gas Heater (GGH) for reheating exhaust gas installed in the desulfurization unit is installed upstream of the existing ESP, the exhaust gas temperature at the ESP inlet will be lowered to about 90 ° C. As a result, the volume flow rate of exhaust gas is reduced by about 20%, and the Dust collection performance of ESP is also improved. At the same time, by lowering the gas temperature, the charging characteristic of the ESP is improved. (Figure 3-57)

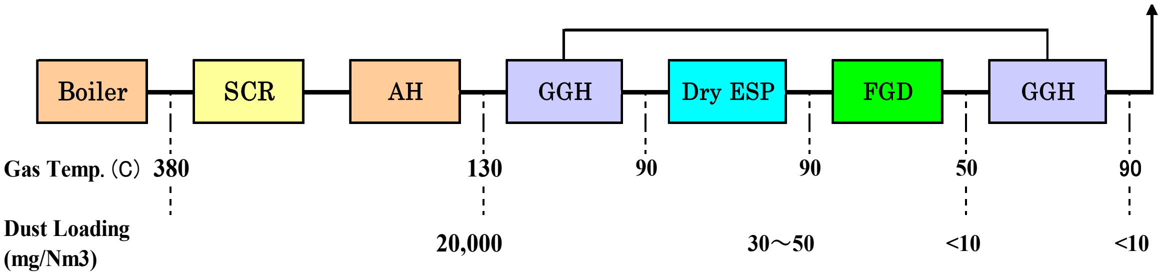

Figure 3-57 Low-Low Temperature ESP System (New System)

* 2: Methods of reducing the amount of exhaust gas to the ESP are (1) reducing the amount of air leaking in the air pre-heater, (2) low O_2 combustion of the burner, and (3) reducing the amount of air leaking into the boiler.

According to the measurement results, the leaked air volume at the current air pre-heater is about 50% of the theoretical air volume of combustion air, and it is necessary to reduce it to 10%, same as the level at the time of the construction, by adjusting and repairing the seal of the air pre-heater.

Since the exhaust gas temperature at the outlet of the air pre-heater is lowered by mixing air with the exhaust gas after heat exchange in the air pre-heater, if the amount of the leaked air in the air pre-heater is reduced, the air pre-heater outlet gas temperature rises. Therefore, when taking measures to reduce the amount of the leaked air in the air pre-heater, it is necessary to carry out simultaneously the measures stated later for reducing the exhaust gas temperature.

Since a low NO_X burner as a NO_X reduction measure can burn low exhaust gas O_2, replacement with a low NO_X burner also contributes to improvement of ESP performance.

Routine maintenance is important to reduce the amount of air penetration from the boiler furnace.

* 3: ESP inlet gas temperature reduction

Causes of the rise in boiler exhaust gas temperature are: (1) Contamination of heat transfer surfaces such as economizers, super-heaters and re-heaters, or uneven gas flow in the boiler furnace due to ash accumulation, and (2) Heat transfer deterioration of the air pre-heaters due to the decrease in the thickness of the heat transfer element.

When the boiler is stopped, it is necessary to check for dirt and ash blockage on the heat transfer surfaces of the economizer, super-heater and re-heater. In order to check the deterioration of the heat transfer element of the air pre-heater, it is necessary to take out the heat transfer element and check it visually, and check the weight loss of the heat transfer element by weight measurement.

If any dirt or ash blockage is found on the heat transfer surfaces such as the economizer, super-heater, and re-heater, clean them and install a soot blower in the places where ash adheres strongly to make sure that the heat transfer to the steam and water is performed properly.

If the heat transfer element of the air pre-heater is found to be deteriorated, it must be replaced with a new element.

ii) NO_X Reduction Measures

In order to reduce the NO_X level from 670 mg/Nm^3 to 200 mg/Nm^3, it is mandatory to replace the existing burner with the two-stage over fire air (OFA) +

low NO_X burner. However, it is considered quite difficult to always satisfy 200 mg/Nm^3 because the NO_X level is very high and Low NO_X burners may not perform well due to the air leakage into the furnace from other place than the burner.

Regarding the furnace height required for low NO_X combustion, the boiler of TPP Kosovo A is operated at about 25% de-rating to the design specification, so the residence time of combustion gas in the furnace is 25% longer than design. So it is considered that the residence time of the combustion in the furnace can be secured even if the conversion to the two-stage combustion + low NO_X burner is performed. It is considered that low NO_X burner can be applied without increasing the furnace height.

At the time of the burner remodeling, it is necessary to replace the start-up oil burner that generates black smoke when the boiler is started.

If 200 mg/Nm^3 of NO_X cannot be satisfied with the two-stage combustion + low NO_X burner, it is necessary to install a de-NO_X facility, but since the NO_X reduction rate required for the de-NO_X facility is small, it is considered that the requirements can be met by application of the non-catalytic de-nitration system[32] (SNCR). If a catalyst-based de-nitration system (SCR) is applied, the ash generated by the lignite firing contains a large amount of alkali components, so care must be taken in selecting a catalyst that does not deteriorate due to alkali components.

The low NO_X burner can be operated with an excess air rate of about 20% of the theoretical air quantity for combustion. If the gas flow is reduced and the exhaust gas temperature can be maintained at the current level of about 180 ° C, the boiler efficiency (based on the higher heating value) will increase by about 7% as a relative value compared to the current level. The measures are also effective in improving the boiler efficiency.

iii) SO_2 Reduction Measures

It has been confirmed that SO_2 changes greatly from 0 mg/Nm^3 to 2000 mg/Nm^3, but the cause is due to the In-furnace desulfurization due to Ca contained in the lignite. In order to efficiently perform desulfurization in the furnace, it is necessary to establish a temperature range suitable for the In-furnace desulfurization reaction in the furnace of the boiler. In the existing boilers, the means of adjusting the gas temperature in the boiler furnace to a temperature range suitable for desulfurization reaction is limited, but it has been confirmed that SO_2 can be reduced by changing some operating parameters.

When replacing with a two-stage combustion + low NO_X burner, the following

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[32] By supplying a reducing agent such as ammonia or urea to the high gas temperature zone in the furnace of the boiler (almost the same temperature zone as the in-furnace desulfurization), 30% to 50% of NOx reduction can be obtained without a catalyst.

operating parameters are added to the operating parameters that can be applied with the existing boiler as a means to adjust the gas temperature in the furnace, and it is expected that the furnace desulfurization is efficiently improved through the operation described below.

- Changing the combustion state of the lignite by adjusting the opening of the burner damper
- Adjusting the gas temperature in the furnace by increasing or decreasing the amount of air from the over-fire air-port.

Therefore, after installing a two-stage combustion + low NO_X burner, it is necessary to conduct a test for improvement of the In-furnace desulfurization and confirm how far SO_2 can be reduced before considering the SO_2 reduction measures.

The gas temperature in the furnace changes because the amount of heat absorbed by the furnace wall tube changes depending on the thickness of the ash adhering to the furnace wall surface. Therefore, the soot-blowers installed on the furnace wall are an effective means for adjusting the furnace gas temperature. There is a gas temperature difference between the left side and the right side in the furnace. It is important to equalize the gas temperature in the cross section of the furnace, and this can be adjusted by the amount of the lignite supply from the mill and the amount of air supplied from each burner. For this purpose, it is necessary to add at least two set of the furnace outlet gas thermometers, monitor the gas temperature in the furnace and adjust so as to minimize the gas temperature difference.

If the SO_2 regulation value cannot be satisfied even after taking these measures, it is necessary to consider installing a desulfurization unit.

6) Estimation Cost of Measures

The cost of the measures for pollutants for implementation on three boilers in TPP Kosovo A was estimated based on general equipment costs. As there are the following uncertain factors at the each plant, when implementing measures, it is necessary to clarify the conditions and consult with the manufacturer. It does not include the cost of measures for the deterioration due to the aging of the boilers

i) Local Condition of installation site;

- Climate conditions (temperature, humidity, wind speed, rainfall, snowfall), Seismic coefficient, Noise regulation value
- Performance of the equipment of existing boiler (mill fineness, combustion air temperature, etc.)
- Utility source (water, electricity) supply conditions
- Necessity of inland transportation
- Whether local procurement of materials and sub-materials necessary for construction is possible

- Local labor costs-Types
- Capacity and number of heavy equipment that can be procured, and their costs
- Possible plant stop period
- Required environmental measures during construction
- Expenses for processing waste materials generated during construction

etc.

ii) Ancillary work

- Does not include civil works up to foundation setting
- Remodeling of floors, steel frames, backstays (holding up from the back), etc. due to remodeling of burners, etc.
- Automated remodeling of existing parts of the central control panel
- Restrictions on installation location and route changes such as ducts received from the existing equipment layout of the plant.
- Curing of existing equipment for construction, removal and relocation of existing equipment.
- Temporary removal and restoration of equipment affecting the delivery of construction equipment
- Restrictions on heavy equipment that can be used in terms of equipment placement in the plant and restrictions on installation of temporary facilities for construction

Especially since the boiler is obsolete, there is a possibility that the scope of construction will be expanded in relation to deterioration.

iii) Contractor ;

- Available contractors are limited
- Is the drawing etc. that can be provided to Contractor complete?

iv) Economy Environment

- Timing of the implementation and the global economic environment at that time will affect the implementation costs

a) Dust Reduction Cost (excluding renovation expense)

Item	**Cost**
・Renewal of air pre-heater seals and heat transfer elements （3 set / boiler x 3 boilers）	1.2 million €
・Installation of additional Soot Blowers （34 set / boiler x 3 boilers）	7.5million €

Above mentioned cost is the additional cost for securing dust reduction measures. The on-going improvement such as the improvement of the gas flow distribution inside the ESP and the application of Intermittent Energization Control is not included. It is hard to estimate the improvement of the gas flow distribution since it is in-house work in TPP Kosovo A. The application of Intermittent Energization Control is not yet determined since it is under negotiation. However, the investment for these two measures is presumed to be relatively small compared with the above mentioned investment, and therefore, these costs are not considered.

b) NOx Reduction Cost (excluding renovation expense)

Item	Cost
・Two-stage OFA + low NOx burner （8 corners / boiler x 3 boilers）	33 million €

c) SO_2 Reduction Cost (excluding renovation expense for existing equipment)

Item	Cost
・De-sulfurization (FGD) （2 set / boiler x 3 boilers）	88 million €

3.8.2 Evaluation of the Objectively Verifiable Indicators in the PDM

The Objectively Verifiable Indicator of PDM is "Diagnosis on NO_X, SO_2 and Dust emissions for LCPs are conducted. Three Pollution control measures for each pollutant are elaborated for Kosovo A TPP.”.

The Project proposed to TPP Kosovo A three measures for the dust reduction, one for NO_X and one for SO_2 reduction. Total five measures are proposed and the indicator has been satisfied. However, only two out of three measures for dust have been applied or are under application. Other measures require pretty large investment, and this may affect the government decision on whether to rehabilitate TPP Kosovo A or decide on its decommissioning.

As for dust reduction, the three aforementioned measures (the improvement of the gas flow distribution inside ESPs, the application of the intermittent energization control for ESPs and the exhaust gas flow rate reduction) are proposed. The improvement of the gas flow distribution inside ESPs has been applied to each boiler one by one and the application of the intermittent energization control for ESPs is now under negotiation with the manufacturer. The exhaust gas flow rate reduction needs not a little investment, and it is a future issue. If these measures are applied, ELVs will be satisfied. As for NO_X, the introduction of low NO_X burners and two stage combustion is proposed, and as for SO_2, temperature control such as the introduction of combustion air control, prevention of air infiltration, etc. but they have not been realized because of the restriction of the budget.

As for NO_X, since the boilers of the TPP are old, and the burner equipment for controlling the combustion is not sufficient, the method that can reduce NO_X by changing the operating method of the burner is limited to the low excess air ratio (low O_2) operation, and its effect has been confirmed. However, when the low excess air ratio operation was performed, the gas temperature in the furnace changed and as a result SO_2 level increased. In order to satisfy the ELVs, at least the replacement of the existing burner with "Two-stage combustion + Low NO_X burner" was proposed, as there is a limit to reduce NOx by the operational improvement of the existing burner.

Regarding SO_2, it was revealed that SO_2 concentration fluctuates due to the desulfurization reaction in the furnace by Ca contained in lignite (it is so called "In-furnace desulfurization"). In order to reduce SO_2, it is necessary to efficiently carry out the desulfurization reaction in the furnace. The behavior of SO_2 was investigated when the gas temperature in the furnace was changed by changing the operation method of the boiler. As a result, it became clear that maintaining the appropriate gas temperature in the furnace is effective for the In-furnace desulfurization. However, with the existing equipment, the gas temperature inside the furnace can be changed only slightly, and the SO_2 cannot be significantly reduced, so ELVs cannot be satisfied at the present.

In order to realize the SO_2 reduction, rather than deciding to install the expensive desulfurization equipment immediately, it is suggested to carry out the SO_2 reduction test based on the tests carried out in the project so far, as the furnace gas temperature can be changed a little more after replacement of the existing burner with the "Two-stage combustion + Low NO_X burner".

When ELVs become severer in the future, it will be necessary to introduce higher performance of emission reduction equipment (for example wet ESP, desulfurization unit, de-nitration unit, etc.).. Therefore, the basic knowledge of emission reduction equipment generally adopted in LCP and the points to be noted when adopting them were repeatedly explained through the workshops, in order to deepen their understanding.

3.8.3 Capacity development through the activities

The goal of Output 7 is "Emission control measures are developed at LCPs". Actual activities include clarifying the behavior of pollutants in LCPs, planning the emission reduction measures, improving the operation methods that can be implemented immediately, and applying measures that can be carried out with relatively small investment. Through these activities, capacity of C/Ps was intended to be improved.

- In order to reduce SO_2, Dust and NOx as environmental measures for LCPs, it is important to understand the current status of the exhaust gas properties. Through OJT, C/P acquired the measurement technology, such as the setting of sampling ports for collecting exhaust gas, the preparation of measurement equipment on site, the cooperation with related parties at the time of measurement, the cleaning of the equipment after measurement, the processing of the collected data, etc. Through a series of activities, operation manuals were prepared and C/P reached the level of capability where they can independently carry out the measurement process without the support of JET. However, the number of members available for measurement is limited, and it is necessary to increase the number of members of the measurement group.

- The boilers are old as they have been built nearly 50 years ago, the properties of the Lignite are not stable and the properties of the exhaust gas from the boiler can change significantly. It is very difficult to find ways to improve the exhaust gas properties by changing the boiler operation method, but the method to find the ways and/or processes to make improvements have been acquired.
- In order to improve the performance of ESP, a series of tasks including the flow distribution measurement inside ESP, the flow distribution analysis using CFD model based on the measurement results, and the measures to equalize the gas flow at the inlet of ESP based on the analysis results were conducted through collaboration between members of TPP, the UP and JET. Through this work, a series of approaches for solving the problem has been transferred to the Kosovo side.
- Environmental measures for LCPs have been explained repeatedly during the seminars, and C/P understood the principles of the emission reduction equipment and the points to be considered for the case when they are adopted.

3.9 Output 8: Capabilities for evaluating air pollution control measures of Kosovo side are developed.

3.9.1 Activities

(1) Activities for evaluation of air pollution measures

The activities shown in Table 3-117 on capacity development for evaluating the air pollution control measures (hereinafter referred to as “the Measures”) of Kosovo side were carried out.

Table 3-117 Seminars, Lectures, OJT on Output 8

Date	Contents	Participant
First period		
Apr. 20, 2018 9：00~12：00	Seminar: History of air pollution measures in Japan	18 C/Ps
Second Period		
Jan. 22, 2019 13：30~14：30	Discussion on study of qualitative evaluation method for the Measures	1 C/P
Jan. 28, 2019 9：00~12：00	Discussion on review of the Measures in Kosovo	1 C/P
Jan. 29, 2019 9：00~12：00	Seminar on evaluation method for the Measures in Kosovo	8 C/Ps
Jan. 29, 2019 13：30~16：00	Discussion on review of the Measures in Kosovo	1 C/P
Apr. 19, 2019 13:30~15:30	Discussion on review of the Measures in other country	1 C/P

Jun. 24, 2019	Discussion on the Measures for household equipment	1 C/P
Jun. 25, 2019	Discussion on the Measures for vehicle exhaust gas	1 C/P
Jul. 2, 2019 9:30~11:00	Discussion on results of review of the Measures in other country and Action Plan for Air Quality in Kosovo	3 C/Ps
Third Period		
Nov. 1, 2019 9:30~11:50	Discussion on Activity in third period and visiting interviews for the Measures	2 C/Ps
Nov. 5, 2019 13:30~15:30	Discussion on contents of visiting interviews for the Measures	2 C/Ps
Nov. 6, 2019 13:30~15:30	Discussion on contents of visiting interviews for the Measures and schedule adjustment	2 C/Ps
Nov. 11, 2019 10:00~11:50	Discussion on study method for the Measures based on the Action Plan for Air Quality	2 C/Ps
Nov. 12, 2019 9:30~10:15	Meeting with Termokos on future expansion plan for district heating	3 C/Ps
Nov. 12, 2019 13:30~14:30	Meeting with MCC/MFK on support activities for energy conservation planned by MCC/MFK	2 C/Ps
Nov. 14, 2019 9:30~10:45	Meeting with GIZ on support activities for energy conservation planned by GIZ	2 C/Ps
Nov. 15, 2019 9:00~12:00	Discussion on the Measures for vehicles	3 C/Ps
Nov. 18, 2019 9:00~15:30	Preparation of materials on the Measures of vehicle for meeting among C/Ps and the relevant organizations	2 C/Ps
Nov. 20, 2019 13:00~15:30	Study with C/Ps on the Measures for household heating	2 C/Ps
Nov. 22, 2019 10:15~11:30	Consultation with Ministry of Internal Affairs (MIAPA/MIA: Traffic Police) on the Measures for vehicle	2 C/Ps
Nov. 22, 2019 13:00~15:30	Preparation for seminar of 25 Nov. on the Measures for household heating	1 C/P
Nov. 25, 2019 9:00~11:50	Joint Consultation Seminar by C/P on the Measures for household heating	6 C/Ps
Dec. 3, 2019 13:30~15:00	Discussion on development of scenario for evaluation of household heating measures	2 C/Ps
Dec. 5, 2019 10:00~15:00	Discussion on development of scenario for evaluation of vehicle measures	2 C/Ps
Jan. 22, 2020 13:30~15:00	Introduction of the Evaluation Sheet for Measures and discussion on the content of activities	2 C/Ps
Jan. 24, 2020 13:30~15:00	Discussion on content of activities for finalization of evaluating the Measures	2 C/Ps
Jan. 31, 2020 11:00~12:00	Visiting Interview of Termokos on future expansion plan for district heating	2 C/Ps
Feb. 4, 2020 13:30~15:30	Discussion on cost calculation method for the Measures	6 C/Ps
Feb. 5, 2020 9:15~11:45, 13:45~14:45	OJT by C/Ps on emission reduction calculation for the Measures of household heating	6 C/Ps
Feb. 7, 2020	Discussion on contents of the Evaluation Sheet for Measures	2 C/Ps

9:30~11:30		
Feb. 10, 2020 9:30~11:30	Discussion on results of emission reduction calculation for the Measures	2 C/Ps
Feb. 11, 2020 9:30~11:50	Lecture on the Evaluation Sheet for Measures	8 C/Ps
Feb. 12, 2020 13:30~15:30	Arrangement of issues based on lecture, and Discussion on cost calculation method of the Measures for vehicle emissions	3 C/Ps
Feb. 13, 2020 9:15~11:45	Study for cost calculation method for the Measures of vehicle emissions and energy conservation of introduction of insulation material	3 C/Ps
Feb. 18, 2020 13:30~15:00	Wrap-up on the evaluation of the Measures	3 C/Ps
Feb. 21, 2020 9：30~11:30	OJT on emission reduction calculation for the Measures	4 C/Ps
Feb. 26, 2020 10:45~11:45	OJT on emission reduction calculation for the Measures	3 C/Ps
Feb. 28, 2020 9:30 – 11:30	Discussion on finalization of the Evaluation Sheet for Measures	2 C/Ps
Mar. 4, 2020 9:30 – 11:30	Lecture on Evaluation Sheet for Measures with other groups	9 C/Ps
Apr. 16, 2021 9:00 – 11:00	Discussion on the Final Report	3 C/Ps
May 7, 2021 9:00 – 11:00	Discussion on the Final Report and preparation of presentation materials for the Final Seminar	3 C/Ps
May 13, 2021 9:00 – 11:00	Discussion on the Final Report and preparation of presentation materials for the Final Seminar	3 C/Ps
May 21, 2021 9:00 – 11:00	Preparation of presentation materials for the Final Seminar	3 C/Ps
May 28, 2021 9:00 – 11:00	Preparation of presentation materials for the Final Seminar	3 C/Ps
Additional activities in the third period		
Nov. 12, 2020 9:00 - 11:00	Discussion on additional remote activities on evaluation of the Measures	2 C/Ps
Nov. 20, 2020 9:00 - 11:00	Preparation of Evaluation Sheet on Measures for Households changing to Pellet Heater, LPG Heater, and Electric Heater	3 C/Ps
Nov. 26, 2020 9:00 - 11:00	Preparation of Evaluation Sheet on Measures for Households changing to Pellet Heater, LPG Heater, and Electric Heater	3 C/Ps
Dec. 2, 2020 9:00 - 11:00	Simulation Calculation of additional air control pollution measures	7 C/P
Dec. 9, 2020 9:00 - 11:00	Re-consideration of Evaluation Sheet on Measures for Expansion of District Heating	3 C/Ps
Dec. 14, 2020 9:00 - 11:00	Re-consideration of Evaluation Sheet on Measures for Expansion of District Heating	3 C/Ps
Dec. 15, 2020 9:00 - 11:00	Simulation Calculation of additional air control pollution measures	6 C/Ps
Jan. 22, 2021 9:00 - 11:00	Discussion on Measures for Vehicles	3 C/Ps

Jan. 28, 2021 9:00 - 11:00	Discussion and Confirmation of scenario and cost effectiveness on Measures for Vehicles	3 C/Ps
Feb. 03, 2021 9:00 - 11:00	Preparation of Evaluation Sheet on Measures for Vehicles with Euro Emission Regulation	3 C/Ps
Feb. 16, 2021 9:00 - 11:00	Preparation of Evaluation Sheet on Measures for Vehicles Entry Restriction by Plate number	3 C/Ps
Feb. 26, 2021 9:00 - 11:00	Discussion on Improvement of Cost Calculation Procedure and Discussion on Fuel Tax Information	3 C/Ps
Mar. 5, 2021 9:00 - 11:00	Finalization of additional remote activities on Output 8	3 C/Ps
Mar. 12, 2021 9:00 - 11:00	Discussion on Achievements of additional remote activities on Output 8	3 C/Ps
Mar. 17, 2021 9:00 - 11:00	Discussion and Preparation of presentation materials for seminar on achievement of additional remote activities of Output 8	3 C/Ps
Mar. 26, 2021 9:00 - 11:00	Discussion and Preparation of presentation materials for seminar on achievement of additional remote activities of Output 8	3 C/Ps
Mar. 31, 2021 9:00 - 11:00	Preparation of presentation materials for seminar on achievement of additional remote activities of Output 8	3 C/Ps
Apr.2, 2021 9:00 – 11:00	Seminar with JICA HQ and JICA Balkan on Achievement of additional remote activities of Output 8	3 C/Ps

The establishment of institutional framework for developing the Measures by Government is necessary in order to plan, study, implement, and evaluate the Measures. Through the discussion with C/Ps, JET recommended the institutional arrangement shown in Figure 3-58.

The roles and responsibilities for evaluation of the Measures in accordance with Figure 3-58 is shown in Table 3-118.

It was confirmed through consultation between C/Ps and JET that the activities for planning, studying, implementing, and evaluating the Measures according to Figure 3-58 and Table 3-118 will be implemented in the steps shown in Table 3-119. In addition, it was also confirmed that the Activities of Output 8 of the Project are focused mainly on Steps 4, 5, and 6.

The evaluation for air pollution control measures was a trial study, since adequacy of the results by simulation calculation has not been verified yet, and it is not sufficient to understand actual emission conditions due to insufficient information on emissions. However, it is highly effective to use this method for making policies for air pollution control.

By using the second Emission Inventory and comparing amount of emissions by each emission source (sub-categories), the important emission sources for studying the Measures were listed as follows: TPPs sub-category of the energy industry category, the residential stationary sub-category of small combustion category, and vehicle emissions sub-category of transportation category. The emissions of all air pollutants from TPPs are largest in all the sub-categories. In addition, the TSP and PM_{10} emissions from the residential stationary are large and NO_X emissions from vehicles are also large.

In addition, the contribution on the air quality was analyzed by using the ground level concentration map calculated by simulation modeling by using the above emission inventories.

Through the results of this calculation, it was comprehended that the emissions from residential stationary and vehicle are large and these emission sources should be set as target for measures to improve the air quality.

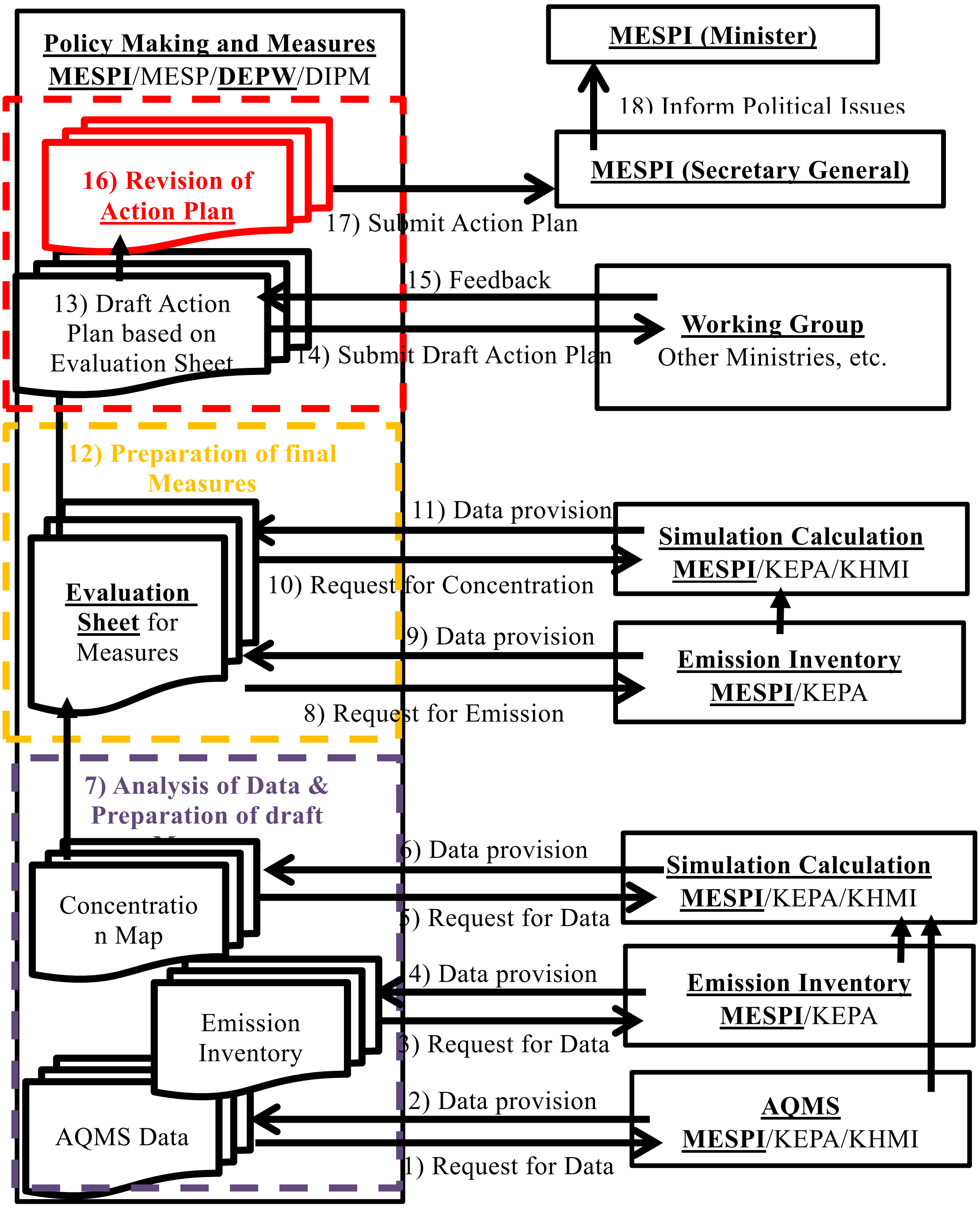


Figure 3-58 Institutional Arrangement for Measures in Kosovo

Table 3-118 Roles and Responsibilities for Measures in Kosovo

Relevant Organization	Roles and Responsibilities
MESPI/MESP/D	・ DEPW/DIPM shall request the AQMS data for KEPA/KHMI.

EPW/DIPM	・DEPW/DIPM shall request the Emission Inventory from MESPI/MESP/KEPA. ・DEPW/DIPM shall prepare the Air Pollution Control Measures (the Measures) by using air pollutant emission inventory. ・DEPW/DIPM shall provide the calculation conditions for emission reductions by the Measures to MESPI/MESP/ KEPA. ・DEPW/DIPM shall request from KHMI the Simulation Modeling Calculation for evaluation of the Measures. ・DEPW/DIPM shall finalize the Measures for air quality by evaluating ground level concentration map of air quality. ・DEPW/DIPM shall prepare the Evaluation Sheet for Measures, which includes emission reductions by measures, concentration map before/ after measures, cost-effectiveness, and implementation method. ・DEPW/DIPM shall prepare the Action Plan by using the Evaluation Sheet.
MESPI/MESP/KEPA	・KEPA shall submit the emission inventory to DEPW/DIPM in accordance with request. ・KEPA shall calculate the emission reductions by using the Emission Inventory in accordance with the calculation condition provided by DEPW/DIPM. ・Quality control for data provided such as emission inventory and emission reductions.
MESPI/MESP/KEPA/KHMI	・KEPA/KHMI shall submit the AQMS data to DEPW/DIPM. ・KEPA/KHMI shall calculate the Simulation modeling for Air Quality in accordance with the request by DEPW/DIPM. ・KEPA/KHMI shall submit the result of above simulation modeling calculation to DEPW/DIPM.
Working Group for the Measures	・Working Group consists of the relevant organizations for the Measures. ・Working Group shall evaluate the Measures provided by DEPW/DIPM.

Table 3-119 Outline for Flow of Preparation and Implementation of the Measures

Step 1	Analysis of Air Quality using AQMS Data
Step 2	Analysis of emission sources using Emission Inventory
Step 3	Analysis of structure of air pollution using Simulation modeling
Step 4	Identification of the Measures to be implemented
Step 5	Evaluation of the Measures from the viewpoint of cost, emission reductions, effectiveness, social demands, etc.
Step 6	Consideration of implementation for the Measures
Step 7	Preparation of the Action Plan under the Strategy of Air Quality in Kosovo
Step 8	Implementation of the Measures
Step 9	Follow-up and Feed-back of the Measures (and go back to '1')

Therefore, the measures for emissions from household heating, vehicle exhaust gas, and TPP were studied and evaluated.

The measures for emissions from household heating equipment that use fuel were studied as follows. Since currently the Municipality of Prishtina is implementing administrative instruction to stop the use of coal, the use of lignite was set as zero. Next priority is the measures for using wood, because PM_{10} emissions from detached house and semi-detached house were understood. In addition, regarding row or terraced house and apartment building, the expansion of the district heating will be considered. The outline of measures for household heating equipment is shown in Table 3-120.

Table 3-120 Outline of Measures for equipment of household heating

Measures	Outlines
Fuel Shift from Wood and/or Lignite to woody Pellet and/or LPG	1. Fuel shift to woody Pellet on all detached houses and all semi-detached houses using Lignite in Urban area of Municipality of Prishtina 2. Fuel shift to woody Pellet on approximately 70% of detached house and semi-detached house using Wood in Urban area of Municipality of Prishtina
Promotion for introduction of solar heating system	Since the capacity of this equipment is at the level of auxiliary equipment for household heating, detailed measure evaluation will not be conducted.
Energy Saving (Improvement of thermal insulation effect, improvement of equipment efficiency and top runner method)	Energy saving activities (introduction of thermal insulation materials): Improvement of thermal insulation materials for residential buildings will lead to reduction of fuel consumption. Evaluation is conducted by setting thermal insulation improvement effect. Energy-saving activities (improvement of equipment efficiency/ top-runner method): In EU, there is a system called eco-design. Since the efficiency of the existing facility is unknown, detailed evaluation of measures will not be conducted.

From the vehicle registration information as shown in Table 3-121 and Table 3-122, it was assumed that it is necessary to replace vehicles that do not meet the Euro emission regulations and vehicles that have the old Euro emission regulations with vehicles with new Euro regulation. The Measures for vehicle emissions are shown in Table 3-123.

Table 3-121 Number of vehicles by fuel type and Euro Emission Regulation for PC and LCV

Euro Emission Regulation	Passenger Car (PC)				Light Commercial Vehicle (LCV)		
	Petrol	Diesel	LPG	Other	Petrol	Diesel	Other
Euro6	1800	7517	0	190	7	457	0
Euro5	2901	22288	35	43	39	2011	5
Euro4	7096	54207	117	36	133	6781	18
Euro3	16893	75065	352	32	283	12402	10
Euro2	12842	21975	373	4	395	11034	6
Euro1	4810	6518	288	6	189	4614	5
Before Euro	19819	29497	1085	17	285	5556	10
Total	66161	217067	2250	328	1331	42855	54

Table 3-122 Number of vehicles by fuel type and Euro Emission Regulation on HDV and Bus

Euro Emission Regulation	Heavy Duty Vehicle (HDV)		BUS		
	Diesel	other	Diesel	CNG	Other
Euro6	209	1	55	0	0
Euro5	857	0	98	0	1
Euro4	1011	0	156	0	2
Euro3	3561	1	658	0	3
Euro2	2475	1	905	0	2
Euro1	1227	2	340	0	2
Before Euro	3366	6	352	0	2
Total	12706	11	2564	0	12

Table 3-123 Outline of Measures for Vehicles listed by the Project

Measures	**Outline**
1. Zone regulation that allows only vehicles meeting Euro Emission Regulation	For vehicles not meeting Euro Emission Regulation, this is a measure to limit access to the center of the city of Prishtina for a certain period of time. As a result of consultation with traffic police of MIAPA/MIA (Ministry of Internal Affairs), since it was difficult to set the zone, vehicle type, time, etc., detailed evaluation was not carried out.
2. Regulation by Vehicle Number	Even day: Allow the use of vehicles with even number license plate Odd day: Allow the use of vehicles with odd number license plate
3. Euro Emission Regulation for Vehicle	**All types of Vehicles with Euro Emission Regulation 2 or less are replaced by Vehicles with Euro Emission Regulation 3.**
4. Setting Priority Lane for Public Transportation	This is a measure to set priority lanes for public buses and taxis on some road in the city of Prishtina. Since it is difficult to set the calculation conditions (setting of road with priority lanes, traffic volume after introducing this measure, etc.) for this measure, detailed evaluation was not carried out.

Regarding TPP Kosovo A, the emissions of the Measure case from TPP Kosovo A was calculated under the calculation condition where the measures proposed by the Project will be implemented to the entire TPP Kosovo A, and the emission reductions were calculated by subtracting these emissions from the emissions of TPP Kosovo A in the second emission inventory. Regarding TPP Kosovo B, the emissions from the Measure case from TPP Kosovo B was calculated under the calculation condition where ELVs of TPP Kosovo B will be in compliance with the Euro Emission Regulation after the rehabilitation by the EU, and the emission reductions were calculated by subtracting these emissions from the emissions of TPP Kosovo B in the second emission inventory.

Based on the above explanations, the measures listed by the Project and the measures evaluated in detail are shown in Table 3-124.

Table 3-124 Relation between the evaluations of the measures listed up in the Project and the Action Plan

Outline of Action Plan	Measures examined in the Project	Reasons for presence or absence of detailed evaluation of measures
Strategic Objective 1: Implementation of the Legislation for Air		
1.1 Establishment of the National Inventory System for air 1.1.1 Preparation of the air emission inventory 1.1.2 Air quality assessment and pollution prediction-modelling /simulations 1.2 Establishment of the Air Quality Management System 1.2.1 Development of the system for emission measurement in industry 1.2.2 Inspection of the working condition of AQMSs and rehabilitation of analyzers	Not studied	Since these contents are not measures but legal issues, the evaluation was not carried out.
Strategic Objective 2: Reduction of emissions from specific sources		
2.1 Small combustion Implementation of high standards in energy production capacities which are consumed by households and small businesses	**Fuel shift from Wood and Lignite to wood Pellet**	**Implementation of detailed valuation of Measures by the Project (Refer to Table 3-125)**
	Fuel shift from Wood and Lignite to Electricity	**The use of electricity for heating in households has not prevailed that much, but the Project evaluated this measure in the additional activities in the third period. (Refer to Table 3-126)**
	Fuel shift from Wood and Lignite to LPG	**The use of LPG for heating in households has not prevailed that much, but the Project evaluated this measure in the additional activities in the third period. (Refer to Table 3-127)**
	Promotion for introduction of solar heating system	Since the capacity of this equipment is about the level of auxiliary equipment for household heating, detailed measures evaluation will not be conducted.
	Expansion of district heating	The Project evaluated the measure as a reference case.

	Energy saving (Improvement of equipment efficiency and top runner method)	In EU there is a system called eco-design. Since the efficiency of the existing facilities is unknown, detailed evaluation of measures will not be conducted.
	Energy saving (Improvement of thermal insulation effect)	**Implementation of detailed valuation for Measures by the Project (Refer to Table 3-128)**
2.2 Decrease of the air pollution in the energy sector - Feasibility study for introduction of concrete regulations such as fuel tax, high quality fuel, etc. and economic measures such as biogas production, etc.	**TPP Kosovo A: Measures for ESP considered by the Project**	**Implementation of detailed valuation for Measures by the Project (Refer to Table 3-131)**
	TPP Kosovo B: Rehabilitation by EU	**Emission reductions were calculated using the calculation condition where regulations of exhaust gas emissions in 2027 are met.**
	Introduction of Fuel Tax was evaluated as one of the measures by state programs such as the introduction of fuel tax, high-quality fuel and biogas production	Biogas is not evaluated due to insufficient information. **The measure of the Fuel Tax combined with a subsidy for facilities consuming petroleum coke was evaluated in the additional activities in the third period. (Refer to Table 3-132)**
2.3 Reducing of air pollution from industry - Dissemination of knowledge through seminars and lectures - Support for the introduction of BAT in order to comply with the ELVs - Emission reduction measures for large-scale combustion plants through introduction of equipment in order to comply with the IPPC permit	Emission Reduction for stationary sources in the tertiary industries Fuel shift from wood to woody pellet and/or electricity	In the Pristina area, contribution by tertiary industries is not large, and solid fuels are not only for heating but also necessary for providing services such as in the case of bakeries, etc. Therefore, fuel shift is hard to be implemented and measures have not been studied. Measures for introduction of equipment in order to be compliant with the IPPC permit have not been studied.
Specific Objective 3: Reducing emissions from transport emission sources		
3.1 Public Transportation Reducing emissions from public vehicles, especially from buses and taxis - Development of the program for Pristina (Introduction of	Setting exclusive lane for public transportation	Through the consultation with traffic police of MIAPA/MIA, it is difficult to set the calculation conditions (setting of road with exclusive lanes, traffic volume after introducing this measures,

an exclusive lane for buses on the city roads/ removal of old buses from traffic)		etc.), and therefore, evaluation was not carried out.
3.2 Vehicle tax - Vehicle tax based on emission (higher tax for Euro 2 and less emission standards)	Not studied	The detailed evaluation for the application of Euro Emission Regulation for vehicles was carried out as described below (3.3), but was not conducted for the case of the vehicle tax.
3.3 Inflow control of vehicles Limited access to polluted urban zones for high pollutant vehicles - legislation Organization of the system to identify Euro emission standards for each vehicle by stickers, etc.	Zone regulation	Through the consultation with traffic police of MIAPA/MIA, it was concluded that it is difficult to set the zone, vehicle type, time, etc., and therefore, evaluation was not carried out.
	Regulation by vehicle number	**Through the consultation with the traffic police in MIAPA/MIA, it was concluded that it is not easy to implement this measure, however, this measure was evaluated in a detailed way in the additional activities in the third period. (Refer to Table 3-130)**
	Introduction of Euro Emission Regulation	**Detailed evaluation of Measures was carried out (refer to Table 3-129)**
	Introduction of Diesel Particulate Filter (DPF) for older buses	Evaluation for vehicles with DPF was not carried out because there are no exhaust gas measurement results
3.4 Public transportation services Improvement of services - Improvement of services such as increase of the frequency of buses, timetables, etc. Change of buses free of charge for passengers, standardization of high quality bus services, promotion of the use of clean means of traffic such as bicycles, etc.	Not studied	Since information on changes in traffic volume and travel speed due to increased bus transportation are not sufficient, it is difficult to quantify the amount of emission reduction, and therefore, evaluation was not carried out.
Strategic Objective 4: Reduce emissions from public activities		
4.1 Public information and awareness campaigns - Information service on the effect of exhaust gas from vehicles	Not studied	Since it is difficult to quantify the amount of emission reduction, the evaluation was not carried out.

- Promotion of the use of efficient and clean means of traffic - promotion of the use of bicycles		
4.2 School education Awareness raising for young generation on air quality protection - Organizing workshops, lectures, etc. in schools and universities	Not studied	Since it is difficult to quantify the amount of emission reduction, the detailed evaluation was not carried out.

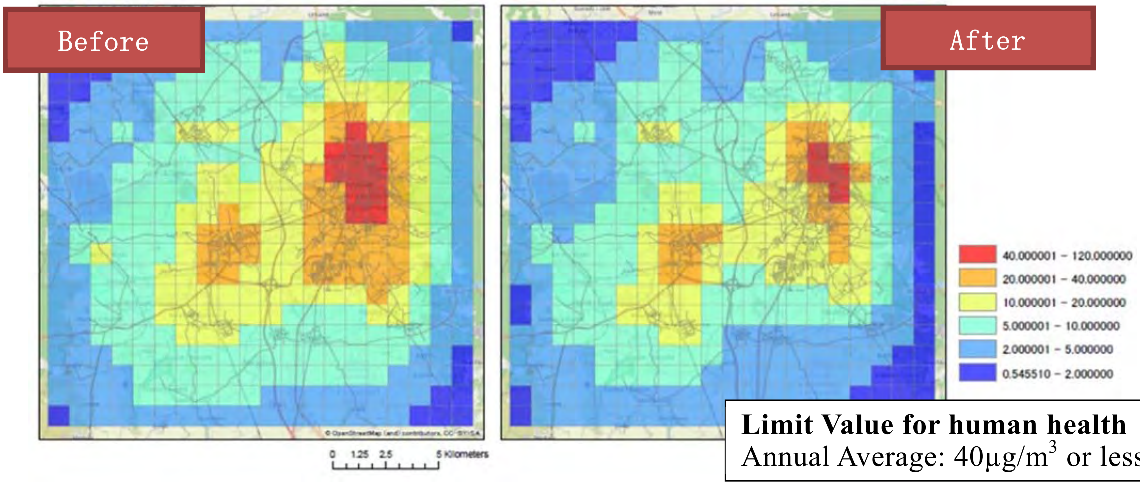
The Measures studied by the Project are summarized from Table 3-125 to Table 3-132. The calculation condition for cost effectiveness was set through the discussion with C/Ps in February 2020. C/Ps and C/P members of Output 1 with support of JET calculated the emission reductions based on this calculation condition by using the second Emission Inventory. The issues for the Measures were prepared through discussion, lectures and OJT in third Period of the Project.

Through these activities, the collaboration work for the study of the measures between DEPW/DIPM and KEPA was able to be carried out. In addition, C/Ps were able to obtain the experience of utilizing the analysis of the emission inventory for studying the Measures. C/Ps could acknowledge 1) The Importance of developing the emission inventory that can consider the measures and 2) The Importance of quantitatively studying and evaluating the measures using technical evidence such as the emission inventory.

Table 3-125 Evaluation Sheet for Measures 1: Fuel Shift for Residential Stationary Combustion

Name	Fuel shift from Wood and Lignite to woody Pellet for Residential Stationary Combustion
Outline	Targeting Detached houses and Semi-detached houses, the fuel shift (which is fuel changed from fuel emitting large air pollutants to fuel emitting less air pollutants) for around 7500 households will be carried out.
Scenario	The households living in detached house and/or semi-detached house will shift fuels from the wood-fired / coal-fired heating and cooking to central heating system using woody pellet. 1. Fuel shift from Lignite to woody Pellet for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 610 (Detached house) + 127 (Semi-detached house) = 737 (All households using Lignite shift fuel) from the data of the Emission Inventory. 2. Fuel shift from Wood to woody Pellet for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 6000 (Detached house) +1448 (Semi-detached house) = 7448 (around 70% carry out fuel shift) from the data of the Emission Inventory.
Emission Reduction	Total Emissions from Households in Municipality of Prishtina 1) Before (Emissions in 2017): Approximately 1,731.5 (PM_{10} ton/year) 2) After (Measure Case): Approximately 1,013.7 (PM_{10} ton/year) PM_{10} Emission Reduction: Approximately - 718 ton/year (41 % Reduction)

PM_{10} Concentration Map (before- after, The figure only considers the emission from households)



Limit Value for human health
Annual Average: 40μg/m^3 or less

※ Since the concentration distribution map shows only the contribution of household emission sources, it cannot be directly compared with the environmental standard value.

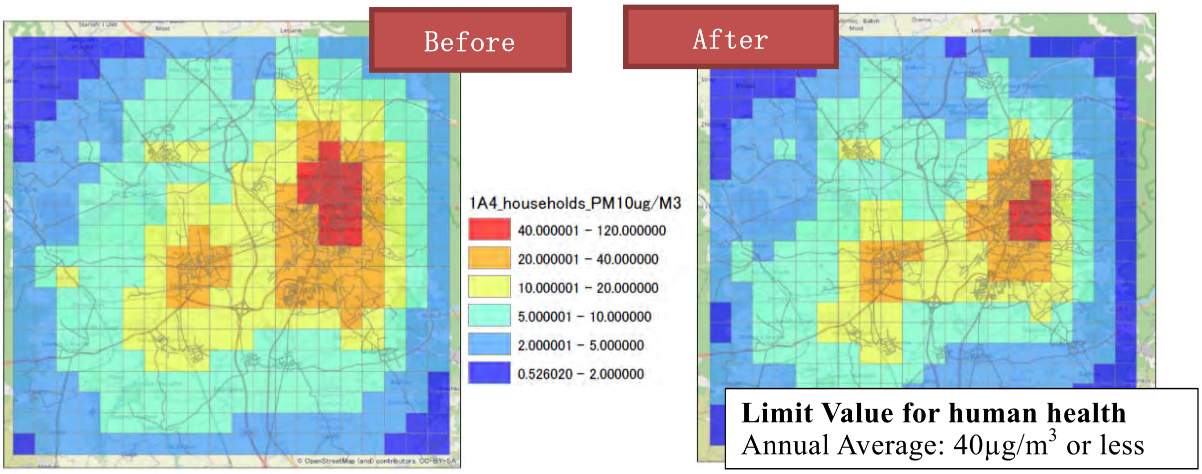
Cost	<Before the implementation of measures > 1) Initial Cost: 350 Euro/household (Wood burning stove, same level of equipment for existing equipment) 2) Operation Cost per year: 400 Euro/household/year (Average Wood Cost per household by setting average wood cost per household from results of research interviews by students, assuming lignite has same price as wood fuel) 3) Total Cost for 10 years: 350 + 400*10 = 4,350 Euro/household < After the implementation of measures > 1) Initial Cost: 1,750 + 900 = 2,650 Euro/household (Set the price of new heating equipment: 1750 Euro for woody Pellet Boiler, and 900 Euro for Pipe & Panel (radiator), etc.) 2) Operation Cost per year: 900 Euro/household/year (Average woody Pellet Cost per household by setting average woody pellet cost per household from results of research interviews by students) 3) Total Cost for 10 years: 2,650 + 900*10 = 11,650 Euro/household <Increase of Cost after Measures> 11,650 (Pellet) – 4,350 (Wood) = 7,300 Euro/household during 10 years Number of target household: 7,448 households 7,300 * 7,448 = 54.37 million Euro during 10 years (Total cost increases)
Cost-Effectiveness	PM_{10}: Approximately 7,600 (Euro/ton) (approximately 910 thousand (Yen/ton) Total Cost for a year: 5.437 million Euro/year, PM_{10} Emission Reduction: 718 ton/year
Issues	・How to establish the support of operation cost by Government of Kosovo for households of low socioeconomic status ・Real performance data on equipment using Wood, Lignite, and wood Pellet in Kosovo by measurement is necessary. ・There is a gap in dissemination: There are households already using woody Pellet, but this is still minor part.
Implementation Method	1. Campaign/ awareness activities (information on impact due to fuel quality to the health) 2. Study on Loan Campaign (for medium income households) 3. Subsidies (Government/Municipality, and/or Donators) (for low income) 4. Facilitate the introduction of tax reduction
Evaluation of the Technical aspect	・MESPI/MESP staffs have knowledge of fuel quality. However, they do not have sufficient capacity to evaluate the effect by fuel and/or combustion method such as emission factor, because of lack of knowledge and experience. In Kosovo, there are very few data and experiences which measure emissions for various types of fuel

	and various types of fuel combustion equipment. ・ Regarding EMEP/EEA Guidebook, the Emission Factor of woody Pellet has better value than ones of Lignite and Wood. Although it is necessary to conduct exhaust measurement from woody pellet boiler at homes, the fuel shift from Lignite and Wood to woody Pellet has some potential for air pollution control measures ・ In addition, from research interviews by students under the Project in 2018, woody Pellet consumption per household is clearly smaller than Wood consumption and Lignite consumption per household. Therefore, the fuel shift from Lignite and Wood to woody Pellet has high potential as one option for air pollution control measures. ・ If this policy is applied to entire Kosovo, it needs huge budget and this measure may have a low potential.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.

Table 3-126 Evaluation Sheet for Measures 2: Fuel Shift for Residential Stationary Combustion

Name	Fuel shift from Wood and Lignite to Electricity for Residential Stationary Combustion
Outline	Targeting Detached houses and Semi-detached houses, the fuel shift (which is fuel changed from fuel emitting large air pollutants to fuel emitting less air pollutants) for around 7500 households will be carried out.
Scenario	The households living in detached house and/or semi-detached house will shift fuels from the wood-fired / coal-fired heating and cooking to the electricity heating and cooking system. 1. Fuel shift from Lignite to Electricity for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 610 (Detached house) + 127 (Semi-detached house) = 737 (All households using Lignite shift fuel) from the data of the Emission Inventory. 2. Fuel shift from Wood to Electricity for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 6000 (Detached house) +1448 (Semi-detached house) = 7448 (around 70% carry out fuel shift) from the data of the Emission Inventory.
Emission Reduction	Total Emissions from Households in Municipality of Prishtina 1) Before (Emissions in 2017): Approximately 1,731.5 (PM$_{10}$ ton/year) 2) After (Measure Case): Approximately 989.90 (PM$_{10}$ ton/year) PM$_{10}$ Emission Reduction: Approximately - 742 ton/year (43 % Reduction)

PM$_{10}$ Concentration Map (before- after, The figure only considers the emission from households)



Limit Value for human health
Annual Average: 40µg/m^3 or less

※ Since the concentration distribution map shows only the contribution of household emission sources, it cannot be directly compared with the environmental standard value.

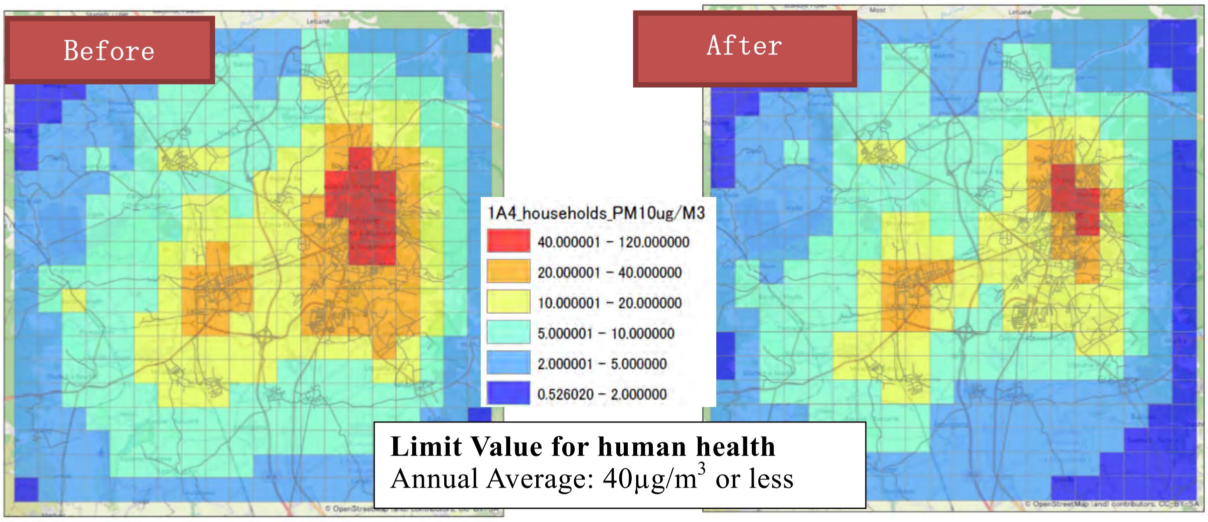
Cost	<Before the implementation of measures > 1) Initial Cost: 350 Euro/household (Wood burning stove, same level of equipment for existing equipment) 2) Operation Cost per year: 400 Euro/household/year (Average Wood Cost per household by setting average wood cost per household from results of research interviews by students, assuming lignite has same price as wood fuel) 3) Total Cost for 10 years: 350 + 400*10 = 4,350 Euro/household < After the implementation of measures > 1) Initial Cost: 1,000 + 900 = 1900 Euro/household (Set the price of new heating equipment: 1000 Euro for Electric heater, and 900 Euro for Pipe & Panel (radiator), etc.) 2) Operation Cost per year: 900 Euro/household/year (Average Electric Cost per household by setting average electric cost per household from results of research interviews by students) 3) Total Cost for 10 years: 1,900 + 900*10 = 10,900 Euro/household <Increase of Cost after Measures> 10,900 (Pellet) – 4,350 (Wood) = 6,550 Euro/household during 10 years Number of target household: 7,448 households 6,550 * 7,448 = 48.78 million Euro during 10 years (Total cost increases)
Cost-Effectiveness	PM_{10}: Approximately 6,600 (Euro/ton) (approximately 790 thousand (Yen/ton)) Total Cost for a year: 4.88 million Euro/year, PM_{10} Emission Reduction: 742 ton/year
Issues	・ How to establish the support of operation cost by Government of Kosovo for households of low socioeconomic status ・ Real performance data on equipment using Wood, Lignite, and Electricity in Kosovo by measurement is necessary. ・ There is a gap in dissemination. There are households already using Electricity, but this is still minor part. Since the expansion of electricity use for households depends on the electric generation capacity of the coal-fired TPPs in Kosovo, there might be some limit for expansion of electricity use for households.
Implementation Method	1. Campaign/ awareness activities (information on impact due to fuel quality to the health) 2. Loan Campaign (TEB, EBRD, current activities) (for medium income households) 3. Subsidies (Government/Municipality, and/or Donators) (for low income) 4. Facilitate custom tax exemption procedures for fuel import
Evaluation of the Technical aspect	・ MESPI/MESP staffs have knowledge of fuel quality. However, they do not have sufficient capacity to evaluate the effect by fuel and/or combustion method such as emission factor, because of lack of knowledge and experience. In Kosovo, there are very few data and experiences which measure emissions for various types of fuel and various types of fuel combustion equipment. ・ Regarding Air Pollution, the fuel shift from Lignite and Wood to Electricity has a very good potential for air pollution control measures, but regarding GHG, this measure should be considered based on advantages and disadvantages. ・ However, if this policy is applied to the whole of Kosovo, it needs a large budget such as for installation of heating and cooking equipment and installation of electricity generation facilities, and therefore this has a low potential.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.

Table 3-127 Evaluation Sheet for Measures 3: Fuel Shift for Residential Stationary Combustion

Name	Fuel shift from Wood and Lignite to LPG for Residential Stationary Combustion
Outline	Targeting Detached houses and Semi-detached houses, the fuel shift (which is fuel

<table>
<tr><td></td><td>changed from fuel emitting large air pollutants to fuel emitting less air pollutants) for around 7500 households will be carried out.</td></tr>
<tr><td>Scenario</td><td>The households living in detached house and/or semi-detached house will shift fuels from the wood-fired / coal-fired heating and cooking to central heating system using LPG.
1. Fuel shift from Lignite to LPG for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 610 (Detached house) + 127 (Semi-detached house) = 737 (All households using Lignite shift fuel) from the data of the Emission Inventory.
2. Fuel shift from Wood to LPG for Detached and Semi-detached house: Number of Household in urban area of Municipality of Prishtina is 6000 (Detached house) +1448 (Semi-detached house) = 7448 (around 70% carry out fuel shift) from the data of the Emission Inventory.</td></tr>
<tr><td>Emission Reduction</td><td>Total Emissions from Households in Municipality of Prishtina
1) Before (Emissions in 2017): Approximately 1,731.5 (PM_{10} ton/year)
2) After (Measure Case): Approximately 990.3 (PM_{10} ton/year)
PM_{10} Emission Reduction: Approximately - 742 ton/year (41 % Reduction)</td></tr>
<tr><td colspan="2">

PM_{10} Concentration Map (before- after, The figure only considers the emission from households)



Limit Value for human health
Annual Average: 40μg/m^3 or less

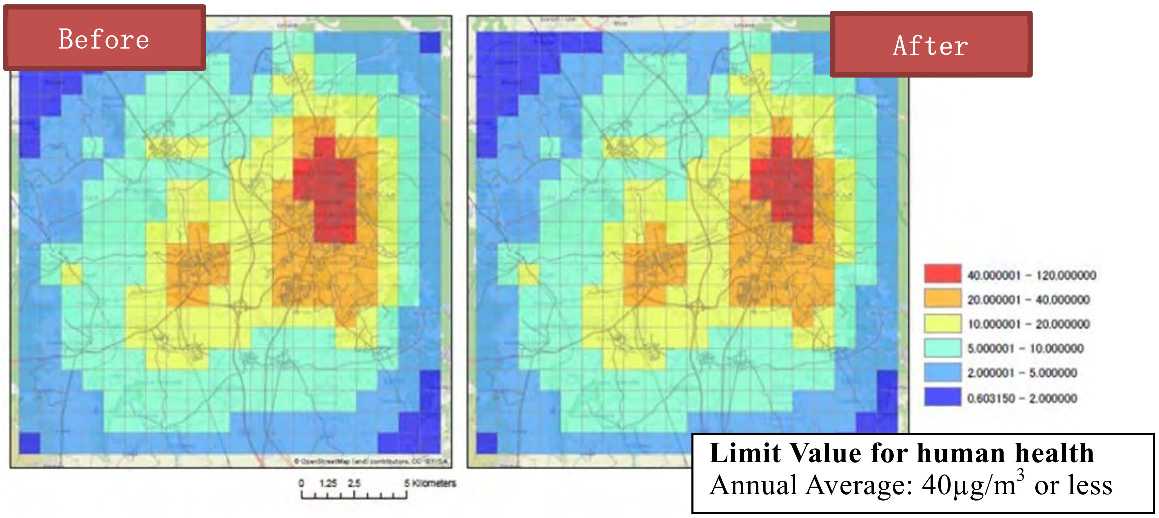
※ Since the concentration distribution map shows only the contribution of household emission sources, it cannot be directly compared with the environmental standard value.

</td></tr>
<tr><td>Cost</td><td><Before the implementation of measures >
1) Initial Cost: 350 Euro/household (Wood burning stove, same level of equipment for existing equipment)
2) Operation Cost per year: 400 Euro/household/year (Average Wood Cost per household by setting average wood cost per household from results of research interviews by students, assuming lignite has same price as wood fuel)
3) Total Cost for 10 years: 350 + 400*10 = 4,350 Euro/household
< After the implementation of measures >
1) Initial Cost: 800 + 900 = 1,700 Euro/household (Set the price of new heating equipment: 800 Euro for LPG Boiler, and 900 Euro for Pipe & Panel (radiator), etc.)
2) Operation Cost per year: 1150 Euro/household/year (Average LPG Cost per household by setting average LPG cost per household from results of research interviews by students)
3) Total Cost for 10 years: 1,700 + 1150*10 = 13,720 Euro/household
<Increase of Cost after Measures>
13,320 (LPG) – 4,350 (Wood) = 8,850 Euro/household during 10 years
Number of target household: 7,448 households</td></tr>
</table>

	8,850 * 7,448 = 65.91 million Euro during 10 years (Total cost increases)
Cost-Effectiveness	PM_{10}: Approximately 8,900 (Euro/ton) (approximately 1,070 thousand (Yen/ton)) Total Cost for a year: 6.591 million Euro/year, PM_{10} Emission Reduction: 742 ton/year
Issues	・ How to establish the support of operation cost by Government of Kosovo for households of low socioeconomic status ・ Real performance data on equipment using woody Pellet in Kosovo by measurement is necessary. ・ There is a gap in dissemination: There are households already using woody Pellet, but this is still minor part. LPG has almost the same price as woody Pellet, but there are very few households that use LPG. This is a future issue.
Implementation Method	1. Campaign/ awareness activities (information on impact due to fuel quality to the health) 2. Study on Loan Campaign (for medium income households) 3. Subsidies (Government/Municipality, and/or Donators) (for low income) 4. Facilitate the introduction of tax reduction
Evaluation of the Technical aspect	・ MESPI/MESP staffs have knowledge of fuel quality. However, they do not have sufficient capacity to evaluate the effect by fuel and/or combustion method such as emission factor, because of lack of knowledge and experience. In Kosovo, there are very few data and experiences which measure emissions for various types of fuel and various types of fuel combustion equipment. ・ Regarding EMEP/EEA Guidebook, the Emission Factor of LPG has better value than ones of Lignite and Wood. Although it is necessary to conduct exhaust measurement from LPG boiler at homes, the fuel shift from Lignite and Wood to LPG has some potential for air pollution control measures If this policy is applied to entire Kosovo, it needs a large budget and this measure has a low potential.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.

Table 3-128 Evaluation Sheet for Measures 4: Energy Saving

Name	Energy Saving (Improvement of thermal insulation)
Outline	This is the measure for energy saving by installation of improved insulation material for residential building. Since the performance of residential building is improved through installation of insulation material, the amount of fuel consumption for heating reduces and air pollution is improved.
Scenario	Target: Detached Houses in urban area of Municipality of Prishtina Number of detached housed for measures: 1,000 households According to the research interviews by UP student, the introduction of heat insulation for apartment is already progressed and the introduction for detached houses is also already progressed to a certain extent. In case of detached houses, approximately 10% of houses seems to have poor heat insulation, as a result of calculating the ratio of households that consume a large amount of fuel. Therefore, calculation was carried out on the scenario of improving heat insulation condition for such detached houses. From analysis of interview data, 214 households consume more than 15 m^3 wood/year and the average annual wood consumption is 18 m^3/year. Therefore, it is assumed that the annual average wood consumption of these households will decrease from 18 to 11 m^3/ year by installing heat insulation material. This 11 m^3/year is the whole average of annual wood consumption per household.
Emission	Total Emissions from Households in Municipality of Prishtina

<table>
<tr><td>Reduction</td><td>1) Before (Emissions in 2017): Approximately 1,731.5 PM_{10} ton/year
2) After (Measures): Approximately 1,676.1 PM_{10} ton/year
PM_{10} Emission Reduction: Approximately 55 ton/year</td></tr>
<tr><td colspan="2">PM_{10} Concentration Map (before- after, The figure only considers the emission from households)


Limit Value for human health
Annual Average: 40µg/m^3 or less
※ Since the concentration distribution map shows only the contribution of household emission sources, it cannot be directly compared with the environmental standard value.</td></tr>
<tr><td>Cost</td><td>Total number of households targeted: 1000 households
Size of detached house targeted: 10m * 10m * 6m
<Before the implementation of measure>
1) Initial Cost: 0 Euro/household (Nothing changes and the same insulation condition remains).
2) Operation Cost per year: 720 Euro/household (Wood consumption on detached house with not good insulation: 18 m^3/year/household, Price of wood: 40 Euro/m^3)
3) Total Cost for ten years: 0 + 720*10 = 7,200 Euro/household during 10 years
< After the implementation of measures >
1) Initial Cost: 3,600 Euro/household (Insulation application cost: 15 Euro/m^2. The insulation material (Styrofoam) is applied to all outside walls. 10m * 6m * 4 walls * 15 Euro/m^2 = 3,600 Euro)
2) Operation Cost per year: 440 Euro/household/year (Average wood consumption: 11 m^3/year/household, Price of wood: 40 Euro/m^3 from the research interviews)
3) Total Cost: 3,600 + 440*10 = 8,000 Euro/household during 10 years
<Increase of Cost after Measures>
8000 (After) – 7200 (Before) = 800 Euro/household during 10 years
Number of target household: 1000 households
800 * 1000 = 0.8 million Euro during 10 years (Total cost increases)</td></tr>
<tr><td>Cost-Effectiveness</td><td>PM_{10}: Approximately 1,500 (Euro/ton) (Approximately 180 (thousand YEN/ton))
Cost-Effectiveness is better, because the initial costs can be recovered by operating cost in energy saving activities.</td></tr>
<tr><td>Issues</td><td>More accurate improvement rate of thermal insulation effect</td></tr>
<tr><td>Implementation Method</td><td>1. Campaign/ awareness activities (information on impact due to fuel quality to the health)
2. Loan Campaign (European Bank for Reconstruction and Development (hereinafter referred to as ”EBRD”) is financing through banks in Kosovo) (for medium income)
3. Subsidies (Government/Municipality, and/or Donators) (for low income)</td></tr>
</table>

	4. Facilitate the introduction by tax reduction
Evaluation of the Technical aspect	MESPI/MESP staff has knowledge of the effect of thermal insulation but not sufficient skill for quantitative calculation of the effect of thermal insulation. MESPI/MESP needs support from other relevant organizations to implement the measures. In addition, the implementation of the measures is already encouraged by some banks in the form of Loan Campaigns.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.

Table 3-129 Evaluation Sheet for Measures 5: Vehicle Measures

Name	Vehicle Measures (Introduction of Euro Emission Regulation)
Outline	This is a measure to replace all vehicles with no Euro Emission Regulation, Euro Emission Regulation one (1) and two (2) by vehicles with Euro Emission Regulation three (3) and higher. As the emission regulations on vehicles become tighter, air pollutants emitted from vehicles will be reduced.
Scenario	Target vehicle are all types. The following values are total vehicle number targeted in Prishtina area. These vehicles will be replaced by vehicles meeting Euro Emission Regulations 3.

Prishtina Area		Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
Passenger Car (M1)	Petrol	12502	2205	508	1540	4039	2688	1105	416
	Diesel	49473	8726	2011	6093	15985	10638	4373	1646
	LPG	358	63	15	44	116	77	32	12
	Other	189	33	8	23	61	41	17	6
LCV (N1)	Petrol	129	17	14	33	37	20	6	1
	Diesel	7701	1018	837	1991	2210	1207	358	81
	Other	4	1	0	1	1	1	0	0
HDV (N2-N3)	Diesel	3007	798	291	586	842	239	203	51
	Other	2	1	0	0	1	0	0	0
Bus (M2-M3)	Diesel	706	97	94	248	180	43	28	16
	CNG (Buses)	0	0	0	0	0	0	0	0
	other	3	0	0	1	1	0	0	0
Motorbike (L)	Petrol	515	118	102	71	179	40	0	2
	Other	5	1	1	1	2	0	0	0

Emission Reduction	The emission factors for each vehicle type on no Euro emission regulation, Euro emission regulation one (1) and two (2) are replaced with emission factors of Euro emission regulation three (3), and the emissions after the measures are calculated. Then, the amount of emission reduction was calculated with the difference between the emissions before the measures and after the measures. <Measures for PC> PM$_{10}$ emission reductions: Approximately -25 ton/year NOx emission reductions: Approximately -142 ton/year <Measures for LCV including Van> PM$_{10}$ emission reductions: Approximately -4 ton/year NOx emission reductions: Approximately -17 ton/year <Measures for HDT> PM$_{10}$ emission reductions: Approximately -4 ton/year NOx emission reductions: Approximately -68 ton/year

<Measures for Bus>

PM_{10} emission reductions: Approximately -2 ton/year

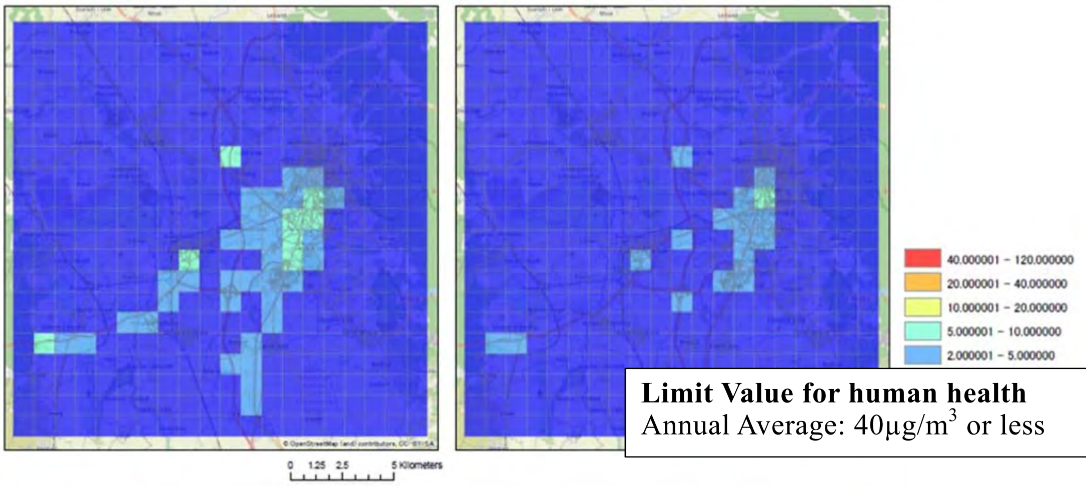
NOx emission reductions: Approximately -26 ton/year

<Total>

PM_{10} emission reductions: Approximately -35 ton/year

NOx emission reductions: Approximately -253 ton/year

PM_{10} Concentration Map (before- after, The figure only considers the emission from vehicles)



Limit Value for human health
Annual Average: 40µg/m^3 or less

※

Since the concentration distribution map shows only the contribution of vehicle emission sources, it cannot be directly compared with the environmental standard value.

Cost

The initial cost and operation cost were calculated for each vehicle type and fuel type. The table below shows data for PCs.

<Before the implementation of measure>

The Purchase Price of used car, annual operation cost, and total cost for 10 years for PCs with No Euro Emission Regulation are as follows. The purchase cost was set in consultation with C/P based on the actual situation in Kosovo. The operation cost was calculated from the average annual mileage of PCs in Kosovo and the average fuel consumption calculated from the EMEP/EEA Guidebook.

No Euro Emission Regulation	Residual value (Euro)	Operation Cost (Euro/year)	Total Cost for ten years (Euro/10 years)
Gasoline Vehicle	300	2408	24380
Diesel Vehicle	300	1483	15130
LPG Vehicle	300	2311	23410

<u>Case 0 of Purchase of Vehicle with **no Euro Emission Regulation**</u>

Initial Cost

Euro 0	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 0	500	1000	0	10000	0
Diesel Vehicle with Euro 0	500	1000	22500	10000	15000
LPG Vehicle with Euro 0	500	0	0	0	0

Operation Cost (every year)

Euro 0	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 0	2446	2890	0	2890	0
Diesel Vehicle with Euro 0	1427	2167	17194	2167	9704
LPG Vehicle with Euro 0	2242	0	0	0	0

Total Cost for 10 years

Euro 0	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 0	24961	29896	0	38896	0
Diesel Vehicle with Euro 0	14769	22672	194442	31672	112037
LPG Vehicle with Euro 0	22922	0	0	0	0

Similarly, the table below shows PC with Euro Emission Regulation 1.

Euro Emission Regulation 1	Scrap value (Euro)	Operation Cost (Euro/year)	Total Cost for ten years (Euro/10 years)
Gasoline Vehicle	300	1699	17290
Diesel Vehicle	300	1273	13030
LPG Vehicle	300	2295	23250

Similarly, the table below shows PC with Euro Emission Regulation 2.

Euro Emission Regulation 2	Scrap value (Euro)	Operation Cost (Euro/year)	Total Cost for ten years (Euro/10 years)
Gasoline Vehicle	300	1692	17220
Diesel Vehicle	300	1342	13720
LPG Vehicle	300	1995	20250

Case 1 of Purchase of Vehicles with Euro Emission Regulation 1

Initial Cost

Euro 1	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 1	500	1000	0	10000	0
Diesel Vehicle with Euro 1	500	1000	22500	10000	15000
LPG Vehicle with Euro 1	500	0	0	0	0

Operation Cost (every year)

Euro 1	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 1	1631	2890	0	2890	0
Diesel Vehicle with Euro 1	1223	2167	14932	2167	8427
LPG Vehicle with Euro 1	2242	0	0	0	0

Total Cost for 10 years

Euro 1	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 1	16807	29896	0	38896	0
Diesel Vehicle with Euro 1	12730	22672	171818	31672	99269
LPG Vehicle with Euro 1	22922	0	0	0	0

Case 2 of Purchase of Vehicles with Euro Emission Regulation 2

Initial Cost

Euro 2	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 2	500	1000	0	10000	0
Diesel Vehicle with Euro 2	500	1000	22500	10000	15000
LPG Vehicle with Euro 2	500	0	0	0	0

Operation Cost (every year)

Euro 2	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 2	1631	3130	0	3130	0
Diesel Vehicle with Euro 2	1427	2167	14479	2167	8172
LPG Vehicle with Euro 2	2038	0	0	0	0

Total Cost for 10 years

Euro 2	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 2	16807	32304	0	41304	0
Diesel Vehicle with Euro 2	14769	22672	167294	31672	96715
LPG Vehicle with Euro 2	20884	0	0	0	0

< After the implementation of measures >

Similarly, the table below shows PC with Euro Emission Regulation 3.

Euro Emission Regulation 3	Initial Cost (Euro)	Operation Cost (Euro/year)	Total Cost for Ten Years (Euro/10 years)
Gasoline Vehicle	1500	1735	18850
Diesel Vehicle	1500	1271	14210
LPG Vehicle	1500	1995	21450

Case 3 of Purchase of Vehicles with Euro Emission Regulation 3

Initial Cost

Euro 3	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 3	500	1000	0	10000	0
Diesel Vehicle with Euro 3	500	1000	22500	10000	15000
LPG Vehicle with Euro 3	500	0	0	0	0

Operation Cost (every year)

Euro 3	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 3	1631	2890	0	2890	0
Diesel Vehicle with Euro 3	1223	2167	14932	2167	8427
LPG Vehicle with Euro 3	2038	0	0	0	0

Total Cost for 10 years

Euro 3	PC	Van	Bus	LCV	HDT
Petrol Vehicle with Euro 3	16807	29896	0	38896	0
Diesel Vehicle with Euro 3	12730	22672	171818	31672	99269
LPG Vehicle with Euro 3	20884	0	0	0	0

<Increase of Cost after Measures>

The number of registered PCs in Kosovo is as shown in the following table.

PCs by type of fuel	No Euro Emission Regulation	Euro Emission Regulation 1	Euro Emission Regulation 2
Gasoline Vehicle	19819	4810	12842
Diesel Vehicle	29497	6518	21975
LPG Vehicle	1085	288	373

The following is a 10-year comparison of total costs for PCs with Euro Emission Regulation 3. In particular, since PCs with No Euro Emission Regulation have poor fuel economy, the total cost can be reduced (minus value) by replacing PCs with less than Euro Emission Regulation 3 by PCs of all fuel types with Euro Emission Regulation 3.

PCs by type of fuel	No Euro Emission Regulation (Euro/vehicle 10years)	Euro Emission Regulation 1 (Euro/vehicle 10years)	Euro Emission Regulation 2 (Euro/vehicle 10years)
Gasoline Vehicle	-7154	1000	1000
Diesel Vehicle	-1038	1000	-1038
LPG Vehicle	-1038	-1038	1000

Using the above two tables (number of PCs and cost evaluation per PC), the total cost reduction can be grasped.

The Costs can be calculated using the same calculation procedure for vans, LCVs, HDTs, and buses. The calculation results are shown in the table below.

(million Euro/year)

Unit: million Euro	PC	Van	Bus	LCV	HDT	Sub-total
Petro	-0.89	0.02		0.01		-0.86
Diesel	-0.27	1.12	0.42	0.92	1.65	3.84
LPG	-0.01	0.00		0.00		-0.01
Sub-total	-1.17	1.13	0.42	0.93	1.65	2.97

PCs: Approximately -1.17 million Euro/ year (Decrease)
Van: Approximately 1.13 million Euro/ year (Increase)
LCVs: Approximately 0.93 million Euro/year (Increase)
HDTs: Approximately 1.65million Euro/ year (Increase)
Buses: Approximately 0.42million Euro/ year (Increase)
Total: Approximately 2.97million Euro/ year (Increase)

Cost-Effectiveness	<Measures for PC> PM_{10}: Approximately - 46,800 (Euro/ton) NO_X: Approximately -8,240 (Euro/ton) <Measures for Mini-Van & LCV> PM_{10}: Approximately 515,000 (Euro/ton) NO_X: Approximately 121,180 (Euro/ton) <Measures for HDT> PM_{10}: Approximately 412,500 (Euro/ton) NO_X: Approximately 24,260 (Euro/ton) <Measures for Bus> PM_{10}: Approximately 210,000 (Euro/ton) NO_X: Approximately 16,150 (Euro/ton) <Total Cost of Measures for above vehicle type> PM_{10}: Approximately 84,900 (Euro/ton) (Approximately 10.2 million (YEN/ton)) NO_X: Approximately 11,700 (Euro/ton) (Approximately 1.4 million (YEN/ton))
Issues	Real performance data for vehicles with each Euro Regulation
Implementation Method	1. Preparation of regulation for measurement of exhaust gas 2. Measurement of exhaust gas 3. Stickers 4. Monitor by Traffic Police
Evaluation of the Technical aspect	・ Municipality of Prishtina has already stipulated this measure in the law. Since April 2019, all public buses possessed by the municipality of Prishtina meet Euro Emission Regulation VI. However, the buses possessed by private companies have not responded to it yet. ・ For implementation of these measures, MESPI/MESP needs support and cooperation with other organization such as other departments (MI, etc.), police, and the municipalities, but this relationship is not completely established. ・ MESPI/MESP does not possess any equipment and staff relevant to exhaust gas measurement from vehicles. These are the issues from now on. It is not clear about equipment and human resources in this field. Priority is high for this measure and this has medium potential in Kosovo, but Kosovo government cannot control anything that has to do with vehicle emissions, except the control of the vehicle import.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.

Table 3-130 Evaluation Sheet for Measures 6: Vehicle Plate Number Regulation

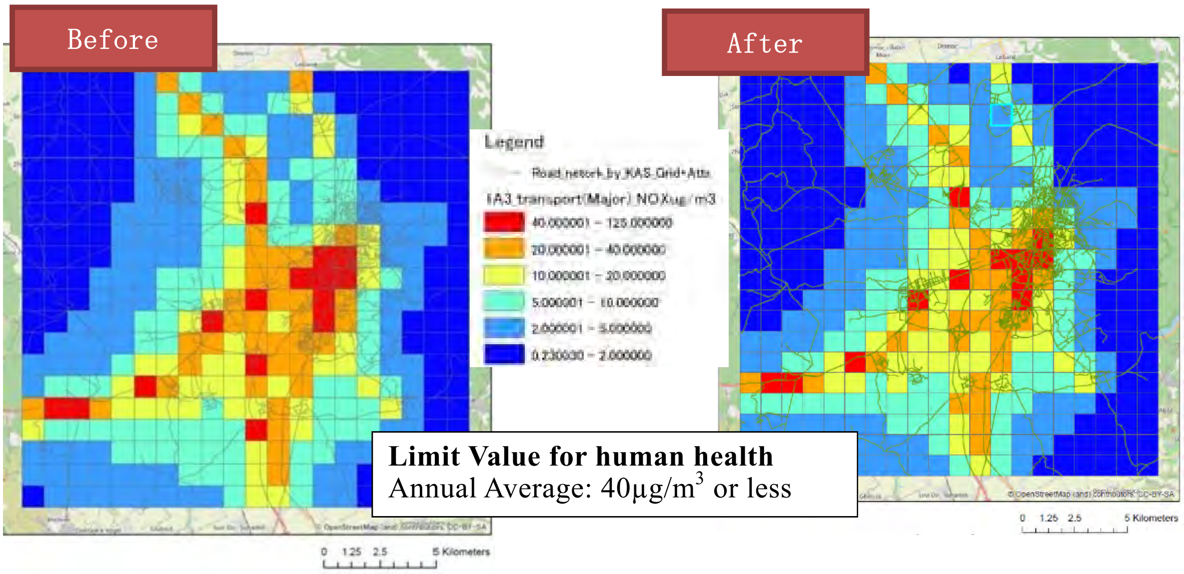
<table>
<tr><th>Name</th><th>Vehicle Measures (Vehicle Plate Number Regulation)</th></tr>
<tr><td>Outline</td><td>Target Area: Center of Prishtina
Even plate number cars can enter the Target Area on even days
Odd plate number cars can enter the Target Area on odd days</td></tr>
<tr><td>Scenario</td><td>1) Simplifying it, the volume of vehicles will be halved, but generally additional requirements will occur, so it will not be halved.
2) Passenger Cars (PCs) and Vans: 25 % PCs and Vans users will shift from using PCs and Van to using Bus, others will continuously use PCs and Van. This means that there will be 25% reduction in the Volume of PCs and Van.
3) Number of Light Commercial Vehicles (LCVs) and Heavy Duty Trucks (HDTs) is the 50% reduction (Number becomes half volume.).
4) Since the Buses are part of the public transport system, all buses can be used under the regulation for Vehicle plate number.
5) Number of Buses is increased in accordance with the passenger capacity of Bus and the number of people shifting from using PCs and Vans to using Buses.
6) Number of these people is multiplied with 3 persons/PC and 6 persons/Van by the volume of 25% of the Number of PCs and Van.</td></tr>
<tr><td>Emission Reduction</td><td>The activity data are changed in line with the above scenario such as reducing the number of passenger cars, vans, LCVs and HDTs, while increasing the number of buses. It is a simple calculation condition because of not changing the emission factors.
Then, the amount of emission reductions was calculated by calculating the difference between the emissions before the measures and after the measures.

Emissions and Fuel Consumptions from before measures are as follows.
<table>
<tr><th>Before</th><th>PC</th><th>Van</th><th>Bus</th><th>LCV</th><th>HDT</th><th>Total</th></tr>
<tr><td>NOx (ton/year)</td><td>683.96</td><td>89.59</td><td>159.87</td><td>32.19</td><td>294.27</td><td>1259.88</td></tr>
<tr><td>PM (ton/year)</td><td>47.89</td><td>6.89</td><td>4.28</td><td>2.48</td><td>8.81</td><td>70.35</td></tr>
<tr><td>SOx (ton/year)</td><td>0.95</td><td>0.11</td><td>0.08</td><td>0.04</td><td>0.14</td><td>1.32</td></tr>
<tr><td>Petrol (TJ/year)</td><td>693.30</td><td>10.96</td><td>0.00</td><td>3.94</td><td>0.00</td><td>708.20</td></tr>
<tr><td>Diesel (TJ/year)</td><td>1682.17</td><td>8.36</td><td>209.93</td><td>96.73</td><td>390.86</td><td>2388.05</td></tr>
<tr><td>LPG (TJ/year)</td><td>19.93</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>19.93</td></tr>
</table>

Emissions and Fuel Consumptions from after measures are as follows.
<table>
<tr><th>After</th><th>PC</th><th>Van</th><th>Bus</th><th>LCV</th><th>HDT</th><th>Total</th></tr>
<tr><td>NOx (ton/year)</td><td>557.51</td><td>73.57</td><td>255.22</td><td>20.17</td><td>187.36</td><td>1094.03</td></tr>
<tr><td>PM (ton/year)</td><td>39.97</td><td>5.66</td><td>6.82</td><td>1.55</td><td>5.61</td><td>58.71</td></tr>
<tr><td>SOx (ton/year)</td><td>0.78</td><td>0.09</td><td>0.14</td><td>0.02</td><td>0.09</td><td>1.11</td></tr>
<tr><td>Petrol (TJ/year)</td><td>565.70</td><td>9.00</td><td>0.00</td><td>2.47</td><td>0.00</td><td>577.17</td></tr>
<tr><td>Diesel (TJ/year)</td><td>1372.42</td><td>6.87</td><td>335.75</td><td>60.58</td><td>248.87</td><td>2024.49</td></tr>
<tr><td>LPG (TJ/year)</td><td>16.26</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>16.26</td></tr>
</table>

Emission Reductions and reductions of fuel consumption are as follows. Minus value means increase.
<table>
<tr><th>Before-After</th><th>PC</th><th>Van</th><th>Bus</th><th>LCV</th><th>HDT</th><th>Total</th></tr>
<tr><td>NOx (ton/year)</td><td>126.25</td><td>16.02</td><td>-95.35</td><td>12.02</td><td>106.91</td><td>165.85</td></tr>
<tr><td>PM (ton/year)</td><td>8.81</td><td>1.23</td><td>-2.54</td><td>0.93</td><td>3.20</td><td>11.63</td></tr>
<tr><td>SOx (ton/year)</td><td>0.17</td><td>0.02</td><td>-0.05</td><td>0.01</td><td>0.05</td><td>0.21</td></tr>
<tr><td>Petrol (TJ/year)</td><td>127.60</td><td>1.96</td><td>0.00</td><td>1.47</td><td>0.00</td><td>131.02</td></tr>
<tr><td>Diesel (TJ/year)</td><td>309.75</td><td>1.50</td><td>-125.82</td><td>36.15</td><td>141.99</td><td>363.56</td></tr>
<tr><td>LPG (TJ/year)</td><td>3.67</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>3.67</td></tr>
</table>
NO_X Emission Reduction: Approximately -166 ton/year
PM_{10} Emission Reduction: Approximately -11 ton/year</td></tr>
<tr><td></td><td></td></tr>
</table>

NO_X Concentration Map (before- after, The figure only considers the emission from vehicles)



Limit Value for human health
Annual Average: 40µg/m^3 or less

※ Since the concentration distribution map shows only the contribution of household emission sources, it cannot be directly compared with the environmental standard value.

Cost

The total number of vehicles except Buses does not change.

The number of Buses increases in accordance with the increase in demand by passengers who shift from using PCs and Van to using Buses.

The estimated number of Vehicles in the Target Area (Prishtina Area) is as follows.

Prishtina Area	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
Passenger Car (M1)	Petrol	12502	2205	508	1540	4039	2688	1105	416
	Diesel	49473	8726	2011	6093	15985	10638	4373	1646
	LPG	358	63	15	44	116	77	32	12
	Other	189	33	8	23	61	41	17	6
LCV (N1)	Petrol	129	17	14	33	37	20	6	1
	Diesel	7701	1018	837	1991	2210	1207	358	81
	Other	4	1	0	1	1	1	0	0
HDV (N2-N3)	Diesel	3007	798	291	586	842	239	203	51
	Other	2	1	0	0	1	0	0	0
Bus (M2-M3)	Diesel	706	97	94	248	180	43	28	16
	CNG (Buses)	0	0	0	0	0	0	0	0
	other	3	0	0	1	1	0	0	0
Motorbike (L)	Petrol	515	118	102	71	179	40	0	2
	Other	5	1	1	1	2	0	0	0

Unit: Number

The number of Vehicles related to this measure is the number of Vehicles that will undergo the shift from PCs and Van to Buses.

Shift vehicles	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
PC	Petrol	3125	551	127	385	1010	672	276	104

	Diesel	12369	2182	503	1523	3996	2660	1093	412
	LPG	90	16	4	11	29	19	8	3
	Other	47	8	2	6	15	10	4	2
Mini-Van	Petrol	24	3	3	6	7	4	1	0
	Diesel	1457	193	158	377	418	228	68	15
	Other	0	0	0	0	0	0	0	0

Unit: Number
<Initial Cost for the measure>
It is set that 20 PCs is equal to one Bus, and 10 Mini-Van is equal to one Bus.
All new Buses put in circulation meet the Standard of Euro 4 Emission Regulation.
Number of new Buses is 1859. Purchase Price is 100,000 Euro/one.
Total Initial Cost is 185.9 million Euro.
<Operation Cost for the measure>
Before: Current Situation
After: Fuel consumption decreases in accordance with the decrease in Number of PCs and Vans driving in center of Prishtina.

Shift vehicles	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
PC	Petrol	-5.339	-1.327	-0.216	-0.651	-1.284	-1.189	-0.488	-0.184
	Diesel	-19.186	-3.236	-0.64	-2.044	-7.972	-3.381	-1.389	-0.524
	LPG	-0.128	-0.037	-0.009	-0.022	0	-0.038	-0.016	-0.006
	Other		Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated
Mini-Van	Petrol	-0.066	-0.009	-0.009	-0.018	-0.015	-0.013	-0.002	0.000
	Diesel	-2.208	-0.421	-0.334	-0.798	0	-0.482	-0.142	-0.031
	Other		Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated	Not Estimated
	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
Buses	Diesel	26.500					26.500		

Unit: Million Euro/year
LCV and HDT related to measures (these are in circulation every second day)

Shift vehicles	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
LCV	Petrol	15	2	2	4	4	2	1	0
(N1)	Diesel	937	124	102	242	269	147	43	10
	Other	0	0	0	0	0	0	0	0
HDT	Diesel	1507	399	146	293	421	120	102	26
(N2-N3)	Other	2	1	0	0	1	0	0	0

Unit: Number
LCVs and HDTs
Fuel Cost Reductions (operation cost reductions) occur because these vehicles are in circulation every second day.

Shift vehicles	Fuel type	Total	before Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
LCV	Petrol	-0.044	-0.006	-0.006	-0.012	-0.012	-0.006	-0.002	0
(N1)	Diesel	-1.989	-0.27	-0.216	-0.512	-0.569	-0.311	-0.09	-0.021

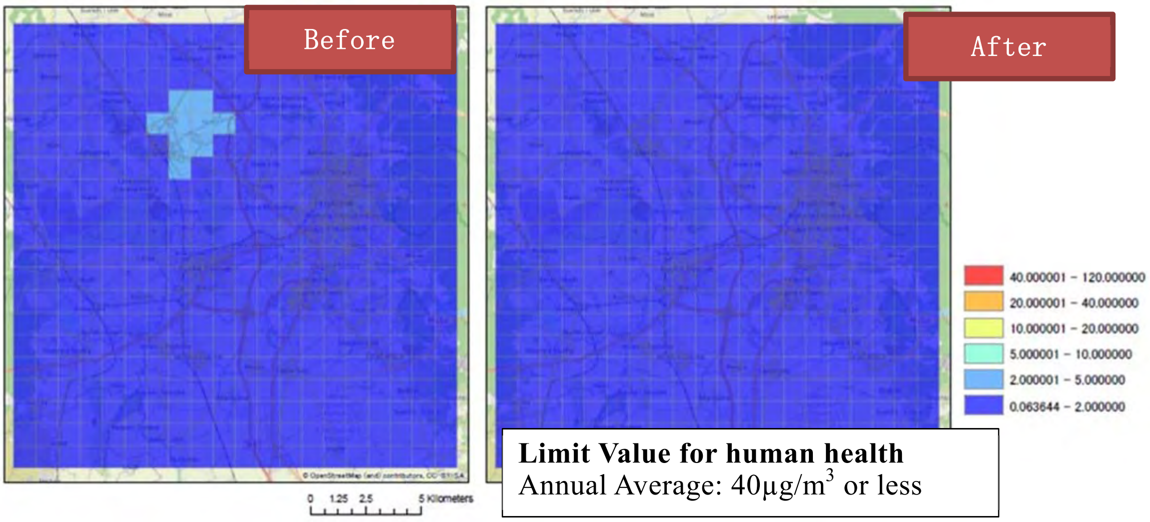
<table>
<tr><td></td><td>
<table>
<tr><td></td><td>Other</td><td>0.000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">HDT
(N2-N3)</td><td>Diesel</td><td>-13.002</td><td>-3.836</td><td>-1.242</td><td>-2.39</td><td>-3.547</td><td>-0.963</td><td>-0.816</td><td>-0.208</td></tr>
<tr><td>Other</td><td>0.000</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Unit: Million Euro/year
Total Operation Cost
PCs: -24.653 (million Euro/year): Decrease
Min-Van: -2.274 (million Euro/year): Decrease
Bus: +26.500 (million Euro/year): Increase
LVCs: -2.033 (million Euro/year): Decrease
HDT: -13.002 (million Euro/year): Decrease
Total: -15.462 (million Euro/year): Decrease
<Total Cost for the measure>
Initial Cost: 185.9 (million Euro)
Operation Cost: -15.462 (million Euro/year)
Total Cost for 10 years: 31.28 (million Euro/year)
</td></tr>
<tr><td>Cost-Effectiveness</td><td>Cost Effectiveness is estimated for only the total Cost of this Measure, because all types of vehicles are closely related to the vehicle shift, especially there is a close relation with PCs, Mini-Vans, and Buses.
<Total Cost of Measure for above vehicle types>
PM_{10}: Approximately 284,400 (Euro/ton) (Approximately 34.1 million (YEN/ton))
NO_X: Approximately 18,800 (Euro/ton) (Approximately 2.3 million (YEN/ton))</td></tr>
<tr><td>Issues</td><td>1) PM_{10} Emission reductions are not so large.
2) If total number of vehicle will increase, the emission reduction effect will become lower.
3) How to secure Government support for switching to vehicles with higher Euro Emission Regulation.</td></tr>
<tr><td>Implementation Method</td><td>1) Set target area
2) Public awareness for Vehicle Plate Number Regulation
3) Monitor by Traffic Police</td></tr>
<tr><td>Evaluation of the Technical aspect</td><td>Through the consultation with the traffic police, it was concluded that it is difficult to implement this measure. MESPI/MESP should identify the implementation issues.
MESPI/MESP, especially KEPA, should build the capacity for emission reduction calculation from measures on vehicles.
MESPI/MESP should develop the Future Scenario in accordance with Without Measures (hereinafter referred to as “WOM”), With Existing Measures (hereinafter referred to as “WEM”), and With Additional Measures (hereinafter referred to as “WAM”) on this measure.
MESPI/MESP should consider how to carry out the implementation through citizen consensus.</td></tr>
<tr><td>Evaluation of the Social aspect</td><td>Since the results of qualitative evaluation by using 17 Goals of SDGs (Sustainable Development Goals) is very high, this policy has high priority from the view point of social demand.</td></tr>
</table>

Table 3-131 Evaluation Sheet for Measures 7: Measures for TPPs

Name	Improvement of TPP Kosovo A and Rehabilitation of TPP Kosovo B
Outline: TPP Kosovo A	Measures for ESP at TPP Kosovo A will be carried out in accordance with measures considered by the Project. In this scenario, the emission factors are changed in accordance with following emission concentration, but the calculation of emission reduction is carried out under the condition that the activity data are not changed. DUST: 50 mg/Nm^3 at O_2 6% in the exhaust gas (Target of 2018)

	SO_2 & NOx: no change from the second Emission Inventory
Outline: TPP Kosovo B	Since Kosovo B will be rehabilitated by EU, the emission reductions were calculated using the following calculation condition where the regulations of exhaust gas emissions in 2027 are met. ・ DUST: 20 mg/Nm^3 at O_2 6% in the exhaust gas (Target of 2027) ・ SO_2: 200 mg/Nm^3 at O_2 6% in the exhaust gas (Target of 2027) ・ NOx: 200 mg/Nm^3 at O_2 6% in the exhaust gas (Target of 2027)
Emission Reduction	PM_{10} Emission Reduction for TPP Kosovo A 2,306 (ton/year)、Approximately 86% reduction PM_{10} Emission Reduction for TPP Kosovo B 6,592 (ton/year)、Approximately 96% reduction
Cost	TPP Kosovo A: 8.7 million Euro（total additional cost necessary for securing dust reduction measures described in 3-8-1, 5）, vi）,a)) TPP Kosovo B: rehabilitation supported by EU Operation Cost did not change because the fuel consumption at TPPs did not change between before and after measures.
Cost effectiveness	Total cost is evaluated for 10 years, same as for other measures. TPP Kosovo A: PM_{10}: approximately 380 Euro/ton of the power plant TPP Kosovo B: not evaluated

PM_{10} Concentration Map (before- after, The figure only considers the emission from LCPs)

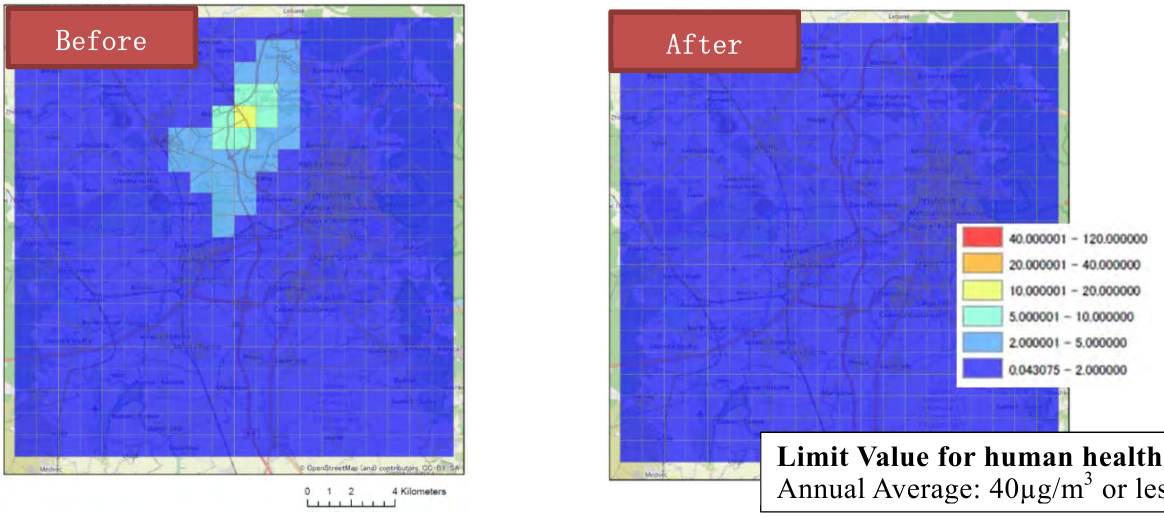


Limit Value for human health
Annual Average: 40μg/m^3 or less

※ Since the concentration distribution map shows only the contribution of emission from the power plants, it cannot be directly compared with the environmental standard value.

Table 3-132 Evaluation Sheet for Measures 8: Fuel Tax

Name	Fuel Tax for Factories using Petro-Coke
Outline	This is the example of the measure on fuel shift for factories using Petro-Coke to shift to LPG by setting the Fuel Tax.
Scenario	Target is the factory using Petrol-Coke. Since Petrol-Coke is not a good quality fuel, GoK is trying to stop the use of Petrol-Coke under the emission regulation scheme, but this currently is impossible. This is an alternative administrative method by the Government for fuel shifting from Petrol-Coke (bad fuel) to LPG (good fuel). Currently, the Taxes on fuel are only Import Tax and VAT. The Fuel Tax for Petrol-Coke is set in accordance with the difference of price per GJ (calorific value) between Petrol-Coke and LPG. The price of Petrol-Coke is 7.692 (Euro/GJ), by calculating information on “250

<table>
<tr><td></td><td>Euro/ton". The price of LPG is 36.923 (Euro/GJ), by calculating information on "12 Euro/10kg" from Research Interviews by students. The difference in price is approximately 29.231 (Euro/GJ).
The following table of the activity data shows the Fuel Consumption for the Brick Factory before and after measure.
<table><tr><th>Fuel Type</th><th>Unit</th><th>Before Measures</th><th>After Measures</th></tr><tr><td>Petro-Coke</td><td>GJ/year</td><td>46052.5</td><td>0</td></tr><tr><td>LPG</td><td>GJ/year</td><td>1950.48</td><td>48002.98</td></tr></table>The subsidy and fuel tax is necessary for this case as follows.
1/3 of the difference is a Subsidy: 590,805 (Euro/year)
2/3 of the difference is Fuel Tax: 1,181,609 (Euro/year)</td></tr>
<tr><td>Emission Reduction</td><td>Emission Reductions on the Brick Factory as an example is as follows.
SO$_2$ Emission Reduction: Approximately -192 ton/year
NO$_X$ Emission Reduction: Increasing (due to setting Emission Factors)
PM$_{10}$ Emission Reduction: Approximately -205 ton/year</td></tr>
<tr><td colspan="2">PM$_{10}$ Distribution Concentration Map (shows only before and after the measure and contribution of factories)

Limit Value for human health
Annual Average: 40µg/m^3 or less
※ Since the concentration distribution map shows only the contribution of emissions from brick factory, it cannot be directly compared with the environmental standard value.</td></tr>
<tr><td>Cost</td><td>Fuel Cost before Measures at brick factory
Approximately 426,253 (Euro/year)
Fuel Cost after Measures at brick factory
Approximately 1,772,414 (Euro/year)
Increase of Cost after Measures
Approximately 1,346,161 (Euro/year) (Total cost increases)</td></tr>
<tr><td>Cost-Effectiveness</td><td>SO$_2$: Approximately 7,000 (Euro/ton)
PM$_{10}$: Approximately 6,600 (Euro/ton)
The Level of Cost-Effectiveness for this Fuel Tax Case is almost same as Measures for households. One reason is the initial cost does not include the LPG facilities, because the target factory already installed the LPG facilities.</td></tr>
<tr><td>Issues</td><td>If GoK sets the Fuel Tax, it is thought that the business operation of this factory will become difficult. Therefore, this measure sets not only the Tax but also the Subsidy. It is difficult to set Ratio of Tax and Subsidy.
If carrying out this measure, GoK should establish the legal framework. This fuel tax seems like a "penalty charge".
If Petrol-Coke is no longer used after the Measure is implemented, the situation is that a subsidy should be provided. Kosovo side should consider if this fuel tax is sufficient or not to restrain the factory to return to the use of Petrol-Coke even after</td></tr>
</table>

	the subsidy is stopped.
Implementation Method	1. GoK request the Factory to meet Emission Regulation. 2. If impossible, GoK will set the Fuel Tax for the Factory using low quality fuel and subsidize purchasing high quality fuel. 3. GoK will monitor the fuel usage situation, and if necessary, GoK should carry out the exhaust gas measurement. 4. GoK should consider the future Measures for such factories.
Evaluation of the Technical aspect	MESPI/MESP staff has no sufficient knowledge on fuel tax system. Other Ministry has the responsibility of tax collection. MESPI/MESP needs support from other relevant organizations to implement the measures.
Evaluation of the Social aspect	Since the results of qualitative evaluation by using 17 Goals of SDGs is very high, this policy has high priority from the view point of social demand.

Measures on household heating equipment and vehicle are compared and summarized as shown in Table 3-133. In this way, the C / P understood that it is possible to communicate the plan of the Measures to decision-makers in an easy-to-understand manner by compiling the Measures studied as the list.

According to Table 3-133 and the Evaluation Sheet studied above, in order to improve the ground level concentration of air quality in Prishtina area, the fuel shift for residential stationary is absolutely imperative. However, since the total cost for implementation of this measure is high, it seems not to be easy to be implemented.

On the other hand, improvement of thermal insulation effect is also limited, and the measures for vehicles are expected to have a large impact on NOx but not on PM_{10}.

In the future, it is necessary for the Kosovo side to obtain information on other future plans, and evaluate more measures after many of the measures have been studied and integrated. In order to do so, it is necessary to draft the future scenario based on emission inventory to be developed, the future plans by each ministry and agency as well as the support activities and future support plans by oversea donors, and more Measures should be prepared.

Table 3-133 Summary and Comparison of the Measures evaluated by the Project

	Target of Measures	**PM_{10} Emission Reductions**	**Total Cost (Initial Cost + Operation Cost of 10 years)**	**Cost-Effectiveness**	**Issues**
Fuel Shift to wood Pellet	Mainly Detached houses and Semi-detached houses Target Number: Approximately 7500	Approximately 718 ton/year	Approximately 54.37 million Euro during 10 years	PM_{10}: Approximately 7,600 (Euro/ton)	Total cost is large. How to establish the support of operation cost by GoK.
Fuel Shift to	Mainly Detached	Approximately 742 ton/year	Approximately 48.78 million	PM_{10}: Approximately	Total cost is large.

Electricity	houses and Semi-detached houses Target Number: Approximately 7500		Euro during 10 years	6,600 (Euro/year)/ton	How to establish the support of operation cost by GoK.
Fuel Shift to LPG	Mainly Detached houses and Semi-detached houses Target Number: Approximately 7500	Approximately 742 ton/year	Approximately 65.91 million Euro during 10 years	PM_{10}: Approximately 8,900 (Euro/year)/ton	Total cost is large. How to establish the support of operation cost by GoK.
Thermal Insulation Improvement	Detached houses Target Number: Approximately 1000 households	Approximately 55 ton/year	Approximately 0.8 million Euro during 10 years	PM_{10}: Approximately 1,500 Euro/ton	Emission reductions of air pollutant cannot be expected to be large.
Vehicle Euro Emission Regulation	All vehicle types within the target area PC: 62522 LCV including Van: 7834 HDT: 3009 Bus: 709	・PCs: Approximately 25 ton/year ・LCVs including Van: Approximately 4 ton/year ・HDTs: Approximately 4 ton/year ・Bus: Approximately 2 ton/year ➢ Total: Approximately 35 ton/year	・PCs: Approximately 11.7 million Euro during 10 years (Decrease) ・Van: Approximately 11.3 million Euro during 10 years (Increase) ・LCVs: Approximately 9.3 million Euro during 10 years (Increase) ・HDTs: Approximately 16.5 million Euro during 10 years (Increase) ・Bus: Approximately 4.2 million Euro during 10 years	・PCs: PM_{10}: Approximately 46,800 Euro/ton ・LCV including Van: PM_{10}: Approximately 515,000 Euro/ton ・HDTs: PM_{10}: Approximately 412,500 Euro/ton ・Bus: PM_{10}: Approximately 210,000 Euro/ton ➢ Total PM_{10}: Approximately 1,090,700 Euro/ton NO_X: Approximately 153,400 Euro/ton	For NOx, it is very good but for PM10, it has limited effect.

			(Increase) ➢ Total: Approximately 21.650 million Euro during 10 years		
Vehicle Number Plate Regulation	Target Area: Center of Prishtina Even plate number cars can enter the Target Area on even days Odd plate number cars can enter the Target Area on odd days	・Approximately 11 ton/year	・Approximately 32.28 million Euro during 10 years	PM_{10}: ・Approximately 277,560 (Euro/year)/ton	Emission reductions are not so large. If total number of vehicle will increase, the emission reduction effect will become lower.
TPP Kosovo A	Measures for ESP studied by the Project	Approximately 2,300 ton/year	Approximately 8.7 million Euro	PM_{10}: Approximately (Euro/year)/ton	It is necessary to study comprehensively since the facilities are very old and deteriorated, the performance is low, etc.
Fuel Tax	Fuel Tax for Factories using Petro-Coke	Approximately 205 ton/year	Approximately 1.35 million Euro	PM_{10}: Approximately 6,600 (Euro/year)/ton	Although GoK should set the Fuel Tax together with the Subsidy for the private company, it is not easy to set the Ratio between Tax and Subsidy.

Figure 3-59 shows the graph of PM_{10} while comparing potential amount of reduction with the reduction cost for each measure. The height of each box in the graph represents the required cost for reduction and the width shows the potential amount of reduction in a target year for each measure. The graph places the measures from left to right from the lowest cost to the highest cost measures. The Measures below the zero horizontal axis offer the potential for financial savings even after the upfront costs of capturing them have been factored in. Measures above the zero horizontal axis are expected to come at a net cost.

Among the measures examined in the Project, the cost regarding household heating is evaluated based on the comparison between woody pellet, electricity and gas fuels, and this does not necessarily show the marginal abatement costs.

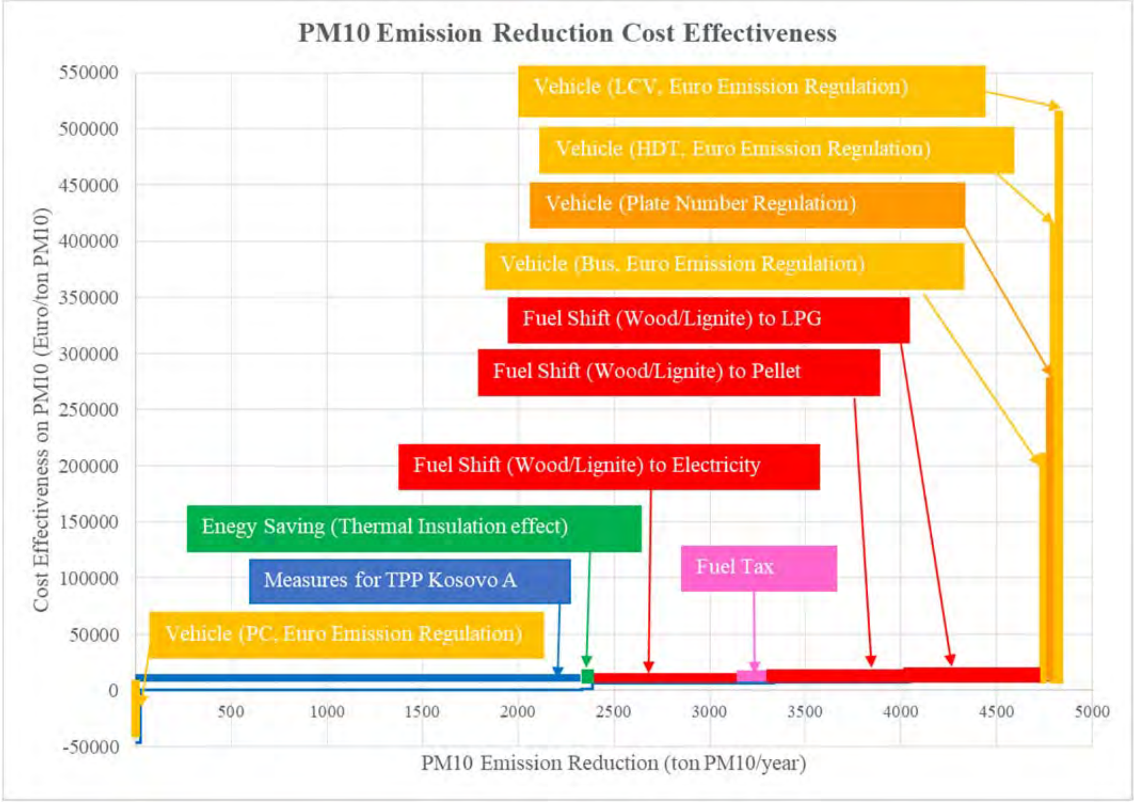
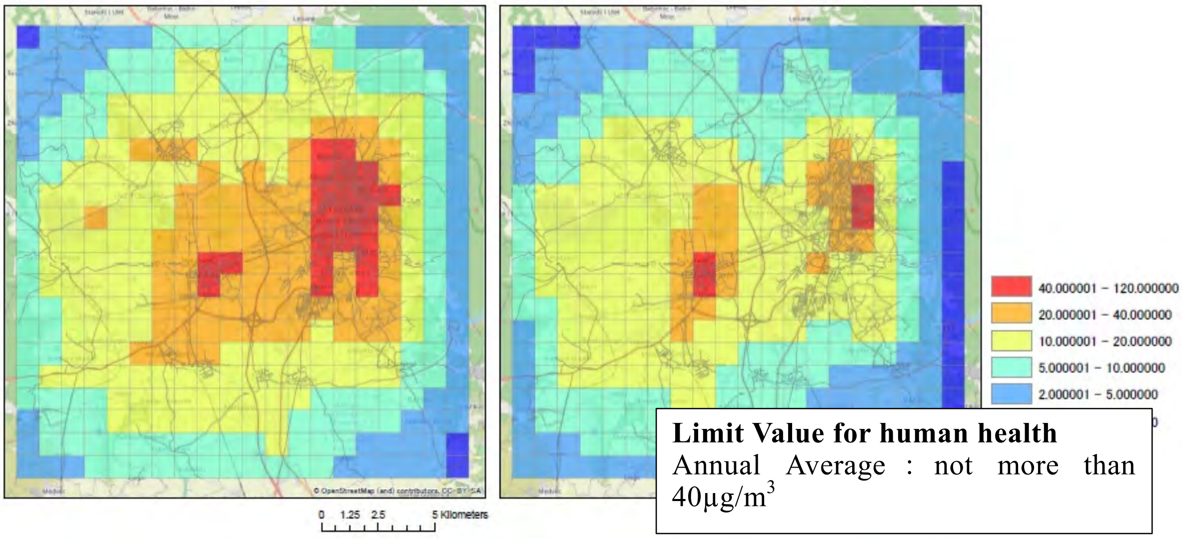


Figure 3-59 Cost-effectiveness graph related to PM_{10}

Out of the approximately 13,000 ton/year of PM_{10} emission in 2017, these measures will reduce approximately 3,300 ton/year. The total annual cost for them is approximately 13.2 million Euro/year. In addition, when the emission reduction (approximately 6,600 ton/year) by the measures for TPP Kosovo B currently planned to be rehabilitated by the EU is added, the emissions of approximately 9,900 ton/year will be reduced.

From the view point of the cost of measures, the measures such as energy saving should be carried out. On the other hand, from the view point of the emission reduction potential, the measures such as measures for TPPs and fuel shift should be carried out. In addition, the implementation of evaluation for measures needs more measures studied through the evaluation sheets for measures.

Figure 3-60 shows the concentration distribution map before and after the measures where all the above measures are implemented.



Limit Value for human health
Annual Average : not more than $40\mu g/m^3$

Before the implementation of measures After the implementation of measures

Figure 3-60 PM_{10} concentration map taking all abovementioned measures into consideration

Although the issue that the adequacy of simulation results are not confirmed remains yet, the area which meets environmental standard expands to a considerable extent. However, the area which does not meet environmental standard still remains in the center of the city of Pristina and Fushe Kosovo. The map suggests that more measures are required in order to meet environmental standard for the whole Pristina area.

Through the activity, the Kosovo side has learned the process of studying, planning and evaluating measures. It is expected to study measures by utilizing the method they learned.

(2) The Law system and Action plan for implementation of air pollution control measures

The law "Air Protection from Pollution" is the basis for improving air quality. The Project has conducted the evaluation of the draft law and the existing condition in Kosovo. Table 3-134 shows the activities for this study. The present law is drafted in 2010, but after then, the SAA agreement is concluded and therefore, a new law taking in the EU directives is drafted, and it is going to be implemented within not such a long period. However, it is obvious that there are many issues that remain in regard to the enforcement of the law. Table 3-135 shows the future issues resulting from the discussion with C/Ps.

Table 3-134 Activities on the study on the draft law "Air Protection from Pollution"

Date	Activities	Participants
Additional activities in the third period		
Dec. 4, 2020 (Fri) 9:00 ~ 11:00	Discussion on the content of the law for air and its enforcement condition	C/P: 1
Dec. 11, 2020 (Fri) 9:00 ~ 11:00	Discussion on the content of the law for air and its enforcement condition	C/P: 3
Dec. 22, 2020 (Tue) 9:00 ~ 11:00	Discussion on the content of the law for air and its enforcement condition	C/P: 4

Table 3-135 Results of the discussion on the law for air

Scope of the law The draft law is now being checked by the relevant institutions. Then, the law will be reviewed and sent to the parliament.	
・ protect the air	To Protect air This is the target of the Project ・ components to be monitored – SO2、NO2、NOX、PM(PM_{10}, $PM_{2.5}$), Pb, benzene, CO, ozone and surface ozone precursors, As, Cd, Hg, Ni, benzo (a) pyrene and other polycyclic aromatic hydrocarbons (PAH) in the air ・ Emission limit values for stationary sources are stipulated by the sub-legal Act – Private facilities etc. must report the exhaust gas measurement results. – The Polluter is obliged to ensure the air quality monitoring through The Environmental Consent, Environmental Permit and Integrated Environmental Permit However, at this moment, there are few reports form private facilities. ・ Implementation of air quality monitoring and exhaust gas measurement – Implementation bodies must have accreditation. The accreditation is made by DAK (Directory of Accreditation of Kosovo: Previous Accreditation Agency). Implementation bodies need to have ISO17025 or equivalent certification. – Measurement instruments must be accredited by DAK. There are no bodies which have ISO17025 including the KHMI.
・ protection of the ozone layer,	To protect Ozone layer This is out of scope of the Project ・ At this moment, there is no Sub legal Act, and nothing is proceeding.
・ reducing the level of greenhouse gas emissions and adaptation to climate change,	Reduction of greenhouse gas This is out of scope of the Project ・ At this moment, there is no Sub legal Act, but it is reported to EU. Since Kosovo is not a member of UN, it is not mandatory.

・ Strategic documents	Preparation of Strategy and Action Plan ・ Strategy 2023 to 2032 must be prepared. ・ Action plans for central and local government must be prepared. At this moment, the action plan from 2021 by central government must be prepared. However, because of the COVID-19, it is not prepared yet and the preparation is not planned concretely.
・ monitoring and assessment of air quality	・ Monitoring of air quality must be conducted by central and local government, and the level of pollution must be assessed. However both governments do not have sufficient capacity. – Components are SO2, NO2, NO, PM (PM_{10}, $PM_{2.5}$) , Pb, benzene, CO, Carbon, surface O3, As, Cd, Hg, Ni, benzoic (a) pyrene ・ KHMI is responsible for air quality monitoring data, including analyzers. Therefore, KHMI needs ISO17025. KHMI must conduct measurement for all components by standard measurement methods. However, at this moment, KHMI can analyze only SO_2, NO_2, NO_X、PN_{10}, and $PM_{2.5}$ through AQMSs.
・ measures to prevent and reduce air pollution,	In the Project, concrete measures have been studied, but further support such as in planning and implementation of concrete measures is required. ・ Planning and implementation of Short-term Action Plan by local government Short-term Action Plan: these are plans which need to be implemented for a short time period in order to reduce air pollution and give permanent solution to problems.
・ reporting air quality and exchange of information,	Public Information, Exchange of information, Access to information, Annual report on air quality, etc.
・ activities of monitoring of air quality	System for air quality monitoring through AQMSs has been organized.　However, all the components requested by EU are not covered. ・ KHMI must watch air quality. ・ Private facilities, etc. must watch emissions thorough accredited bodies.
・ emissions into air and substances that damage the ozone layer,	This is out of scope of the Project

・ the information system of air,	Enhancement of data collection ・ Collection of air quality information ・ Collection of emission data from stationary sources ・ Protection and improvement program for air quality ・ Data collection and improvement of Ozone layer protection, climate change, etc. Are the targets for information
・ financing of the air protection,	At this moment, mainly from donors, expectation form private companies but not much from the government
・ Inspection management and supervision.	Inspectors have many roles. ・ Monitoring the emissions from stationary sources for air pollution and confirmation of compliance with the regulation ・ Monitoring the implementation of Action Plan, Short-term Action Plan, etc. ・ Monitoring the monitoring condition of AQMSs ・ Monitoring the implementation condition of measures determined by environmental consent, environmental permit and integrated environmental permit etc.

Issues and measures	
Issues	Measures
Collection of air quality data	Acquisition of analysis technology for air quality monitoring ・ Acquisition of ICP-MS, GC-MS, etc. for analysis of required components ・ Acquisition of ISO17025 At the present KHMI does not sufficient lineup to acquire it. And the precondition is to increase the number of staff by at least three persons. Even if the conditions are fulfilled and foreign donors support the activities, it will take at least five years. As the first activity it is necessary for KHMI to increase the number of staff and start from the training for analysis technology, organization of laboratory environment, etc.
Monitoring of air quality data	Establishment of data management system and strengthening of the ability for air quality

	analysis ・ Training for establishment of data management system ・ Improvement of the assessment capacity for air quality by strengthening the analysis ability The establishment of data management system is the first priority for the assessment capacity for air quality.
Data collection for emissions from stationary sources	In order to regulate emissions from stationary sources, the main precondition is that the exhaust gas measurement results are reported. ・ Strengthening of the instruction abilities on exhaust gas measurement results: capacity development of DIPM and Inspectorate In order to disseminate the report of exhaust gas measurement results, it is thought that inspectors take initiative to carry out measurement for every kinds of stationary sources and instructs private facilities, etc. which leads to the establishment of the exhaust gas measurement system. Measurement can be carried out to evaluate emissions from heating devices in households. This activity will contribute to the reduction of emissions from households.
Accreditation	The following need accreditation ・ Measurement of air quality, exhaust gas measurement from stationary sources, etc. ・ Certification of measurement instruments, continuous measurement instruments, etc. etc.
Action Plan, etc.	Capacity development for planning measures is required not only for the officials of central government but also for the officials of local government. ・ Drafting and implementation of Action Plan, Short-term Action Plan, etc. etc.
Roles of Inspectors	Inspectors have many roles and capacity development is necessary. Reinforcement of the staff is indispensable. ・ Capacity development for the activities on stationary sources

	– Learning exhaust gas calculation, industrial processes, etc. – Trainings regarding the assessment of exhaust gas measurement results by utilizing capacities mentioned above. – Expanding further the knowledge on emission reduction measures ・ Capacity development for other activities – It is necessary to enhance knowledge for air quality monitoring, implementation of Action plans, etc.

3.9.2 Evaluation for the Objectively Verifiable Indicators in the PDM

Regarding PDM, the Objectively Verifiable Indicator for Output 8 is ‘8.1 Pollution control measures discussed in the Kosovo sides strategy on air quality and action plan are evaluated at least once’.

In the second period, the Action Plan based on the Strategy of Air Quality in Kosovo was reviewed, and in the third period, the results of the review were broken down to concrete air pollution control measures as shown in Table 3-124. Along with the discussion with C/P, the air pollutant control measures shown in Table 3-133 were studied in further detail and proposed to the Kosovo side.

3.9.3 Capacity development through the activities

In the first period, C/Ps learned the history of Japanese environmental administration for air quality through lecture and discussion, and JET tried to collect information on Kosovo environmental administration for air quality.

In the second period, through discussion with C/Ps, JET carried out the review of the Action Plan for Air Quality 2018-2020 (the Action Plan) from the following viewpoints. In addition, the example of measures in another country was revised in accordance with Kosovo situation/condition, and these measures were also reviewed from the following same view point. The review was carried out by using the following viewpoints: 1) individual and technical aspect, 2) organizational aspect, and 3) Institutional and social aspect. The individual and technical aspects were the evaluation for individual skill, etc. The organizational aspect was the evaluation for such as organizational structure and management, equipment and facilities. The institutional and social aspects were the evaluation conducted by the scores based on four grades which consider contribution to the 17 Goals of SDGs provided by United Nations. Through these activities, C/P obtained the experience of review for the Measures.

In the third period, C/Ps with the assistance of JET carried out making list for measures planning, emission reduction calculation of the Measures by using the second emission inventory, calculation of cost-effectiveness for the Measures, studying implementation method for the Measures, discussion on benefits and issues for the Measures, etc. C/Ps with the assistance of JET organized these wide activities as the evaluation sheet for Measures. Through these activities, C/Ps learned the practical and concreate activities for planning, studying, implementing, and evaluating the Measures. In particular, the groundwork for future measures implementation was able to be conducted through studying the procedure of the Measures implementation, making the evaluation sheet for the Measures, making the table for summary and comparing of the Measures, studying establishment of institutional framework for the Measures, etc.

In the additional activities in the third period, C/Ps with the support of JET carried out planning and studying of the additional measures such as fuel shift from Wood and Lignite to Electricity and LPG for residential stationary sources, the fuel tax, and the vehicle plate number regulation. At the same time, as a reference, the measures for district heating was examined, the importance of future scenarios for planning measures was understood deeply, and the consideration of current issues for creating future scenarios was carried out.

Through the above activities, C/Ps were able to grow understanding of the planning and evaluation for policies and measures, and practical activities of evaluation for the Measures were implemented. In addition, since the establishment of institutional framework for the Measures progresses, JET judges that Kosovo side has already taken the first step for future continuous air quality improvement activities in Kosovo.

3.10 Final Seminar and Regional Conference

The Project held the final seminar as the final event, in which the concerned personnel were invited and the status of achievement of the activities, future issues, proposals and lessons learned, requests from the Kosovo side, etc. were presented and discussed. Furthermore, the Project held the Regional Conference where officials of neighboring countries in Balkan area were invited. In the Conference, the content of the Project and achievements obtained through the Project were presented, and at the same time, participants shared the issues and information regarding air pollution in their countries.

Considering the situation of COVID-19, both Seminar and Conference were held by the form where Kosovo side mainly attended the venue and the Japanese side participated through internet.

(1) Final Seminar

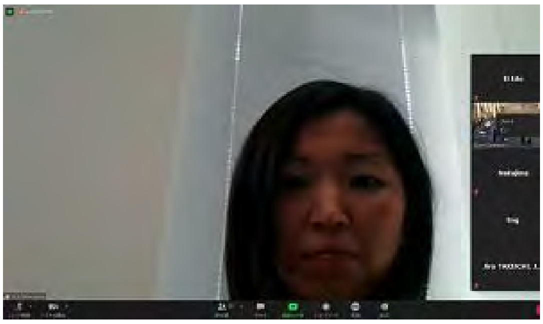
Date: June 9, 2021: 9:00~16:00

Venue: Emerald Hotel (Prishtina)

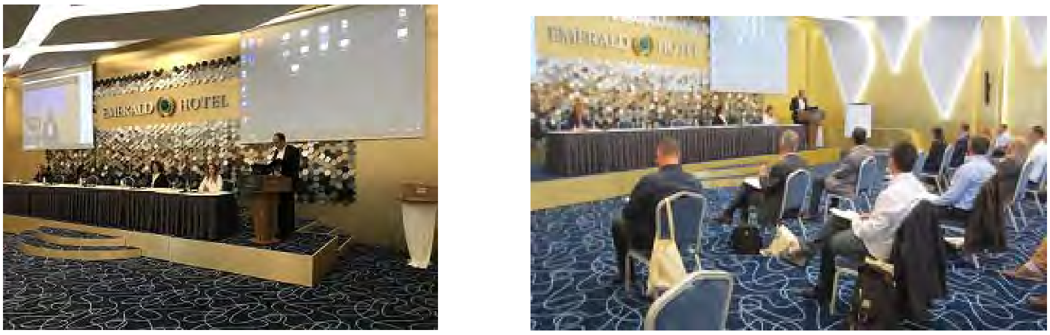
The Seminar began with the greeting from the minister of MESPI and Ms. SHIMODAIRA (JICA Head Quarter). The coordinator in each output made a presentation regarding its achievement. Each presentation had Questions and Answers time and Active discussion were held. At the end, the seminar was finished by the greeting of the Secretary General.

Agendas and participants are described below.

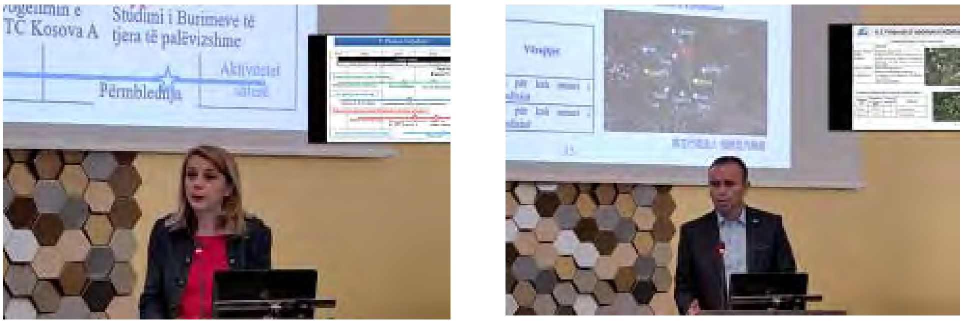
(Greeting by the Minister of MESPI)



(Greeting by the JICA Headquarters)



(Scenery of the venue)



(Scenery of presentations)

(Scenery of the stage and the group photograph)

Agendas

8:30 ~ 9:00	Registration	
9:00 ~ 09:20	Welcoming remarks Minister of Environment, Spatial Planning and Infrastructure: Mr. Liburn Aliu Director, Global Environmental Department, JICA: Ms. Chie SHIMODAIRA	
09:20 ~ 9:40	Introduction of the Project “Capacity development for air pollution control”	Ms. Visare Hoxha: DIPM/MESPI
9:40 ~ 10:10	Improvement of Air quality monitoring activities	Mr. Shkumbin SHALA: KHMI/MESPI
10:10~10:30	Coffee Break	
10:30 ~ 10:50	National Emission Reduction Plan in Kosovo and the current	Mr. Lulzim KORENICA: Ministry of Economy

	situation	
10:50~ 11:50	Emission measurement and Emission reduction measures for TPP Kosovo A	Mr. Agron Shala: KHMI/MESPI Mr. Sabri Simnica: KEK Mr. Drilon MEHA: University of Prishtina
11:50~ 12:50	Lunch	
12:50 ~ 13:20	Preparation for Emission Inventory in the Pristina Area	Mr. Afrim Berisha: KEPA/MESPI
13:20 ~ 13:50	Simulation for the air quality condition in the Pristina Area	Mrs. Letafete Latifi, KHMI
13:50 ~ 14:20	The evaluation of possible air pollution control measures	Ms. Albana Kashtanjeva DIPM /MESPI
14:20~ 14:40	Coffee Break	
14:40 ~ 15:05	Results of the Capacity Assessment	Mr. Fumihiko KUWAHARA: JET
15:05 ~ 15:30	Issues remained and Future direction for air pollution control (discussions)	Ms. Visare Hoxha: DIPM /MESPI
15:30 ~ 15:40	Closing remarks	JICA Balkan Office (Mr. Jiro TAKEICHI, Chief Representative, JICA Balkan Office)
15:40 ~ 15:50	Closing remarks	Secretary General of Environment Spatial Planning and Infrastructure: Mr. Izedin Bytyqi

Participants in the venue (random order)

	NAME	Organization
1	Liburn Aliu	Minister of Environment, Spatial Planning and Infrastructure
2	Izedin Bytyqi	Secretary General of MESPI
3	Mentor Shala	KHMI
4	Alban Shala	Translation-Center
5	Mimozë Veliu	Office of Prime Minister
6	Kastriot Halili	Office of Prime Minister
7	Florent Tahiri	KEK
8	Shpresa Kastrati	World Bank
9	Lulzim Mjekiqi	Municipality of Obiliq
10	Armend Agushi	KEPA
11	Jehona Mavraj	Municipality of Pristina
12	Shkumbin Shala	KHMI
13	Visare Hoxha	DEPW
14	Perparim Gashi	KEPA
15	Edmond Nulleshi	KEK
16	Blerim Morina	Termokos
17	Binasa Ukaj	Office of the Prime Minister
18	Ismet Dervari	MESPI/Inspectorate
19	Drilon Meha	University of Prishtina

20	Nijazi Miftari	Ministry of Internal Affairs
21	Agron Kelmendi	MFK/MCC
22	Sabit Restelica	MFK/MCC
23	Sabri Simnica	KEK
24	Naim Alidema	DEPW
25	Kastriot Abazi	KEK
26	Seniha Bajraktari	Municipality of Pristina
27	Beqir Gashi	KHMI
28	Letafete Latifi	KHMI
29	Donika Peja	KHMI
30	Agron Shala	KHMI
31	Arsim Mulaku	MESPI
32	Ajet Mahmuti	KEPA/MESPI
33	Afrim Berisha	KEPA/MESPI
34	Lulzim Korenica	Ministry of Economy
35	Ilir Jakupi	Interpreter
36	Xhelal Gashi	JICA
37	Nezakete Hakaj	JET/JICA
38	Kastriot Maxhuni	JET/JICA
39	Ardi Rexhepi	JET/JICA
40	Isak Kerolli	KEK
41	Albana Kashtanjeva	DEPW
42	Adem Tusha	DEPW
43	Kaltrina Drancolli	MESPI

Participants through internet (random order)

	NAME	Organization
Kosovo side		
1	Muhedin Nushi	Municipality of Prishtina
2	Dr. Antigona Ukëhaxhaj Dervishaj	National Public Health Institute of Kosovo
3	Përparim Kabashi	KEK
4	Luigj Imeri	KEK
Japanese side		
1	Mr. Taizo YAMADA	JICA Headquarters
2	Mr. Keita HARADA	JICA Headquarters
3	Mr. Chie SHIMODAIRA	JICA Headquarters
4	Mr. Jiro TAKEICHI	Chief Representative, JICA Balkan Office
5	Mr. Jun Hirashima	JICA Balkan Office
6	Mr. Masuto SHIMIZU	JICA Expert Team
7	Mr. Fumihiko KUWAHARA	JICA Expert Team
8	Mr. Ei EDO	JICA Expert Team
9	Mr. Toru TABATA	JICA Expert Team
10	Mr. Yasufumi NAKAJIMA	JICA Expert Team
11	Mr. Keiichi TAKAHASHI	JICA Expert Team

12	Mr. Kyoichi KAMEYAMA	JICA Expert Team

(2) Regional Conference for the Balkan Area

Date: June 23, 2021: 9:00~16:00

Venue: Emerald Hotel (Prishtina)

Republic of Northern Macedonia and Republic of Croatia participated in the Regional Conference as neighboring countries. The conference began with the greeting from the minister of MESPI and Ms. OGASAWARA (Charge d'Affairs, Embassy of Japan in Kosovo). The coordinator in each output made a presentation regarding its achievement. Furthermore, the officials from Northern Macedonia and Croatia presented the air quality status in their own countries. The Conference was carried out successfully. At the end, the conference was finished by the greeting from the Director of JICA Balkan Office.

The official from Northern Macedonia showed the interest in the research interviews carried out in the Project by which emission inventory data were supplemented, and the Kosovo side will exchange information with the Northern Macedonia later.

Presentation from the Northern Macedonia and Croatia were mainly air quality monitoring (kinds of monitored pollutants, and their historical trends and characteristics), response to the requirements of EU Directives, etc. As for the air quality monitoring, these countries seems to be very advanced in comparison to Kosovo. There were much information which will contribute to the future activities in Kosovo, and future communication with the information exchange should be facilitated.

Agendas and participants are described below.

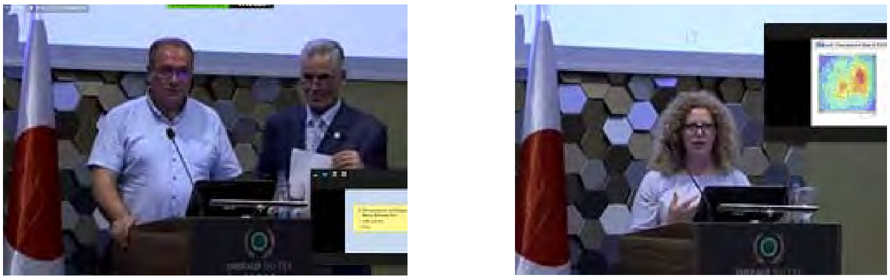
(Greeting by the Minister of MESPI)

(Greeting by the Charge d'Affairs, Embassy of Japan)

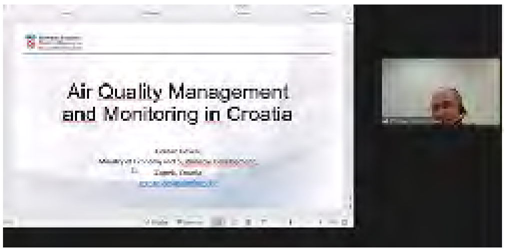
(Greeting by Headquarters)

(Greeting by the Chief Representative, JICA Balkan Office)

(Scenery of the venue: attended by the media)



(Scenery of presentations)



Air Quality Management
and Monitoring in Croatia

(Scenery of the presentation by North Macedonia)   (Scenery of the presentation by Croatia)

Agendas

8:30 ~ 9:00	Registration	
9:00 ~ 9:05	Explanation on the conference	Coordinator
9:05 ~ 9:15	Opening remarks	Minister, MESPI
9:15 ~ 9:20	Greetings speech	Mr. OGASAWARA Mitsunori Charge d'Affairs, Embassy of Japan in Kosovo
9:20~ 09:30	Opening remarks	JICA Head Office (Ms. Chie SHIMODAIRA, Director, Global Environmental Department, JICA)
9:30 ~ 9:55	Issues in air quality management in Kosovo and Introduction of the Project	Ms. Visare Hoxha: DPIP/MESPI

	"Capacity development for air pollution control"	
9:55~ 10:25	Improvement of Air quality monitoring activities	Mr. Shkumbin SHALA: KHMI/MESPI
10:25~10:40	Coffee Break	
10:40~11:00	National Emission Reduction Plan in Kosovo and current situation	Mr. Lulzim KORENICA: Ministry of Economy
10:55~ 11:25	Emission measurement and Emission reduction measure for TPP Kosovo A	Mr. Agron Shala: KHMI/MESPI Mr. Sabri Simnica: KEK
11:25 ~ 11:55	Preparation for Emission Inventory in the Pristina Area	Mr. Afrim Berisha: KEPA/MESPI
11:55~ 12:50	Lunch	
12:50 ~ 13:20	Simulation for the air quality condition in the Pristina Area	Ms. Letafete Latifi, MESPI/KEPA/ KHMI
13:20~ 13:50	The evaluation of possible air pollution control measures	Ms. Albana Kashtanjeva DPIP/MESPI
13:50~ 14:05	Coffee Break	
14:05~14:25	Status of air quality in Croatia	Mr. Gordon Dosen Ministry of Economy and Sustainable Development Republic of Croatia
14:45~15:05	Status of air quality in Northern Macedonia	Aleksandra Krsetska Ministry of environment and physical planning, Republic of Northern Macedonia
15:05~15:25	Discussion	
15:25~ 15:35	Closing remarks	Director of JICA Balkan Office (Mr. Jiro Takeichi)

Participants in the venue (random order)

	NAME	Organization
1	Liburn Aliu	Minister of Environment, Spatial Planning and Infrastructure
2	Gent Zeqiri	Minister Adviser
3	Rineta Jashari	Minister Adviser
4	Mitsunori Ogasawara	Japanese Embassy
5	Kay Kurimoto	Japanese Embassy
6	Mr. Jiro TAKEICHI	Chief Representative, JICA Balkan Office
7	Muhamet Malsiu	MESPI
8	Valerie Tucker	US Embassy

9	Yllka Binaj	US Embassy
10	Florije Kika	MESPI
11	Hana Imeri	MESPI
12	Nijazi Miftari	MIAPA/MIA
13	Armend Agushi	MESPI
14	Nexhat Jashari	GIZ
15	Mentor Shala	MESPI
16	Naim Alidema	MESPI
17	Perparim Terziu	MESPI
18	Perparim Gashi	MESPI
19	Albana Kashtanjeva	MESPI
20	Xhelal Gashi	JICA
21	Visare Hoxha	MESPI
22	Rron Gjyshinca	PR Solutions
23	Erdonite Hebibi	Journalist/Ekonomia Online
24	Seniha Bajraktari	Municipality of Prishtina
25	Murlan Jasiqi	Interpreter
26	Lulzim Korenica	ME
27	Shkumbin Shala	MESPI
28	Agron Shala	MESPI
29	Sabri Simnica	KEK
30	Arsim Mulaku	MESPI
31	Donika Peja	KHMI
32	Letafete Latifi	MESPI
33	Musli Kozhani	MESPI
34	Bujar Rexhepi	WHO
35	Enisa Serhati	UNDP
36	Afrim Berisha	MESPI
37	Vlora Spanca	MESPI
38	Ajet Mahmuti	MESPI
39	Florent Tahiri	KEK
40	Nehat Bojaxhiu	JICA PROJECT
41	Nezakete Hakaj	JET/JICA
42	Kastriot Maxhuni	JET/JICA
43	Ardi Rexhepi	JET/JICA
44	Feriz Teliqi	Interpreter
45	Ilir Jakupi	Interpreter
46	Bruno Neziraj	Interpreter

Participants through internet (random order)

	NAME	Organization
Participation from neighboring countries		
1	Aleksandra Krsetska	Ministry of environment and physical planning Republic of Northern Macedonia

2	Gordon Dosen	Head of Service for air, soil and light pollution and strategic affairs in the Ministry of Economy and Sustainable Development Republic of Croatia
Kosovo side		
1	Katrin Zimmer	SEPA
2	Kristian Silver	SEPA
3	Liridon Hajzeri	
Japanese side		
1	Mr. Taizo YAMADA	JICA Headquarters
2	Mr. Keita HARADA	JICA Headquarters
3	Mr. Chie SHIMODAIRA	JICA Headquarters
4	Mr. Jun Hirashima	JICA Balkan Office
5	Mr. Masuto SHIMIZU	JICA Expert Team
6	Mr. Fumihiko KUWAHARA	JICA Expert Team
7	Mr. Ei EDO	JICA Expert Team
8	Mr. Toru TABATA	JICA Expert Team
9	Mr. Yasufumi NAKAJIMA	JICA Expert Team
10	Mr. Keiichi TAKAHASHI	JICA Expert Team
11	Mr. Kyoichi KAMEYAMA	JICA Expert Team

3.11 Capacity Assessment

The Project conducted Capacity assessment from the first period to third period in order to study the change of capacity of the Kosovo side (C/P and C/P-WG).

Capacity assessment is aiming at providing indicators for as follows. The indicators must be the ones which can assess the capacity of individual level, organization level, and social level systematically regarding the overall goal and the project purpose through the implementation of the Project. In addition, the indicators are the ones through which one can understand the conditions of capacity development of the Kosovo side from the point of view of formation of self-sustained and constructive air quality management system.

The capacity assessment was carried out through the self-assessment test form by getting together all C/P and C/P-WG members on February 6, 2018 in the first period, on January 31, 2019 in the second period and February 25, 2020 in the third period. The tests had several questions to be answered by YES or NO, and then, the current capacity on the individual level, organization level, and institutions/society of each activity in the Project was assessed by themselves. The perfect score of each question item in the test was five points, and the scoring system was set so that the score is higher as the capacity is higher.

Comments on these evaluated results from the JET point of view are given as an attachment.

(1) Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side

Since the general understanding of C/Ps on emission inventory preparation progressed through activities from the first period, the scores at Individual level and Organizational level are high and have increased. On the other hand, since the development of collaboration with relevant organizations through actual data collection activities has not progressed sufficiently, the evaluation on the Social level is rather low. In the 3rd period, since there were many specific activities to prepare the emission inventory, such as carrying out OJT for calculating the emissions from each sector and conducting the calculation of emission reductions as part of the supporting activities for Output 8, C/Ps were able to objectively evaluate their capacities. Therefore, the scores of the self-evaluation in the third period did not raise so much. JET thinks that this is a good trend.

Comments on these evaluated results by JET are as follows.

	Starting point	Final point
Individual level	Although C/P knew the air pollutant emission inventory itself, they did not have sufficient knowledge on the concreate calculation method and did not have experience on preparing it.	C/Ps deepened the understanding of the whole activities for emission inventory preparation. In addition, since they carried out the series of calculation of emissions in each sector through OJT by themselves, their capacity was developing. However, in order to carry out the independent activities by C/Ps in the future, such as adding the target air pollutants, preparing national emission inventory and making improvement plan of the emission inventory, further capacity development is necessary.
Organizational level	MESPI/MESP did not have experience of preparing the air pollutant emission inventory.	Many C/Ps belong to KEPA (MESPI/MESP), and KEPA is preparing the emission inventory as an organization, and the capacity at organizational level is increasing. In addition, roles and responsibilities within KEPA became clear. However, there is a difference in individual abilities, and the actual situation is that the load on the competent people is increasing. In addition, the capacity of the organization to deepen collaboration with relevant organizations is still insufficient.
Social level	There was little understanding of air pollutant emission inventory.	Since regarding the data collection activity of emission inventory, the data is not sufficiently provided from the relevant organizations, the

		situation is not such that emission inventory is sufficiently prevailed at the social level. However, in the Project, C/Ps were able to prepare the emission inventory based on the data from the activities such as research interviews on actual fuel consumption condition in households and services, traffic counting, etc. in collaboration with targeted municipalities, the University of Prishtina, etc. These are the data obtained for the first time in Kosovo, and it they have become valuable data from administrative point of view. In the future, it is necessary to carry out activities such as the development of national emission inventory, the preparation of emission inventory by expanding target air pollutants, and utilization of the emission inventory by planning, studying, and evaluating the Measures in the Action Plan under the Strategy of Air Quality in Kosovo. It is expected that the understanding of emission inventory preparation will be further promoted through widespread public awareness and consultation with more relevant organizations.
Outcome	It is a great achievement that C/Ps has been able to carry out a series of calculation procedures on the emission inventory through OJT, such as collecting multiyear data, entering these data, calculating and coordinating emissions for each year, etc. It is a great progress that after understanding the concept of emission inventory C/Ps understood the significance of data collection and collected the data from the relevant organizations by themselves. In addition, in the C/P-WG, C/Ps informed on the situation where C/Ps were struggling in establishing the data providing system in collaboration with relevant organizations. Since C/Ps recognized the issues and tried to solve them, and it was clearly observed that they are independently tackling the issues. The emission inventory preparation manual prepared by JET includes not only emission calculation procedure but also the recommendation on the institutional framework including roles and responsibilities. These activities created a path for future work on emission inventory preparation.	

Issues / Proposals	The current challenges are that it is not easy to collect the data required for national emission inventories, it is not easy to prepare emission inventories for many target air pollutants required by EU, and the it is not easy for C/Ps themselves to calculate many emission sources. Therefore, the roles and responsibilities for not only KEPA but also the relevant organizations such as data providing organizations should be defined, and it is assumed that measures need to be taken to ensure that the preparation of the emission inventory is legally set as the MESPI/MESP activity... As an activity with legal basis, it is assumed that the emission inventory preparation will be set as an annual routine work and will be set as an essential activity when drafting the Action Plan under the Strategy of Air Quality in Kosovo. These are recommended in the Project.

(2) Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

In the aspect of exhaust gas measurement technology, the members of the measurement group have fully acquired measurement technology. They understood not only the principles of measurement but also the difficulties of measurement, and they reached the where they are able to conduct measurement by themselves.

Total two sets of measurement equipment (one set from the Precedent Activity and another from the Project) were handed over to the Kosovo side, and KHMI and KEK received each one set as both parties became able to conduct exhaust gas measurement. However, both KHMI and KEK are in the situation where the reinforcement of the staff is required in order to conduct measurement independently. Originally the Project planned to donate one more set of equipment to the Kosovo side in order to bring up private measurement agencies. However, since it is difficult for the government to support a specific private agency and there is no proper private agency in Kosovo, this was cancelled.

At present, there is no private agency which can conduct measurement properly. The establishment of the institutional framework where private facilities conduct measurement and report the results is far from being realized. The proper instructions by the officials in MESPI/MESP are desirable in order to enforce the law properly, and therefore, it is indispensable to enhance the knowledge on the exhaust gas measurement and emission reduction measures. Since KHMI acquired the exhaust gas measurement technology, the environment where MESPI/MESP can fully utilize this capacity and instruct private facilities properly is prepared. It is important for MESPI/MESP to develop the capacity and utilize the exhaust gas measurement technology.

Comments on these evaluated results by JET are as follows.

	Starting point	Final point
Individual	Technology transfer has	During the Project period, C/Ps repeated

level	started from the Precedent Activity. C/P had knowledge of measurement to some extent at the starting point.	measurement for LCPs through OJT and also conducted measurement for other stationary sources. Through these experiences, C/Ps have acquired sufficient ability.
Organizational level	One person from DEPW/DIPM, one from KHMI, and one from KEK have learned the technology. However, they have not reached the level to conduct measurement by themselves.	One from DEPW/DIPM, two from KHMI and two from KEK acquired the technology. Manuals for the works are organized and have become available. If these people cooperate, proper measurement can be conducted. Both KHMI and KEK possess the measurement equipment and they can conduct measurement independently. However, especially for the dust measurement at least three persons are needed and neither party can secure the necessary number of persons.
Social level	Neither MESPI/MESP nor private facilities fully understand the significance of exhaust gas measurement.	The law clearly obliges private facilities to conduct measurement and report the results, but in reality, the law is not enforced sufficiently. Members from DEPW/DIPM, KHMI and KEK understood the importance of the measurement. However, except the measurement group members, neither officials in MESPI/MESP nor private facilities understand the importance. The exhaust gas measurement, which is the base for the environmental administration has not been disseminated, and the institutional framework is not at the stage where it can be established.
Outcome	MESPI/MESP has organized the system where as a government can conduct measurement and confirm the results, and both KHMI and KEK possess a set of measurement equipment and operation manuals are organized and provided, which can enable them to conduct measurement independently. Measurement group members can conduct a series of works from preparation for measurement, measurement, tidying up equipment, organization of data, to drafting reports, and consequently, acquired the ability to conduct measurement properly. Especially members from KHMI can lead the measurement activity. However, especially for dust measurement, at least three persons are required, but both KHMI and KEK have two members for measurement, and both parties must reinforce their staff.	

	MESPI/MESP has acquired the measurement technology through KHMI, but it is an issue for MESPI/MESP how to utilize this capacity. The Project could not reach the stage to foster private measurement agencies. Therefore, the framework for dissemination of exhaust gas measurement was not prepared, and as a result, the institutional framework has not been established.
Issues / Proposals	The law of Kosovo clearly obliges facilities to conduct exhaust gas measurement and report the results, but in a reality the law is not enforced sufficiently, and this is a big issue. The cause is presumed to be that neither official in MESPI/MESP nor business operators (other stationary sources) understand the importance of exhaust gas measurement and even the exhaust gas measurement itself is not properly acknowledged in general. The exhaust gas measurement results are and effective tool used not only to manage emissions but also to confirm the functioning of the exhaust gas treatment equipment in case such equipment is installed. In order to expand the acknowledgement of the exhaust gas measurement, officials in charge in MEDSPE/MESP need to instruct private facilities the implementation of exhaust gas measurement. This requires for officials to enhance the knowledge and accumulate the experience on exhaust gas measurement and emission reduction measures. For this purpose, the OJT is thought to be the most appropriate way, in which trainees inspect each facility and conduct measurement by themselves, since each private facility usually have its own process and process flow, and may use different type of fuel. When MESPI/MESP acquires the ability to instruct private facilities through these activities, the implementation of exhaust gas measurement is disseminated and the base for fostering private measurement agencies is expected to be established.

(3) Output 3: Air quality monitoring activities are sustained

Output 3 includes activities related to air quality monitoring, that is air quality monitoring by AQMSs, air quality measurement with the portable device for emergency, the publishing of the monitoring results and the use of them for environmental awareness.

In general, levels were improved very much at individual level, organizational level and social level. The answers to the questionnaire from the first to the second question were significantly improved at the individual level, the organizational level, and the social level but from the 2nd to the 3rd question the level has decreased, except for the ambient air quality measurement by the portable equipment for emergency. During this period, AQMSs inspection, analyzer calibration training, AQMSs analyzer rehabilitation, AQMS maintenance manual preparation and training on the manual, and guideline for AQMSs placement were conducted. In particular, during the 3rd period, MCC/MFK replaced the analyzers in 7 AQMSs outside the Pristina area, installed meteorological equipment in all 12 AQMSs, conducted training, and received the acceptance inspection. SO, their schedule overlapped with the activity schedule of the Project. As result, the participation of C/Ps became quite limited. In addition, the donors prepared the TOR, for the rehabilitation of 5 AQMS in the Pristina area by JICA and for the replacement of equipment for 7 other AQMSs by MCC/MFK. This is considered to be the reason for the low evaluation at the organizational level and the social level, especially from the second to third period, except for the environmental air quality measurement by the portable equipment for emergency.

Accurate and reliable monitoring began in June 2019 with 5 AQMSs in the Pristina area and in November 2019 with 7 AQMSs in other areas. Finally all 12 AQMSs were rehabilitated with the assistance of donors. However, at this inspection the abnormal values of the measurement data of the analyzer have not been detected and evaluated at a sufficient level. Therefore, it cannot be considered that the capacity to find out the analyzer failure from the data has been established.

Regarding the data displays, the Project installed them in four locations in the city of Pristina and in one location in the city of Obiliq. The number of citizens showing interest and stopping in front of the display is increasing, and the installation of displays has been reported in newspapers and television. It is necessary to increase the number of staff in charge of air quality monitoring and secure a stable budget for O&M.

Comments on these evaluated results by JET are as follows

	Starting point	Final point
Individual level	The staff of KHMI performed only very simple tasks such as replacing the dust removal filter, etc. other than managing the contractor in charge of maintenance. KHMI had neither the equipment nor the knowledge regarding the environmental air quality measurement for emergency.	C/P understood the principle of calibration of NOx, SO_2, CO and O_3 analyzers, and became able to calibrate these analyzers. But OJT is still necessary. Furthermore, it is necessary to have training on distinguishing the normal data from the abnormal data, and to find the failure of the analyzers. On the other hand, it has become possible to measure the ambient air pollution by portable equipment for emergencies.
Organizational level	The twelve AQMSs were installed from 2009 to 2012. Before the Project started, MESPI/MESP's budget for AQMS maintenance was approximately 60,000 Euro	The budget for O&M in 2017 has been increased to about 150,000 Euros, and analyzers in more than half of AQMS have retrieved their functions. Furthermore, rehabilitation by the Project has been implemented, and it can be considered that

	for eight years in the row. As of October 2017, at the start of the Project, only 4 AQMSs out of 12 AQMS in Kosovo were in operation. Moreover, the calibration of the analyzers had not been performed for many years.	reliable air quality data can be provided from five AQMSs in the Pristina areas. Following JICA, MCC/MFK replaced analyzers of the remaining 7 AQMSs in November 2019, and as result the air quality monitoring system for all 12 stations in Kosovo was reestablished. At this moment, two KHMI staff must maintain and manage all twelve AQMSs. Two persons are insufficient to conduct all O&M works. These two people are also in charge of laboratory works, so it is necessary to employ at least one more person.
Social level	The staff of KHMI performed only very simple tasks such as replacing the dust removal filter, etc. other than managing the contractor in charge of maintenance. KHMI had neither the equipment nor the knowledge regarding the environmental air quality measurement for emergency.	On the other hand, in the end of January 2018, highly polluted air condition occurred around the Pristina Area for approximately one week. It became a major social issue and concern of citizens. This became one of the reasons that budget was allocated to AQMS maintenance. The Project installed data displays that show real-time air pollution information at four locations in Pristina city and one location in Obiliq. On the other hand, the MCC/MFK integrated the air quality data network from all twelve AQMSs and these data became available to the public through the internet that followed the EC network. The social-level impact for air quality monitoring is now increasing.
Outcome	Outcomes are: The following works necessary for O&M of AQMS were conducted, 1) Rehabilitation/overhaul of analyzers in 5 AQMS in Pristina area, 2) Preparation of standard gases and calibrator required for analyzer calibration, 3) C/P have learned how to calibrate analyzers, 4) Replacement of 3 housings that were inappropriate for maintenance, 5) OJT on repair of analyzers, 6) Preparation of maintenance manual, 7) Guideline for AQMS proper placement, 8) Drill and SOP for using portable devices for emergency. It is considered that the air quality monitoring can be finally conducted with a certain degree of reliability, and the needs for repairs can be met. Furthermore, the Project installed displays in four locations in the city of Pristina and in one location in the city of Obiliq. The number of citizens showing interest and stopping in front of the displays is increasing, and the installation of displays has been reported in	

	newspapers and television. In addition, as a result of the EC data network and the MCC/MFK data network that succeeded the EC one, the general public can now check the level of air pollution in real time through the smartphone app. On the other hand, there have been very few opportunities to scrutinize the air quality data, and thus, it is very difficult for C/P to judge whether it is normal data or abnormal data, and to judge the failure of the analyzer. These are the future issues. Furthermore, systematic maintenance and budget management, such as creating the device management ledger and keeping calibration records for each device, will be a major issue from now on.
Issues / Proposals	From February to April 2019, one person with the experience on AQMS O&M joined as a member, however at the same time one person in charge was relieved of this work. As a result the number of the persons in charge remained the same. Two C/Ps in charge of AQMS at KHMI are not dedicated only to O&M of AQMSs, but also perform soil monitoring, IC analysis, attend the workshops organized overseas, attend meetings, etc. At present, maintenance companies in Kosovo do not have the ability to properly calibrate NOx analyzers, SO_2 analyzers, O_3 analyzers and CO analyzers. It is necessary to transfer technology of calibration. Sustainable maintenance is difficult without at least one more person. Regarding the air quality data displays, it is necessary to secure the budget for continuous stable operation.

(4) Output 4: Capabilities for relevant environmental laboratory analyses are developed for emission measurements and air quality monitoring.

Output 4 consists of the acquisition of laboratory analysis technology (4-1～4-6) through exhaust gas measurement by Standard Reference Method and evaluation (4-7～4-10) for heavy metal analysis in PM in the air.

As for laboratory analysis, in the first period, C/P did not have any knowledge on Standard Reference Method and therefore, the scores were low. In the second period, although the capacity assessment was carried out before the activities, but since C/Ps thought that they can acquire the technology soon, the evaluations seemed to have high scores.

In the last half of the second period, the Project supported the re-functionalization and adjustment of the IC and the adjustment of the AAS. Furthermore, the Project carried out the exhaust gas analysis by Standard Reference Method. In the third period, C/P themselves requested additional training, and deepened the knowledge on handling not only the IC but also the ICP-MS. At the same time, they acquired the technology to properly conduct exhaust gas analysis by Standard Reference Method.

However, the application of Standard Reference Method is limited since only EU directive, which is the base of NERP, demands this method for LCPs in Kosovo, and the IC is possessed only by KHMI. On the other hand, this analysis technology can be applicable to analysis for water quality, and the analysis technology in KHMI, including the re-functionalization of ICP-MS, has been improved. Future needs for these analyses should be clarified, and it is desirable to expand the application of these technologies.

However the problem is the number of staff in charge. Only one person can carry out these analyses, and at least one more person is needed. It is also very important to secure the budget. These analyses require not only for the maintenance of analyzers but also the procurement of standard solutions and many consumables such as reagents, and auxiliary equipment.

At the same time, KHMI as an institution aims at acquiring the EN17025, but it is very far from the establishment of the system, and there remain many issues to be solved. In order to solve the issues, KHMI must start to take the basic measures such as the reinforcement of staff, strengthening the management system for analysis room and analyzers, etc.

As for evaluation of heavy metal analysis in PM in the air, the Project sampled PM in the air, brought them back to Japan and analyzed them in the first period. As a result, Kosovo side decided to monitor heavy metals in PM in the air. In addition, because the factory that could be a pollution source was not operating during the 1st sampling, additional sampling was conducted in the 2nd period and samples were analyzed again in Japan. As a result, Kosovo side decided to monitor heavy metals in PM in the air in Drenas and Mitrovica. Thus, C/P acquired the technology of sampling. On the other hand, heavy metal analysis required the functionalization of the ICP-MS which C/P possesses in KHMI. KHMI has never operated the ICP-MS since it was brought to KHMI, and therefore the level of evaluation was low at the first period. As a result of the subsequent project adjustments, during the 2nd and 3rd period, repairs of ICP-MS, adjustments for heavy metal analysis, and troubleshooting of the phenomenon of plasma shutdown were conducted with one C/P in the activities of the Project. It is the reason why the evaluation has risen in the second period. MCC/MFK is scheduled to train the staff in KHMI through its project. But training is delayed due to Covid-19. Comments on these evaluated results by JET are as follows.

Standard Reference Method and laboratory analysis		
	Starting point	Final point
Individual level	C/P did not understand what Standard Reference Method is. The IC (same as the ICP-MS) had not been operated for six to seven years since it was brought in KHMI around 2012.	C/P experienced Standard Reference Method, understood the principles and acquired the operation techniques. In parallel, the IC was re-functionalized and C/P learned its operation. At the same time, the ICP-MS was re-functionalized too.
Organizational	C/P could not analyze	C/Ps learned analysis of exhaust gas by

level	exhaust gas by Standard Reference Method. C/P could not operate the IC (same as the ICP-MS) either.	Standard Reference Method. Two persons in KHMI can use the IC for analysis. However, in the process from gas sampling to analysis, only one staff can conduct gas sampling, and only one can use the IC for analysis. Therefore, it is very hard to carry out these analyses sustainably. As for ICP-MS, only the same staff who can operate the IC can also operate the ICP-MS.
Social level	So far, only the AAS had been operated, and its application range for analysis is very small. Besides, this output is almost completely occupied by technical elements. Therefore, recognition at the social level is very low.	The starting of the operation of IC made it possible to conduct exhaust gas analysis by Standard Reference Method for LCPs required by EU Directive which is the base for the NERP. The IC and ICP-MS were re-functionalized and the analysis capability of KHMI has improved a lot. However, KHMI does not have any other application plan except the duties carried out in the Project (IC: exhaust gas analysis by Standard Reference Method, ICP-MS: heavy metal analysis in PM in the air). It cannot be said that these analyzers are sufficiently utilized. It is necessary to expand the application range of analyzers.
Outcome	KHMI as a laboratory has acquired the basic technologies for analysis, and these activities produced good results. The Project re-functionalized the IC and ICP-MS, and provided a set of necessary standard solutions, auxiliary equipment, etc. therefore, the analysis can be continued for a while. The application of these analyzes are broad and they are applicable for various analyses. It was necessary to conduct analyses for the works conducted in the Project, since Standard Reference Method is required by the EU directive for exhaust gas measurement for LCPs, and it is also needed for the monitoring of heavy metals in PM in the air.	
Issues / Proposals	KHMI acquired the IC and ICP-MS operation techniques. However, there is only one staff who can do analysis, and at least one more staff is needed. It is also very important to secure the budget for regular maintenance of analyzers, consumables, auxiliary equipment, etc. Analyzes for the sustainable implementation of Project activities are certainly necessary, but it is difficult to	

	say that KHMI has mastered the technology for analysis only by performing these analyzes. KHMI so far has hoped that the various analyzers will be re-functionalized, but only has hoped for the re-functionalization, while there is no other application plan of analyzers except the duties carried out in the Project. It is hard to say that KHMI utilizes the analyzers well. It is necessary to expand their application. In order to establish the analysis system, the following activities are required. 1) In order to use the newly acquired analysis technology, it is necessary to expand the application of analysis and continue with them. At the same time, it is indispensable to reinforce the staff and establish the system for analysis. 2) Existing condition in laboratory shows that it is not well managed, for example the equipment for analysis is not well prepared, analysis room is not kept clean sufficiently (high risk of contamination), analyzers, analyses, reagents, etc. are not well managed. The availability of the analyzers is very low in the present condition, and there is no improvement of the analysis technology any more, and at the same time, the analyzers may become not-operational because of the features of analyzers which are kept in normal condition by continuous use. In order to solve these issues, KHMI must start from the basic measures such as the reinforcement of the staff, strengthening of the management system for cleanliness of the analysis room, well maintained analyzers, etc.

Monitoring of heavy metals in PM in the air		
	Starting point	Final point
Individual level	Sampling device (low volume sampler) was donated by EC in 2011 ~ 2012, but C/P had no experience to sample PM by themselves.	The Project handed over high volume sampler and C/P became able to conduct PM (TSP) sampling. However, analysis of heavy metals in PM is conducted in Japan. It was confirmed that the low volume sampler introduced in the past was not working properly. At the individual level, C/Ps have not yet acquired the whole technology including the heavy metal analysis. The training by MCC/MFK for ICP-MS operation is expected.
Organizational level	C/P did not have capacity to conduct sampling of PM and analysis of heavy metals	C/P became able to conduct sampling, and the sampling was conducted by the high volume sampler by the Japanese method. The Kosovo

	in PM by themselves.	side hopes to use the low volume sampler for sampling of PM_{10} in accordance with EU standard, but since the low volume sampler is not available, until the procurement of the low volume sampler, the Kosovo side is going to use high volume sampler. As for heavy metal analysis, through the activities of the Project, one C/P became able to repair the ICP-MS, make adjustments for heavy metal analysis, and deal with troubles related to the plasma shut down. KHMI is waiting for ICP-MS training by MCC/MFK.
Social level	Kosovo has abundant resources of heavy metals, and there is a concern on heavy metal contamination by industries.	Concerns are high, and analysis results of daily average showed the existence of heavy metals higher than Japanese guideline values (annual average) in PM in the air. C/P decided to continue heavy metal monitoring. MESPI/MESP has not disclosed the existence of heavy metals in PM in the air yet.
Outcome	C/P became able to conduct sampling of PM in the air, but still could not analyze heavy metals in the air. Moreover, KHMI possesses the low volume sampler, which is EU standard method, but it was confirmed that it does not to work properly. Therefore, the Project recommended using the high volume sampler tentatively. The project functionalized ICP-MS and the training for ICP-MS by MCC/MFK is scheduled. However, same as mentioned above, the number of personnel in charge is insufficient and at the same time more experience is required for analysis. Furthermore, there is an issue that the conditions in laboratory are not well organized for conducting analysis. In addition, the operation of ICP-MS requires budgetary support such as continuous purchase of argon gas and the purchase of additional consumables by MESPI/MESP.	
Issues / Proposals	The heavy metal level in PM in the air should to be evaluated on annual average basis, so it is desirable to perform sampling and analysis once a month. It is necessary to conduct sampling and analysis at least four times a year and calculate the annual average. Therefore, at least one more staff is required. In order to conduct heavy metal analysis in line with the EU standard, the sampling of PM_{10} is required, and for this reason the acquisition of low volume sampler is necessary. However, the sampling method by the low volume sampler	

	is the same as the one by the high volume sampler, and therefore, there is no problem with sampling. Although, it is currently delayed due to Covid-19, but ICP-MS will be put into operation after training by MCC/MFK. The Kosovo side has not yet published the analysis results regarding heavy metals in the air. MESPI/MESP is planning to make it public after the discussion with the municipality of Drenas and Mitrovica. It is desirable to handle this issue as earliest possible.

(5) Output 5: Capabilities for air quality simulation modeling are developed.

Output 5 was aimed at developing technical capacity for air pollution simulation modeling. The C/P has learnt the purpose of the simulation model, how to operate the program, and how to analyze air pollution conditions by creating concentration distribution maps using GIS. Some C/Ps were able to operate and execute the program on their own under the guidance of JET, but they have not yet reached the level where they can calculate the simulation model independently, including finding and dealing with errors. In order to gain further experience and maintain/improve the technical skills, it is very important to stipulate the tasks to establish and utilizing the simulation model in the job description of MESPI/MESP as well as individual efforts.

The following is a summary of the current situation from the point of view of JET.

	Starting point	Final point
Individual level	C/Ps had almost no knowledge/experience with the simulation model, just a few C/Ps knew the result of simulation model implemented by other donors. The capacity of handling PC and excel calculation was not sufficient either.	Some of the C/P became to be able to operate the programs under JET's instruction. However, the meaning of each manipulation is not fully understood.
Organizational level	Both MESPI/MESP and KHMI are interested in the simulation model. At the starting point, KHMI was to be the primary organization to do this activity	C/P from both MESPI/MESP and KHMI have joined the trainings well, and both organizations are cooperative to this activity so far. On the other hand, in order to keep the capacity after the project, it is recommended that the job description of MESPI/MESP should stipulate the simulation model task.

Social level	Although citizens are highly interested in the causes of the air pollution, simulation model is not familiar as a tool to analyze that.	No change from the starting point The simulation modeling is not used for the evaluation of air pollution control measures, information disclosure to the public, etc. Since concentration map is a useful tool for dissemination of information to the public, it is recommended that the simulation modeling is utilized for drafting the MESPI/MESP Action Plan for air pollution control, and for information disclosure and communication with the public.
Outcome	The C/P has learnt the purpose of the simulation model, how to operate the program, and how to analyze air pollution conditions by creating concentration distribution maps using GIS. Some of the C/P came to be able to execute the programs using simulation modeling manual under JET's guidance, through a series of practical exercises. At the organizational level, the simulation working group, organized mainly from KHMI members and in cooperation with KEPA staff, was organized and ready to operate simulation modeling including collecting data and GIS manipulation. On the other hand, in order to keep and maintain the capacity after the project, it is recommended that the job description of MESPI/MESP should stipulate the simulation model task.	
Issues / Proposals	Only the basic items in the CALPUFF program have been trained in this project, and this does not address the applied content. Individuals within C/P vary in their achievement of technical competence, and only a few C/Ps have the ability to execute the simulation model on their own by using the manual. A deeper understanding of the content of the calculations and the interpretation of the results still remains as an issue. At the organizational level, the C/P's job description does not include the implementation of the simulation model as part of their duties. To maintain the system and capability to conduct simulations after the completion of the project, the task should be specified in the job regulations of the ministry in order to clarify the roles and responsibilities of each related organization. It is necessary to clarify the purposes and situations in which the simulation model can be utilized and to reach consensus among related organizations. When issues related to the capacity and systems to implement the simulation modeling are resolved, it will be possible to use the simulation model for evaluation of air pollution control measures and information disclosure to the public.	

(6) Output 6: Decision making by Kosovo side is improved based on technical evidence for air pollution control.

Output 6 was aiming for C/P to understand emission reduction measures for LCPs and other stationary sources and to study and instruct measures by themselves. KEK staff deepened their understanding on the study of the emission reduction measures for LCPs through the process implemented in TPP Kosovo A where the Project studied, proposed and implemented emission reduction measures. As for the Dust, the reduction measures were proposed and accepted. The proposal resulted in the implementation of the modification. However, the reduction measures for SO_2 and NO_X need not a little investment, and it is hard to realize them. At this moment, the investment in TPP Kosovo A is limited and difficult because of the scheduled shutdown in 2023 in line with commencement of TPP Kosova e Re.

On the other hand, as for other stationary sources, the reality of the situation has become obvious through the exhaust gas measurement and the study on emission reduction measures by the Project, where the implementation of the exhaust gas measurement and reporting is not fully carried out, or the measurement results are not accurate even though measurement is conducted. This is presumed to be caused by the fact that MESPI/MESP as the competent authority cannot probe the measurement reporting results, judge the adequacy of the results, etc. The enhancement of the capacity of the officials in charge in MESPI/MESP is the future issue, where officials in charge improve the knowledge and experience on measurement and emission reduction measures, and at the same time inspect the measurement results by utilizing the exhaust gas measurement capability acquired by KHMI, etc.

Comments on these evaluated results by JET are as follows.

	Starting point	Final point
Individual level	Persons in charge had little knowledge on emission reduction measures for LCPs and other stationary sources.	Seminars, etc. on emission reduction measures were repeated many times during the Project period. Staff in charge in KEK have improved their knowledge and deepened the understanding. However, the officials in charge in MESPI/MESP do not understand well and they have just started to realize the lack of knowledge.
Organizational level	Laws regarding emission regulation and obligation of reporting emissions are well organized, but these laws are not well enforced.	At TPP Kosovo A, because of the scheduled shutdown in line with commencement of TPP Kosova e Re in the future, it is hard to invest, and therefore, the plants cannot comply with ELVs and no measures can be taken. As for other stationary sources, officials in

		MESPI/MESP did not reach the level to instruct private facilities on improvements from the technical point of view, and at the same time, operators of private facilities do not recognize the importance of the exhaust gas measurement, etc. Now it is not a situation where the law is enforced well.
Social level	As for stationary sources, the concern especially for dust is very high because of the complaints by population. Bur they do not have sufficient knowledge on SO_2 and NO_X. The concern for $PM_{2.5}$ is very high.	MESPI/MESP is lacking the capacity to instruct LCPs and other stationary sources. There are many complains from the citizens about LCPs, but the emission reduction measures are going to be implemented with the support of EU. On the other hand, officials in MESPI/MESP do not instruct properly private facilities (other stationary sources). Currently in Kosovo industries are not very developed, and therefore, the concern by both MESPI/MESP and citizens is not high for other stationary sources.
Outcome	As for TPP Kosovo A, the Project proposed dust reduction measures with the smallest possible investments. The proposals are in the way to be implemented, and part of the modification has been applied. These measures were studied in collaboration with the UP, and the study results were applied, and it became one of the large outcomes. Reduction measures for SO_2 and NO_X are also proposed, but it is very hard to apply them because of the amount of investment needed. On the other hand, as for other stationary sources, from the results of the exhaust gas measurement conducted by the Project for other stationary sources, it became obvious that most facilities do not comply with their ELVs. The actual situation also became clear that both MESPI/MESP as the competent authority and operators of private facilities do not acknowledge the importance of the measurement and do not control the emissions. It is found that officials in MESPI/MESP should enhance the knowledge on exhaust gas measurement and emission reduction measures, which will lead to the acquisition of the capacity to instruct private facilities.	
Issues / Proposals	Dust reduction measures for TPP Kosovo A are now being applied, but the application of reduction measures for SO_2 and NO_X is very difficult to implement because of the plan for construction of TPP Kosova e Re. The	

	rehabilitation of TPP Kosovo B is now on-going, and it is necessary to follow the progress. On the other hand, at present the plan for construction of TPP Kosova e Re is pending, and it is necessary to keep a close eye on the response of the government, including the review of the NERP. As for other stationary sources, it is necessary for MESPI/MESP to instruct other stationary sources to conduct exhaust gas measurement, so first of all understand the emission condition from each private facility and instruct them. In order to realize this, it is indispensable for officials in MESPI/MESP to gain knowledge on exhaust gas measurement and emission reduction measures. The instructions through OJT, such as when inspecting the facilities and conducting the measurement, since each private facility has its own process, process flow, consumed fuel, etc. must be the most appropriate for the enhancement of the capability.

(7) Output 7: Emission control measures are developed at LCPs.

In output 7, since the exhaust gas property frequently varies by the property of Lignite which is the fuel of LCP, the aim is to clarify the behavior of exhaust gas and understand the basic theory about emission reduction measures so that they can develop the measures which can be achieved by the operation method of the boiler and the small-scale investment by themselves

As for Dust reduction measures, it is expected that Dust could be in compliance with ELVs if the ESP performance improvement measures based on the results of various tests conducted in this Project are implemented.

Items that should be implemented on the ESP side are already proceeding through actual modification, but the measures to reduce the amount of the exhaust gas that should be implemented on the boiler side (such as reducing the amount of leaked air in the air preheater) have not been implemented because investment is required. On the other hand, at present the plan for construction of TPP Kosova e Re is pending, and it is necessary to keep a close eye on the response of the government, including the review of the NERP.

Regarding the measures to reduce SO_2 and NOx, it is difficult to reach the level of compliance with ELVs only by improving the operation method of the boiler. The measures have been proposed based on the test results, but they are quite difficult to implement because they require investments. The reason is that the investments in TPP Kosovo A are currently limited as it is scheduled to be stopped in 2023.

Through the process of the examination, proposals for the improvement and the implementation of the emission reduction measures in TPP Kosovo A, C/P understand the actual conditions of the exhaust gas properties in LCP and the way how to proceed with the measures for emission control.

Regarding the emission reduction measures for LCPs, in addition to knowledge on the exhaust gas measurement, a broad knowledge on the boiler and auxiliary equipment is required. Although the number of C/P that can understand all of it is limited, it is considered that the key person has reached the level in which the study on the emission reduction measures implemented in this project can be executed even if the JET is not present.

In the 3rd period, JET provided support from Japan so that the C/P could continue with their activities. As a result, the overall score of the assessment in comparison to the second period result is higher, and it is thought that this is due to the enthusiasm of C/P for preventing air pollution.

Comments on these evaluated results by JET are as follows.

	Starting point	Final point
Individual level	The person in charge has little technical knowledge about LCP emission reduction.	Education through seminars etc. was repeated. The personnel in TPP Kosovo A had a better understanding. However, the persons in charge of MESPI/MESP have not deepened their understanding and are at the stage of recognizing the lack of knowledge. Emission reduction measures by the boiler operation are basic measures that do not require investment, but only few of C/Ps have knowledge on boiler operation, and personnel other than TPP Kosovo A are less interested.
Organizational level	Although there are laws and regulations relating to emission regulation, there are some aspects that cannot be actually enforced.	MESPI/MESP is not at the level where it can provide the guidance for facilities, etc. from a technical point of view, whereas on the other hand, KEK is deepening its technical knowledge. The TPP Kosovo A is unable to comply with ELVs due to investment restrictions, the plans to be stopped in the future, etc.
Social level	Regarding LCPs, there is a great interest for Dust, because it is visible and there are complaints from the residents, but there is a little interest for SO_2 and NOx.	MESPI/MESP lacks the ability to provide the technical guidance to LCPs, and is not able to respond sufficiently. In particular, complaints from residents to KEK are quite great in number, and although the Dust emission reduction by the rehabilitation of TPP Kosovo B is planned, the ability to evaluate the equipment that will be installed is insufficient. Investing in environmental measures affects

		the electricity tariffs, but it seems that consumers do not have enough understanding on the issue. As for the improvement of ESPs, study results through collaboration between industry, academy and government have been applied, and it has become one of the big outcomes of the Project.
Outcome	The emission reduction measures for LCP differ for each plant. Therefore, the judgment on emission values and the technical knowledge are required, but there is a shortage of human resources with that knowledge. As for the emission reduction measures by improving the boiler operation method, C/P in charge of TPP Kosovo A has almost reached the level where he can carry out the examined by himself, and they will be able to find ways to manage emissions and operate the boiler in order to reduce emissions possibly with the current equipment. As for TPP Kosovo A, SO_2 and NOx reduction methods by improving the boiler operation method and Dust reduction measures that can be implemented with a small investment are proposed and are being implemented. Some improvements have already been applied to ESPs based on the results of the study conducted in this Project through industry-academy collaboration with the University of Pristina, and this was a big result of the Project. Proposals have been made regarding SO_2 and NOx reduction measures, but these require considerable investments and are difficult to apply, as they involve the modification of the boiler.	
Issues / Proposals	Regarding the emission reduction for LCPs, the rehabilitation of TPP Kosovo B, the construction of the new Power Plant (TPP Kosova e Re), the stopping of TPP Kosovo A due to operation of the new Power Plant are scheduled to be completed around 2023. Therefore, the measures for emission reductions in TPP Kosovo A have the problems of financial nature (financing and impact on electricity tariff), and it is a major problem as their implementation is not easy. Emission reduction measures by improving the boiler operation method are basic measures that do not require investment, and they can also be applied to TPP Kosovo B, which will continue to operate. When introducing the environmental equipment in the future, it is important to reduce the emissions from the boiler as much as possible in order to minimize the cost of the emission reduction equipment.	

(8) Output 8: Capabilities for evaluating air pollution control measures of Kosovo side are developed

The activities of Output 8 started in earnest in the middle of the second period, and fairly concentrated activities were carried out in the third period. In the second period, the reviews of the Measures prepared already in Kosovo and other JICA project were mainly focused, but in the third period, planning the Measures, calculation of emission reductions and cost-effectiveness for the Measures by using the emission inventory, study of implementation method and issues for the Measures, were considered more broadly, and the results were summarized as the evaluation sheet for the Measures. Since through these activities the capacity was developed and the challenges for implementing the Measures were clarified, the capacity development was enhanced at the individual level, organizational level, and social level, and the lacking fields were clarified. This was reflected in the score of the self-evaluation test.

The evaluation of the capacity development of C/Ps judged by JET is summarized as follows.

	Starting point	Final point
Individual level	C/Ps were able to draft the Measures, but they were not able to fully evaluate technical, economic and social viability of the Measures.	Through the preparation of the evaluation sheet for the Measures, the understanding of the need for scientific and technical evidence in the planning, studying and evaluating the Measures was deepened. At the same time, C/Ps deepened understanding of socio-economic considerations. Through the Project, C/Ps were able to deepen their understanding of the roles for the government on the Measures. On the other hand, there is not enough experience of C/Ps for planning, studying, evaluating and implementing the Measures independently in the future.
Organizational level	It was a situation where measures were considered not as MESPI/MESP but as individuals. In addition, it was not a situation where measures were drafted by considering technical, economic and social viability.	Since activities such as quantification of emission reductions using emission inventory and study of results of simulation modeling were shared through the preparation of the evaluation sheet for Measures, the capacity development at the organizational level was enhanced. However, MEDSPE/MESP is still in the stage of trying to establish the institutional

		framework for the Measures, and it is not able to systematically and independently plan, study, evaluate, and implement the Measures in the future.
Social level	Although the needs for the Measures were understood, there was little understanding of concreate measures.	Since through the Project, which included the preparation activities on the Evaluation Sheet for Measures the activities for planning, studying, evaluating and implementing the Measure were carried out through discussions and consultations with the relevant organizations, the capacity at the social level was enhanced. In addition, through the Project activities covered by mass media, such as large scale field research by many students under the Project, etc., the understanding at the social level is gradually advancing.
Outcome	Since through the preparation of the evaluation sheet for the Measures, quantification of emission reductions and cost-effectiveness, the consideration of implementation method and issue, the evaluation on technical and social aspect, etc. are carried out, the capacity for each process of the Measures such as planning, studying, evaluating and implementing the Measures was enhanced. By utilizing the 17 Goals of SDGs as indicators of evaluation on social level for the Measures, C/Ps was able to evaluate the social effects of the Measures objectively not arbitrarily. Since the quantification of the emission reductions was calculated by utilizing the emission inventory, C/Ps with support of JET were able to set the calculation condition and calculate the emission reductions by themselves in collaboration with the group of Output 1. At the same time, C/Ps with support of JET were able to calculate and evaluate the cost-effectiveness according to the emission reduction scenario by discussing the cost of calculation conditions. Regarding the implementation method for the Measures, deeper discussions related to the measures were able to be carried out by consulting not only C/P members but also the traffic police (MIAPA/MIA) and the district heating company (Termokos).	
Issues / Proposals	Since the outputs of the Project will be shared with society in the future and activities of oversea donors such as MCC/MFK are also advancing, it is expected that the future understanding of the Measures at the social level will advance.	

	Since the C/P leader, who has been proactively implementing the plan of the Measures in MESPI/MESP, retired from MESPI/MESP before the start of the third period, the new person in charge of the Measures lacked experience. However, since the Project hired this previous leader as a local consultant and provided the fields of deepened discussions, the work for the Measures was able to be taken over. In the future, it will be necessary to enhance the capacity mainly focusing on this new person. In the future, it will be necessary to carry out planning, studying, evaluating, and implementing the nationwide Measures. In order to do so, it is necessary to consider the Measures for many fields such as manufacturing industry category, agriculture sector and waste sector, which have not been fully considered in the Project. In addition, regarding the Measures considered by the Project, support for planning, studying, evaluating, and implementing the further Measures, by using more detailed evidence such as consideration of the Measures according to the actual emission performance in Kosovo and according to the region, is necessary.

3.12 Public relations activity and presentations to the ministers

The Project has presented the content of the Project to the Minister of MESPI/MESP and asked for the cooperation. The Project has also actively provided information to the public through media.

Activities were publication of newsletters, cooperation on the media reports, etc.

3.12.1 Presentations to ministers

During the Project period, the minister of MESPI/MESP changed four times because of the replacement and/or change of the government. The content of the presentations to ministers is shown below. The presentations are attached in Appendix-1.

(1) The first presentation to the minister (Ms. Albena RESHITAJ)
November 1 (Wed), 2017

The planned activities were presented to the minister and the minister gave some comments to the Project. After the presentation, the minister made an announcement to the public through press release.

(2) The second presentation to the minister (Ms. Albena RESHITAJ)
February 12 (Mon), 2018

There was a sudden proposal for the meeting from the minister regarding air pollution that occurred in the end of January and the content of the Project regarding air pollution control was presented.

The Project presented mainly the content of three fields being implemented at that moment.


(3) The third presentation to the minister (Ms. Albena RESHITAJ)
July 11 (Wed), 2018

The results of the Project activities in the first period and the planned activities for the second period were presented. After the presentation, there was an announcement for the press release.


(4) The fourth presentation to the minister (Mr. Fatmir MATOSHI)
October 29 (Mon), 2018

The new minister was appointed (after the resignation of the previous minister), and the overview of the Project and the progress of the activities in the field of the emission inventory were presented to the Minister.


(5) The fifth presentation to the minister (Mr. Fatmir MATOSHI)
June 25 (Tue), 2018

The simulation results reported in the fourth JCC meeting were presented the minister. During the presentation, the Project explained that the simulation results had items to be studied more and it was necessary to handle the results very carefully.

(6) The sixth presentation to the minister (Mr. Lumir ABDIXHIKU)
February 19 (Wed), 2020

JET attended the greeting meeting for the new minister by JICA Balkan office chief representative. After the representative made the presentation on JICA activities, the Project explained the Project activities during the short given time.

(7) The seventh presentation to the minister (Mr. Liburn ALIU)
May 11 (Tue), 2021

Kosovo had the general parliament election in February 2021, and the government changed and the new government has taken the office. Because of this change, a virtual meeting was held. JICA Head Office and JICA Balkan Office introduced the overview of JICA activities and activities in Kosovo to the new Minister (Mr. Liburn Aliu) and the Secretary General (Mr. Izedin Bytyqi). At the same time, cooperation for the activities such as Final Seminar, etc. was requested. The minister gave the address of gratitude to the Project activities and showed a will for cooperation.

3.12.2 Newsletters

The Project published four newsletters. They are attached in Appendix-3. Since the Project activities focused mainly on the establishment of the database for studying air pollution control measures, the newsletters was concentrated on the introduction of these activities.

Through the Project activity, C/P obtained knowledge and information on air pollution control to some extent, but the Project did not disclose some important information because of the following reasons.

As for air pollution simulation results, the results was difficult to publish because of the difficulty to verify them due to the lack of reliability of the past air quality data. Furthermore, the assessed cause for air pollution may have an objection from citizens if it is published as it is. Because of these reasons, JET left the information disclosure mentioned above entirely to MESPI/MESP, and therefore, the Project did not provide the information. As for the emissions from LCPs and other stationary sources, data disclosure is difficult since part of the components exceed the ELVs. Because of the same reason, JET left the information disclosure to MESPI/MESP too.

Table 3-136 Newsletters

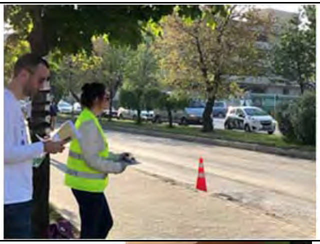
Newsletter	Date of publication	Content
No.1	January, 2018	Introduction of the Project activities
No.2	February, 2018	Introduction of the activities for emission inventory and air quality monitoring
No.3	August, 2018	Introduction of the activities of research interviews on fuel consumption and traffic counting in collaboration with University of Prishtina
No.4	August, 2018	Introduction of the activities for strengthening the exhaust gas measurement capability for LCPs

3.12.3 Publishing in the media

Through the Project activities, the Project has also actively provided information in cooperation with the media. The activities are as follows.

Table 3-137 Activities with the media

November 1 (Wed), 2017 Press interview	After the presentation to the minister, Press interview was held with the minister.	
January 27 (Sat), 2018 TV interview	When the air condition was very bad from January 25 to 29, 2018, one JET member unofficially participated in the interview.	
February 14 (Wed), 2018 Name of the program: Jeta në Kosovë (Life in Kosovo)	When the air condition was very bad from January 25 to 29, 2018, one JET member took part in the TV program and explained the Project activities requested by MESPI/MESP.	

April 28 (Sat), 2018 Newspaper coverage	There was an interview in regards to the activity of traffic volume counting.	
June 1 (Fri), 2018 TV interview	There was an interview in regards to the activity of PM sampling in the air in Drenas and Mitrovica.	
April 19 (Fri), 2019 TV interview	At the starting time of data collection activity for vehicle information, the Project was interviewed when it visited public bus company of the city of Prishtina.	
June 11 (Tue), 2019 Press release	The ceremony of equipment handover from JICA to the Kosovo side was held and interviews from the media were conducted. After the ceremony, the introduction of equipment was carried out.	
October 25 (Fri), 2019 TV interview	The Handover ceremony of air quality data displays from JICA to the Kosovo side was held and there were interviews after the ceremony.	
November 4 (Mon), 2019 Newspaper coverage	At the time of the meeting with the mayor of Obiliq, the Project requested the installation of air quality data display. This event was covered by the newspaper.	
July 4 (Thu), 2020 Newspaper coverage	Explanation to the acting Secretary General who is going to be the next JCC chairperson on the Project overview and revision of the Project schedule due to the COVID-19.	

4. Challenges and Lessons Learned from Project activities

The Project has dealt with many challenges in the activities in order to proceed with the smooth implementation of the Project. At the same time, the Project has learned many lessons. Challenges and lessons learned are described as follows.

4.1 Challenge and measures

Since the Project covers wide range of activities from Output 1 to Output 8, at every visit, the Project planned the schedule for each JET member, shared the schedule with C/P before the visit and arranged the schedule. Furthermore, C/P and JET reviewed the schedule every week during the JET stay, and C/P and JET always tried to share and arrange the schedule.

During the JET stay, the regular meeting at which coordinators from each Working Group participated was held every two weeks, and through these meetings C/P members and JET members shared the information and arranged the activities among Working Groups and the JET.

In the second JCC meeting, JICA and the Kosovo side agreed on the mechanism of how to progress with the coordination with other donors. The content is “Both sides will coordinate with other donors in the course of the Project implementation in order to avoid overlapping and to maximize the synergy effect in the event that other donors provide assistance to Kosovo in the relevant areas of the Project. It is important for the Kosovo side to provide JICA with related information in a timely manner, as the Project implementation might be affected”.

In the Project activities, the mechanism set the focal point of the Kosovo side, which enabled the Kosovo side to proceed with collaborative discussion proactively and efficiently. Especially, in the field of air quality monitoring, the Project could proceed with the duties functionally by using the mechanism, although many activities of JICA and MCC/MFK overlapped during the Project period.

The content regarding the donor coordination is as follows. (At the second JCC meeting MESPI/MESP was still “MESP”, and in the following sentences, the acronym MESP is used.)

i. Overall responsibility in coordination with other donors

Project proposes MESP/Ms. Nezakete Hakaj (as focal point) to be responsible person for coordination with other donors

ii. Information exchange between the Project and other donors

JET will provide information upon request by other donors if there is no objection by MESP focal point and JICA

iii. Discussions at the technical level between JICA Expert Team (JET), C/P-WG and other donors.

MESP as a focal point participates in the discussions with other donors.

iv. Reporting by MESP focal point to Kosovo side with JET

MESP focal point will report the contents of discussions with other donors and actions recommended within the Project implementation to the Kosovo side at regular meetings

v. Decision making and agreement on Project implementation

In the event that an amendment of the Project is required, the Kosovo side, JET and

JICA will discuss such amendment at the JCC Meeting in order to make a decision.

Kosovo side discusses with the other donors in parallel to reflect such discussion results and to agree on any arrangements required within the assistance by the other donors

vi. Exchange of observers between the Project and other donors

The JCC and C/P-WG meetings will invite observers from other donors

4.1.1 Schemes for Output 1

(1) Utilization of EMEP/EEA Guidebook

Since Kosovo is located in the Balkan region, it was suggested that the legal system of EU would have a large impact, so it was decided to prepare the emission inventory based on the EMEP/EEA Guidebook. In addition, the concept of EMEP/EEA Guidebook is same as 2006 IPCC Guidelines, and the calculation method for emission inventory was familiar to one member of C/Ps of Output 1 who was also the person in charge of the national Greenhouse gas (hereinafter referred to as “GHG’) inventory in Kosovo. As a result, understanding by C/Ps for emission inventory was facilitated and activities of Output 1 were able to be implemented efficiently. Furthermore, during the discussion with other foreign donors, the content of activities were smoothly shared when introducing the activity content of the emission inventory preparation carried out by the Project.

(2) Procedure for implementation of lectures

In the first period, firstly lectures were given to C/Ps on the basic contents related to the emission inventory preparation, and the understanding of C/Ps was deepened. After that, the data collection activity was started and the emission inventory preparation was proceeded with. Therefore, at the beginning of the Project in December 2017, a series of lectures were carried out on an intensive schedule. Through these activities, the basis for emission inventory preparation by C/Ps was established, and the various subsequent activities were smoothly implemented.

(3) Use of resource from the GHG inventory

At the time of lectures for C/Ps and discussion with C/Ps, the method for GHG inventories were appropriately illustrated, and the status of GHG inventory preparation in Kosovo was confirmed. Through these activities, understandings of C/Ps were promoted, and in Kosovo, where resources are limited, it was possible to make C/Ps aware that it is possible to prepare the air pollutant emission inventory by utilizing the resources from the GHG. As a result, the incentives for preparing air pollutant emission inventory increased, and the establishment of institutional framework was studied as shown in Figure 3-2, Table 3-4 and Table 3-5.

(4) Promotion of understanding for effectiveness of emission inventory

In the activity of studying and evaluating the Measures on Output 8, the C/Ps members of Output 1 were invited by JET to participate, and in addition to the discussion on the Measures, the C/Ps members of Output 1 carried out the OJT activity on calculating the emission reductions. Through these activities, the example of the utilization of emission inventory was able to be presented.

(5) Classification of activity fields for the emission inventory and simulation modeling

Since the emissions organized in the emission inventory are the main input data of the simulation modeling, it was necessary to classify the duties in charge of activities of Output 1 and Output 5. Since the input data of the simulation modeling depends on the model and calculation condition used and it is desirable to use the format of the annual emission table for each sector when comparing the emission inventory or GHG inventory with other countries, the role of creating input data for simulation modeling on allocating spatial and time resolution of emissions was decided to be the activity of Output 5, which is a group of simulation modeling. As a result, the output of the emission inventory preparation was clarified as a table of annual emissions by sector and category. In addition, it became easier to compare the emission inventory and GHG inventories with other countries. Furthermore, the procedure for creating the input data for the simulation modeling from the emission inventory was clarified.

(6) Implementation of research interviews by students

Since Kosovo has been independent for only around 10 years, it was assumed that there were insufficient statistical data. Therefore, form the planning stage of the Project, it was planned to carry out the research interviews by students in order to supplement statistical data and generate activity data necessary for emission inventory. After starting the data collection activity and it was confirmed once again that there were not enough data on the fuel combustion, which was considered to be particularly important as an emission source, the research interviews by students were planned and implemented. The results of these research interviews were the first data regarding actual fuel consumption by each house and office obtained in Kosovo, and it became extremely useful data not only for emission inventory preparation but also for studying the Measures.

4.1.2 Schemes for Output 2

To conduct exhaust gas measurement does not merely mean measurement of pollutants in exhaust gas, but means that it is necessary to understand the process, process flow and fuel consumed, determine the location and the timing for measurement and select appropriate measurement method and apply it. In general, since operators at the facility are well familiar with the facility and persons in charge of measurement are familiar with measurement method, the appropriate measurement is possible through cooperation between them. At the same time, well-prepared measurement equipment can provide the accurate measurement.

However, in Kosovo, the measurement in the Precedent Activity was almost the first experience, except in the case when foreign agencies came and conducted measurement. Neither the facilities nor the measurement side have sufficient knowledge on measurement, and therefore, the Project took various kinds of approaches for the capacity development of C/Ps.

(1) Exhaust gas measurement activities

1) Preparation for the measurement

i) Inspection of the process and process flow of the facility

The Project had already sufficient information on TPP Kosovo A and TPP Kosovo B through the Precedent Activity. As for other stationary sources, JET preliminarily visited the facility together with C/P, inspected the processes and the process flow together and shared the information with C/P.

ii) Inspection of the operation and specifying the measurement location

At the preliminary visit, JET and C/P interviewed the operator of the facility on the operation and specified the measurement location. At the same time, JET and C/P requested as necessary, the installation of measurement holes and/or platform for safe and appropriate measurement.

iii) Preparation of measurement equipment

JET with C/P confirmed together the necessary equipment for the measurement and prepared them for the measurement.

2) Implementation of the measurement

i) Recording of the operation conditions such as amount of production, fuel consumption, etc.

ii) Securement of the communication during the measurement

At the measurement in LCPs, etc. the location of the gas sampling hole and that of measurement equipment (lower part) are usually far apart and the surrounding is very noisy. Therefore, the Project procured walkie-talkies and conducted the measurement through smooth communication by the walkie-talkies.

iii) Securement of the safety and health

The following measures are taken for the securement of safety and health

- Measure for works at high places (fall prevention by the use of fall preventive tools and safety belts, the use of baskets and rope for lifting equipment, etc.)
- Preventive measures for burns (the use of heat resistance gloves, etc.)
- The use of trolleys for heavy equipment transportation
- Health protection (the use of Tyvek protective clothes, dust mask, etc.)

3) Tidying up equipment after measurement
    i) After measurement, equipment were cleaned, inspected and organized in order to be used for next measurement. As for organization of equipment, JET procured shelves and instructed C/P to put equipment in order on the designated places of the shelves. At the same time, JET instructed C/P to put vinyl sheets in front of the shelves to protect equipment from the dust. These measures make the next preparation easier.

4) Organization of measurement results
    i) The Excel work sheets have been provided in order for C/P to organize measurement data easier. The Excel work sheets have the equations for calculations in advance, and the results can be calculated only by entering the measurement results.
    ii) JET provided the form of measurement report and supported the C/P to draft reports.

(2) Establishment of the framework for exhaust gas measurement

The Project has completed the establishment of the exhaust gas measurement framework within MESPI/MESP. However, the framework of measurement for the private sector has not been established. In order for the exhaust gas measurement to be disseminated, it is necessary for the exhaust gas measurement importance to be acknowledged in general. In Kosovo, the importance of the exhaust gas measurement is not sufficiently acknowledged, and it is a big issue for the future. Therefore, the Project held a seminar for private facilities and domestic measurement agency in order for them to understand the importance of the exhaust gas measurement.

4.1.3 Schemes for Output 3

(1) The point that the project focused on was to emphasize the motivation of C/Ps who participated in the project while having their normal daily works. For example, the Project conducted the analyzer calibration training in AQMS by making use of the situation such as the support to solve urgent and deep problems in analyzers, etc. For example, the Project visited the AQMSs where the analyzer showed an abnormal value, brought in standard gases and the calibrator, and conducted OJT on analyzer calibration as well as troubleshooting. As a result, there are some cases where C/Ps found analyzer’s failure. Through the activities that meet the needs of the C/P, the Project could give a more practical and pragmatic activities where C/P can obtain benefit through the experience.

(2) The Project tried to provide a strong support even when JET was not in Kosovo. In the latter half of 2019 and 2020, C/P often sent inquiries via SMS from AQMS where C/P was calibrating analyzers. In many cases, it was a question that could be solved immediately just

by reading the manual. However, since C/Ps did not have the custom of referring to documents, C/Ps sent pictures of the problems. Even if it was written in the maintenance manual or the instruction manual for the equipment, the Project answered the question by indicating the corresponding parts in the maintenance manual. The C/Ps knew that they could receive support at any time, and in this manner, the Project tried to make C/Ps able to execute what they have learned in the training. Considering this situation, the Project made the maintenance manual more understandable to C/Ps by using as many diagrams and photographs as possible.

(3) The Project sought to provide the Kosovo side with ways to save for maintenance. As one example, the Teflon tube that carries the sampled air from the distributor (so called the manifold) to the analyzer in the housing of the AQMSs should be periodically replaced with a new one, but this is very often ignored. Since the Teflon tube is an expensive spare part, the replacement is frequently postponed. However, there is a method to clean the inside Teflon tube by passing through the tube inside several times using a piano wire with a gauze soaked with ethyl alcohol at the tip. This method makes the inner side of the tube to be as clean as new. For rehabilitation, the Project brought in piano wires and gauzes from Japan and handed them over to C/Ps. The Project has tried to convey the knowledge and experience so that it allows for maintenance to be continued while saving costs.

As for air quality data display, the Project decided to show the AQI stipulated in EU in the simplest way as possible. The Project considered three following points for the screen of the displays.

(1) To make the system easy for maintenance

The displayed data is received from the data server as one hour data, which is processed from the data from MCC/MFK data network, and the data is displayed directly.

(2) To display the data sustainably into the future

In order to display the data sustainably, the maintenance including communications and software, as well as the rapid response to problems are very important. Since MESPI/MESP and KHMI are not expected to carry out maintenance work and rapid response to problems, JET and C/P evaluated the contractor from the view point of not only the cost but also the ability for maintenance and the rapid response.

(3) To display the data that is understandable to citizens

The Project has considered it very important for the citizens to understand the air quality condition and has selected the data display which is understandable for the citizens. The Project had the idea for the displays in the city of Pristina and city of Obiliq to display data from a larger number of AQMSs, but very few citizens know about the existence a larger number of AQMSs. At the same time, when the AQI is different from one AQMS to another, it may cause confusion to citizens. Therefore, it was decided that the displays display data from only one AQMS. Data from other AQMSs can be found in the internet service provided by MCC/MFK[33].

4.1.4 Schemes for Output 4

As for laboratory analysis, the Project re-functionalized the IC and the ICP-MS, and conducted exhaust gas analysis by Standard Reference Method.

Five analyzers were donated to KHMI by EU around 2012, but only the AAS had been operated up to the time of the start of the Project. The Project carried out the re-functionalization of the IC and the ICP-MS. These analyzers are highly professional instruments and considering the high level of complexity, only the manufacturer can perform the repair. Therefore, the Project through e-mails made the arrangement beforehand with the manufacturer, and carried out the re-functionalization work.

The Project selected as a JET member a person who is in charge of the laboratory analysis on daily basis, and this person was in charge of not only the technology transfer but also the transfer of important knowledge such as procedures of analysis, management of the analysis laboratory, etc.

At the same time, in general, very little attention is paid to gas sampling for exhaust gas analysis, but gas sampling is also an important work and the Project valued this work very high.

The activities regarded as important are as follows.

1) The Project made preliminary inspections for the re-functionalization of analyzers, provided information from the inspection and discussed procedures with the manufacturer, and tried to ensure re-functionalization work.

   As for the IC, it was expected that the IC had clogging in the liquid passage, malfunctions of the internal parts, etc. caused by the long non-operational period. In the first period, the IC was diagnosed by the agent from the manufacturer, and the necessary spare parts were listed up. In the second period, the necessary spare parts were procured and the re-functionalization was carried out without any problem.

   As for the ICP-MS, through preliminary inspection the damage of the wiring was found inside the ICP-MS, and it was decide that instead of ICP-MS being diagnosed in KHMI, it will be shipped to the manufacturer in order to repair the wiring and carry out the diagnosis. As a result, the ICP-MS was re-functionalized without any problem.

2) When analysis are conducted, preparation for analysis, such as preparation of solutions, SOPs, etc., as well as the operation of the analyzers, is very important. Therefore, the Project selected as an expert the person who is in charge of the analysis on a daily basis, and tried to make the transfer not only of analysis technology but also of important tasks such as preparation, procedures, data organization, etc. At the same time,

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[33] Air Quality Portal：https://airqualitykosova.rks-gov.net/en/

auxiliary equipment such as beakers, etc. was brought to KHMI, and an attempt was made to create a suitable environment for analysis.

3) Environmental analysis require gas sampling and analysis can only be conducted by sampling the gas. Therefore, the Project also placed the importance on the gas sampling, and made efforts to transfer the proper knowledge and sampling technology.

4) For heavy metal sampling, the Project tried to meet the urgent needs of C/P as much as possible. As a result of heavy metal analysis in PM in Japan, it was found that some components in the PM sampled in Mitrovica exceeded the guideline values of Japan, and MESPI/MESP will continue to monitor heavy metals in PM in the air in Mitrovica. However, when sampling of PM in the air was carried out in May 2018 in Drenas, the factory which is considered to be a possible source of heavy metals in the air was not in operation. Therefore, the Project responded positively to the request from C/P to carry out sampling again. After obtaining quick approval from the JICA headquarters, the sampling was carried out when the factory was in operation. As a result, an amount of certain heavy metals that exceeded the guideline value in Japan was detected, and this was one of the important achievements of the Project.

4.1.5 Schemes for Output 5

Since the simulation model calculations were the first experience for MESPI/MESP, JET paid attention to the following points along the activities of the Project.

(1) Reinforcement of the working group with experts in GIS data

GIS data is a very useful technical tool for spatial distribution of emissions and concentration in simulation modeling. After discussions with the C/P to clarify the GIS data needed for this project, officers from GIS department within MESPI/MESP were added to the C/P members and various useful GIS data were provided. This facilitated the work efficiently, and improved the C/P's understanding of the need and usefulness of GIS data.

In Kosovo, "Human Resource Development Project on Geo-Spatial Information for Implementation of Spatial Plan of Kosovo" (hereinafter referred to as "GIS Project") was implemented by JICA with KCA as the main C/P, and the preparation of basic GIS data such as topographic maps was carried out in the past. The GIS officer also participated in the publication workshops of the GIS Project, and the synergy effect was demonstrated where both projects were integrated and utilized.

(2) Capacity development activities according to the C/P's ability to operate Computers

It was found that some C/Ps had insufficient computer operation skills, including how to operate Excel. Therefore, in the technology transfer of the simulation model, a manual-based explanation of how to operate the model was not sufficient for them to carry out the model on their own. Therefore, in the Project, the C/Ps were not only given a lecture on the simulation model, but were also trained through operating computers by themselves. As a result, the problems that appeared when the C/Ps carried out the calculation were clarified and more practical technology transfer became possible.

(3) Adjustment of data collection process depending on availability of the necessary data

As Kosovo got its independence only a little more than ten years ago, it was expected that the country would not possess sufficient data required for the simulation calculation. In the absence of such data, it was necessary to consider how to deal with the situation. After JET proposed the condition of necessary data, the C/P took the lead in data collection, which allowed the C/P to rediscover the status of data collection in Kosovo. Through the process of thinking about how to deal with the situation, C/P has deepened their understanding of the simulation model.

4.1.6 Schemes for Output 6

The Project studied air pollution control measures for LCPs and other stationary sources. The issue is the same as with the exhaust gas measurement where officials in MESPI/MESP have little knowledge on industrial processes, and also operators of private facilities have little knowledge on the exhaust gas measurement. Furthermore, both sides have little knowledge on emission reduction measures.

Since engineers in TPP Kosovo A and TPP Kosovo B have sufficient knowledge on processes, the work on exhaust gas measurement and emission reduction measures went very smoothly. On the other hand, as for other stationary sources, since JET recognized the necessity to improve the knowledge of officials in MESPI/MESP, JET made efforts to inspect process flow, etc. and interview the operators regarding the operations together with the officials.

In the Project, through the aforementioned activities, JET found out that the officials in MESPI/MESP and operators of private facilities do not have sufficient knowledge on the exhaust gas measurement and emission reduction measures. This is presumed to lead to the situation where the importance of the exhaust gas measurement and reporting is not acknowledged in general.

The Project held various lectures and seminars in the first and second period. However, the Project thought that C/P had not gained sufficient knowledge, and therefore, in the third period, lectures on emission reduction measures were held again in order to improve the knowledge.

In the lectures, the importance was placed on the transfer of the minimum knowledge on emissions such as the effect of the emissions from each facility on the environment, general approaches to emission reduction, method for prediction through pollution diffusion calculation, etc., and through t lectures, the Project made efforts for C/Ps to understand the necessity of emission reduction. Many C/Ps actively took part in the lectures and were interested on these issues, but the situation is that more knowledge and experience is necessary in order to inspire C/Ps to acquire knowledge on emissions.

4.1.7 Schemes for Output 7

(1) The boilers at TPP Kosovo A are obsolete, which were built almost 50 years ago, and there is little documentation about the plant. In addition, the number of instruments installed in the boiler is minimal (for example, Lignite flow rate cannot be measured) and the accuracy of instruments is not so good. Since there is no data logger (continuous recording of operation data), which is usually installed in the modern boilers, in order to understand the relationship between the changes in the state of the boiler condition and the exhaust gas properties, it is necessary to collate the boiler data collected manually and the exhaust gas measurement results collected at the site every half an hour.

Therefore, the collected boiler operation data and the data measured on site were consolidated into a prepared Excel format in order to study the emission reduction.

(2) At the beginning, the boiler operator was reluctant to change the operating parameters sticking to the usual operating method, and the test could not run as expected. Therefore, the test for changing the operating parameters was performed after the consent was given following the explanation on what would happen when the operating parameters were changed. As a result, it became possible to perform the test smoothly after the staff understood the procedure.

(3) The combustion state changes frequently even if the properties of the Lignite show little change in the normal parameter analysis. It has been revealed that even a small change in the combustion state in the furnace causes a slight change in the furnace gas temperature, which in turn affects the In-furnace desulfurization effect, and results in the change of SO_2 concentration. In this boiler, the operating parameters that can change the furnace gas temperature are limited, but in order to find these, all the data accumulated so far had been organized and analyzed, and the possible operating parameters to change the furnace gas temperature were found.

(4) In the field work such as the exhaust gas measurement, the training was given to ensure the safety measures and keeping five **S** for measurement equipment (**S**eiri; Organization, **S**eiton; Tidying, **Se**isou; Cleaning, **S**eiketsu; Keep Cleanliness, **S**hitsuke; Discipline), which are the basic rules of the field work.

(5) Regarding the measurement of the flow distribution inside the ESP, the study of measures to improve the uniformity of the flow distribution using CFD model based on the measurement results, the drafting of the modification plan of the actual ESP and the implementation of the modification work were carried out in collaboration between members of TPP, the UP and JET.

This is the first experience of this nature in Kosovo. Therefore, as there was coordination between all parties involved and the support for each field, good result was obtained.

(6) When measuring the flow distribution inside ESP, there was no suitable floors that are needed to measure inside ESP, so a special jig that traverses the Anemometer (air flow measurement device) was manufactured in advance, and the pulleys were installed at the top of ESP so that the Anemometer could be moved up and down through manipulation from the bottom floor inside ESP.

After installing the equipment in ESP, many trials and adjustments was performed in advance to make sure that the traverse of the Anemometer moves smoothly.

At the time of the flow distribution measurement, it was necessary to start the induced draft fan in the state where a person can enter the ESP. As the access door of ESP was closed, the measurement was performed without the possibility to communicate with persons outside, and this might be dangerous. In order to work in high Dust environment and the loud noise of the fan, it was necessary to give due consideration to safety measures such as securing communication through sending signals to persons outside by hitting with the hammer. In this way, the preparations and the division of the roles of each member were made clear.

4.1.8 Schemes for Output 8

Regarding the activities of Output 8, the following measures were carried out.

(1) Creation of the opportunity for the collaborative study of the Measures

When studying and evaluating air pollution control measures (Measures), the emission inventory and the concentration distribution map of ground level air quality using simulation modeling are very important tools. In particular, it is desirable to calculate the cost and emission reduction amount based on the emission inventory. The Measures should be planned based on these scientific and technical evidences considering a future scenario, and it was assumed that C/Ps did not to have sufficient experience. Therefore, in the third period in particular, measures such as assigning actively the place to study the Measures in collaboration with the members of Output 1 were carried out. The members of Output 1 also participated in discussions on the study of Measures, setting calculation condition for emission reductions through the Measures, and discussion on cost evaluation of the Measures. At the same time, the emission reductions were calculated by the members of Output 1. In order to carry out such activities, JET actively spoke to each member of Output 1 and Output 8, coordinated the schedule, and worked hard to create a place for collaboration. As a result, DEPW/DIPM and KEPA, which had not cooperated so much until now, for the first time were able to jointly carry out the activities on the Measures within the government activities. In addition, C/Ps were also able to understand deeply the roles and responsibilities of these government bodies through the activities of the Project.

(2) Drafting evaluation sheets

The Project has summarized each studied and evaluated air pollution control measure in an evaluation sheet, which enabled for the measures to be compared side by side. As a result, C/Ps could deepen their understandings by comparing items such as emission reduction amount, cost effectiveness, issues for implementation of measures among air pollution control measures. Since C/Ps needs to explain a number of measures to decision makers at the same time, evaluation sheets have become useful materials based on scientific and technical evidences.

(3) Methodologies for cost calculation

Operation costs as well as initial cost have been considered for cost calculation. Through the discussions with C/P, operation cost for ten years was taken into consideration since equipment introduced was supposed to be used for some period and it was better to compare the operation cost between before and after the measures. At the same time, introduction cost and operation cost at demand side such as households, etc. were evaluated, taking into consideration of future support by the government such as subsidies, preferential loans, etc. This makes it easier to understand issues such as evaluation of cost effectiveness and implementation of the measures.

(4) Utilization of seventeen goals of SDGs

It is supposed that many items to be studied will range widely when socioeconomic acceptability and needs are evaluated. At first, C/Ps and JET studied to decide items to be studied. However, in this case some necessary items could be excluded, and it is possible that it might be difficult to explain to the decision makers and stakeholders the reason why the items to be studied are selected. Therefore, the Project had decided to use seventeen goals of SDGs used in the United Nations and to try to solve the problem by clarifying the evaluation indicators. As a result, the capacity for the study and evaluation of measures with a global point of view and clear evaluation indicators had been developed, as well as C/Ps could deepen the understanding of seventeen goals of SDGs.

4.2 Lessons learned

Many donors such as EU, the United States, etc. undertook activities to improve technologies, systems, etc. Introduction of many advanced instruments and equipment has been confirmed. At the same time, it was also confirmed that the laws are organized. However, in the fields of the Project activities, many poor examples have been found such as the introduced instruments and equipment are not effectively utilized and/or cannot be used because of the poor maintenance. When instruments and equipment do not function properly, the Kosovo side often relies on the donors to repair and replace them, which means that the Kosovo side tends not to respect the effective use and maintenance of introduced instruments and equipment. In the field of laws, the law is found not to be enforced well enough due to the lack of technical knowledge.

It is important to utilize well the introduced knowledge and technologies, and the importance of the supportive activities should be placed on the use of knowledge and technologies, as well as the establishment of systems (system, the number of the staff, etc.) for their sustainable use.

The lessons learned through the Project activities are described as follows.

4.2.1 Lessons learned from Output 1

(1) Development of institutional framework for emission inventory preparation

In order to prepare the emission inventory, it is necessary to cooperate with many relevant organizations. In the Project, the relevant ministries and Municipality of Prishtina became members of the C/P-working group, and in addition, the data providing organizations and data to be used were identified, and the roles and responsibilities of the relevant organizations and the schedule for the emission inventory preparation were determined.

The data providing organizations have no obligation to report to MESPI/MESP, do not collect data for preparing the air pollutant emission inventory, and are not in a position to contribute to the quality control of emission inventories prepared with the provided data. Therefore, it was not easy for KEPA to collect data in an efficient manner and to perform the quality control of emission inventories. Also, it was not easy to build a cooperative relationship with the data providing organizations, and it was not easy for KEPA to collect data.

For example, in the first and second period, C/Ps inquired about the data by e-mail to the municipality of Fushe Kosovo and Obiliq, but the request by e-mail was not clear to them. In addition, C/Ps also inquired about information on vehicle to MESPI/MI, but the request by e-mail was not clear to them either. Therefore, C/P with support of JET directly visited the staff in charge of vehicle registration on MESPI/MI and staff in charge of environmental management of each municipality, and carried out discussions by sharing questionnaires prepared by C/Ps. By conducting such face-to-face discussions with sharing opinions, mutual understanding was promoted, and as a result, C/Ps were able to obtain the useful data from these organizations for preparing emission inventory.

When newly establishing the emission inventory preparation system in other areas, when establishing the national emission inventory preparation system or when adding data provided by relevant organizations as a part of future improvement activities for emission inventory preparation, etc., the collaboration system should be established after face-to-face discussion with the relevant organizations.

(2) Quality Control of the emission inventory

From the viewpoint of quality control and quality assurance, preparation of emission inventories should eliminate black boxes (unknown calculation process) and special setups in the calculation process so that anyone can objectively verify the calculation process. In the Project, the emission inventory was prepared using a spreadsheet (Excel). This concept is same as the one of MCC/MFK Project through confirmation from international consultants (NIRAS), and the national emission inventory of air pollutants also uses the spreadsheet (Excel) made by Austrian Environmental Agency Expert.

The emission inventory calculation files consist of several worksheets. The data collected every year is entered into one worksheet, and the parameters and emission factors are set in advance in other worksheet. The calculation structure is as follows: 1) the activity data, which is the basic data of emissions, are calculated using the data collected and entered; and 2) the emissions are subsequently calculated using the activity data, parameters and emission factors. It was confirmed that this approach was effective and straightforward through OJT on the emission inventory. When preparing emission inventories, this approach should continue to be adopted and improved.

(3) Members of C/P-WG

It is good situation because the actual members of C/P-WG are composed of the level of actual working staff. Since the selection of members is decided by each institution, the scope of control as MESPI/MESP in reality is limited and in the future similar project, MESPI/MESP should request for such persons to be selected by each institution.

(4) Procedure of activities for emission inventory preparation

Members of C/P-WG carried out together the data collection activity and preparation of emission inventory, as well as the utilization of emission inventory for analyzing the Measures such as studying the Measures and calculation of emission reductions by each Measure. These activities were very useful for developing the capacity of each member. The similar projects in the future should be implemented in a similar manner, so support is given to C/P to conduct collection of data, calculation and analysis in the condition where C/P take the initiative in the activities.

(5) Questionnaires of research interviews by students

Regarding the questionnaire for the research interviews by students, in the first research, since the question items such as the heating usage pattern were freely described, the response contents varied, and it was difficult to screen and analyze the data. Therefore, in the research interviews conducted in the second period, C/Ps with support of JET prepared the questionnaires by using the selection method as much as possible, and conducted the research interviews by students. In the future, when conducting research by hiring students and interviews in a form of questions to citizens, etc., the form of questionnaires using the selection method should be prepared so that neither questioner nor responders have trouble in answering. As a result, data analysis will be able to be carried out smoothly.

(6) Preparation of memo for each discussion and seminar

JET prepared the memo of every remote meeting and discussion for Output 1 from November 2020 to March 2021. This memo is very useful for C/Ps, because C/Ps and JET shared the contents of discussion and conclusions. Especially, through remote activities, this memo was very important for confirming the progress of our activities. This is one Lessons Learned. In the future, C/Ps should prepare such memos after discussions with other organizations including foreign donors, in order to share ideas and ensure that there are no discrepancies in the outcomes of discussions.

(7) Lessons Learned in Remote Activities for Emission Inventory Preparation

Under Pandemic condition, physical contact was difficult. However, through remote activities, C/Ps with support of JET obtained good results on the preparation of emission inventory. Information Technology (hereinafter referred to as "IT"), this new obtained environment-friendly tool should be utilized in future when face-to-face meetings are impossible. Although there is a limit to what can be achieved through remote activities, it was also found that good results could be obtained by identifying what could be done, and regularly confirming each other's progress. In the future, if a similar situation occurs, we should identify what activities we can carry out under such restrictive circumstances

4.2.2 Lessons learned from Output 2

During and after the measurement it is necessary to make calculation using Excel sheets, but in Kosovo, there are not many people who are accustomed to operate with Microsoft Office applications. Even though the operation manuals explaining the calculations were given to C/Ps, many of them did not understand the manuals. Therefore, the Project repeated the calculation using Excel sheets through OJT, especially during the measurement time.

At the measurement conducted in the last period of the Project, C/Ps conducted measurement and calculations even though it took a long time. This was the first experience for C/P to measure the exhaust gas from preparation to calculation, and C/P carried out this duty to some extent. In this case, OJT worked very effectively. From now on, C/P should repeat consistently the exhaust gas measurement from preparation to reporting.

As for exhaust gas measurement, in same kinds of projects, establishment of OJT program is very effective for capacity development.

4.2.3 Lessons learned from Output 3

(1) The lesson learned is the difficulty of adjusting the schedule when the C/P is implementing multiple donor projects in the same period. The Project made an arrangement with MCC/MFK on the content of the activities. At the same time, the Project informed and adjusted the schedule with MCC/MFK not to overlap the schedule. However, in the case of MCC/MFK projects, it was not the MCC/MFK but the contracted consultants who conducted the activities. As a result, duplications of the schedule between the Project and the MCC/MFK's consultant happened several times. From now on, when adjusting the schedule with donors in other countries, it is necessary to adjust the schedule with the consultants in charge.

(2) At the time of the equipment donation project EU-IPA[34] implemented by the EU for KHMI in 2012, the EU had donated five AQMSs, Gas Chromatography Mass Spectrometer (hereinafter referred to as "GC-MS"), GC-MS with thermal desorption device, IC, ICP-MS and standard gas generator for calibration laboratory, five VOC collection devices, five low volume samplers for PM_{10}, etc. At the time, KHMI staff members had several days of trainings in which the simple usage of each device was executed. However, at the time of the start of the Project (October 2017), the equipment that was operational was only five sets of the NOx analyzer, SO_2 analyzer, O_3 analyzer, CO analyzer, and $PM_{10}/PM_{2.5}$ in five AQMSs. Other equipment was not usable such as the low volume sampler for PM_{10} and the standard gas generator of the calibration laboratory, which could be used in our activities for parallel operation for comparison, because the equipment was contaminated due to inappropriate storage condition. In addition, C/Ps did not remember how to use it.

As a lesson learned when equipment is donated through a project, taking into consideration that provided equipment is utilized well into the future, the following conditions should be comprehensively evaluated with strict criteria.

- The true needs of C/P
- Number of staff in the organization and among them the number of staff with special expertise,
- Confirmation of the room to add additional work that uses the new equipment, which is going to be donated for their daily work
- Confirmation of the laboratory condition where equipment is stored and operated (installation space, environment (cleanliness, etc.), etc.)

4.2.4 Lessons learned from Output 4

In the field of laboratory analysis, IC and ICP-MS were re-functionalized, and technology of exhaust gas analysis by Standard Reference Method was transferred.

Five analyzers were donated to KHMI around 2012, but only one of them was operational at the starting time of the Project. The Project made available two more analyzers, and total three analyzers could be operated. KHMI wanted the analyzers to be re-functionalized and this was carried out by the Project. Through these activities, the Project learned the following lessons.

(1) It is important for analyzers to be kept in normal condition by operating them at least once a month, if possible, once a week. The IC will be used for the Standard Reference Method which has been trained through the Project, but now there are no other analysis targets except for this purpose. Since the time it was donated around 2012, the IC had never been operated, and became non-operational due to clogging, etc., of the analyzer. After the training by the Project, the condition of the IC is kept normal by periodical operation around twice a month. However, it is necessary to use it more frequently through clarification of the

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[34] EU-IPA "Project: Supply of Air Quality Monitoring Stations, Analytical Laboratory and Calibration Laboratory equipment in 2012"

analysis needs and making an analysis plan for the IC. The same is recommended for the case of the ICP-MS. In case of support in the same filed by other projects, analysis needs should be confirmed beforehand.

(2) The condition of the laboratory was found to be not suitable for analyses, which is a big issue. There are problems such as management of laboratory cleanliness, analyzers, samples, etc. and the analysis results can be affected by these conditions. In the Project there was no problem because of the small number of samples and analyses, but it is necessary to confirm and improve the condition of the laboratory for the future. This issue became clear since the Project selected as an expert the member who is in charge of analyses in Japan, and confirmation of the laboratory conditions should be carried out by an expert before the time of the start of the project.

(3) Since the laboratory in KHMI had many analyzers but analysis activities were not carried out so often, the Project selected a member who is responsible for analysis on a daily bases in Japan. As a result, the expert transferred not only the analysis technology but also other important technologies such as analysis procedures, laboratory management, etc. which were very suitable for the needs of C/P. This expert has no work experience abroad, no experience with projects, and does not speak English well. However, the evaluation of this expert by C/P was very high, as C/P also had many other supports from this expert for all activities in the laboratory. This indicates that there are many experts in Japan suitable for the activities in other countries. Considering that the purpose of the technical cooperation projects is the capacity development by using knowledge and experience in Japan, experts should be selected from the viewpoint of the needs of host countries and should be considered not only based on the experience abroad, but work experiences and achievements from a wide range point of view.

(4) In operations related to heavy metal monitoring, in response to the request by the C/P, the high volume sampler, which is the equipment provided by the Project, and the low volume sampler owned by the C/P were operated in parallel for comparative testing in May and June 2018. However, the PM sampled by the low volume sampler showed an abnormal value. As for the low volume sampler, it could have been contaminated as the sample gas passage had not been cleaned and had been kept in a low cleanliness level in the laboratory room for a long time since the test run in 2012. This may endorse the comment pointed out in (2).

This presumption suggests that it is necessary to plan technology transfer regarding capacity development for laboratory analyses and activities using laboratory instruments taking into consideration the contamination of laboratory and instruments.

The Project has learned the lesson mentioned above and has provided recommendations, but there are still many remaining issues such as the lack of the sufficient number of the staff, budget provision (for reagents, auxiliary materials, maintenance of analyzers, etc.), and the laboratory cleanliness management.

4.2.5 Lessons learned from Output 5

(1) Utilization of GIS data

For the calculation of the simulation model, emissions calculated from the emission inventory were needed to be allocated in the designated area. So JET compiled a list of data that Kosovo was expected to have and discussed it with the C/P. The C/P gathered a list of useful data candidates and reviewed them together with JET. In the end, input data for simulation model standard had been collected, such as 1km x 1km grid of Kosovo standard, topographic maps, population in each mesh and land use information by each grid.

When conducting simulation modeling in similar projects in the future, a calculation tool should be prepared to generate input data based on the characteristics of the activity data of the emission inventory, as well as taking into account the GIS data maintained in the host country. Linking the GIS data with emission inventory of each kind of emission sources (sub-categories) would be helpful to improve the calculation in the future.

(2) Validation of the simulation model with insufficient data

In this Project, the simulation model could not be validated sufficiently because there was no available AQMSs data in the past with sufficient accuracy. It is better to analyze the air pollution situation and study measures based on the information from the AQMSs, after they have been developed well. However, it is quite possible that air pollution control measures may have to be implemented as soon as possible in parallel with the collection of air quality information, due to rapid economic growth and the influx of population towards cities, especially in the developing countries. It is expected that many countries need to prepare emission inventories and perform simulation modeling to study, evaluate, and implement air pollution measures, even without sufficient data, same as the Project.

In such cases, it is possible to estimate the causes of air pollution to some extent by analogy with the situation in neighboring countries or similar countries in order to consider air pollution measures. For this purpose, AQMS data and emission inventory data should be shared among countries in cooperation with donors and international organizations to promote support for air pollution control measures in developing countries. In the Project, the output from the Project will be shared through the regional conference and the necessity to publish and share data will become appealing. In this way, meetings such as the regional conference should be held to invite neighboring countries to share information on the outputs from the Project.

(3) Additional activities through virtual meetings

Due to COVID-19 pandemic, activities after March 2020 were carried out through a series of remote meetings using Microsoft Teams. This was the first experience for both JET and C/Ps, so we discussed the advantages and disadvantages of remote meetings, and gave recommendation for better remote meetings. Gathered opinions are shown in Table 4-1.

Table 4-1 Lessons Learned about remote meetings

Advantages	Disadvantages	For a better remote meeting
・Continue activities even under pandemic situation ・Time and money saving ・Very well-organized with limited time (2 hours) and a break, and interactive to keep concentration. ・Once a week (easy to participate) ・Recording of manipulations	・Discussion is more difficult. During face-to-face meeting we can discuss using the break time. ・When using computers for long period of time, the participants tend to lose concentration ・Asking detailed questions is more difficult than in physical meetings.	・Two hours meeting with a break is better, not all the day where participants may lose concentration. ・Recording the meeting should be carried out ・Web camera is better to use in order to see how the meeting goes ・<u>Physical meeting is best method if possible!</u>

4.2.6 Lessons learned from Output 6

As part of MESPI/MESP, DEPW/DIPM is the division which issues environmental permits to facilities, and Inspectorate is the division which goes in and inspects facilities in operation and instructs them as necessary.

The Project, including the Precedent Activity, started the exhaust gas measurement and the study of emission reduction measures, and prioritized the work to deal with the NERP. In the last half of the Project, the study on the emission reduction measures for other stationary sources started, and it was found that in reality the law was not enforced sufficiently. This issue is thought to be indicated for the first time by the Project, and this is not mentioned by other donors.

In the case that the environmental measures are evaluated for industrial sectors in other countries, it is desirable to evaluate not only the capacity for the exhaust gas measurement but at the same time also the emission reduction measures in industrial sectors. The environmental measures by facilities will be clarified, and also the actual situation of the law enforcement will become clear.

4.2.7 Lessons learned from Output 7

(1) The work of the staff of TPP is specialized, there is no one who knows anything other than the work they are in charge of, and no one understands the whole boiler. The person in charge of the boiler operation knows from his experience how the condition of the boiler will change depending on the operating method, even if he does not know the theory. It is important to understand the boiler characteristics and find the suitable operating parameters

for emission reduction. To do this, it is necessary not only to collect information and data but also to give them the information they needed, and to build a mutual trust.

(2) Although many kinds of equipment were provided through the Project, Kosovo still does not have sufficient equipment and materials. However, even if the materials (machinery and materials) were not well prepared, everyone shared their knowledge and experience in order to achieve the desired results. In the future project, it is important for JET not only to prepare the necessary equipment for power plants, stationary sources, etc., but also create a place for sharing knowledge and experiences at the site, as was done in this project.

(3) It is impossible to expect all C/P to understand 100% of the issue, but it was practical to find key persons to understand and improve their knowledge, and to be able to spread their knowledge to others. In the future projects, the project should be carried out efficiently by teaching all C/P and finding the key persons at an early stage.

(4) It is difficult for C/P to participate in the project while also doing their daily works. It is important that management has the will to give priority to participation in the project and the support within the organization is also important. For this purpose, the activities should be planned so that the C/P and their managers can understand the effectiveness of the project as early as possible after the start of the project.

(5) In general, including Kosovo, the industry is weak in theory, while the academia tends not to know the actual situation but only the theory, so efforts through industry-academia collaboration are effective ways to expand the base of the technology. In the future, other projects should be implemented while considering the possibility of industry-academia collaboration.

4.2.8 Lessons learned from Output 8

The lessons learned from Output 8 are as follows.

(1) Implementation of the study of the Measures through collaboration

During studying and evaluating the Measures, not only the C/P members of Output 8 but also the C/P members of Output 1 took part in many activities together and learned many things. In particular, when calculating the emission reduction, the calculation was performed using the second emission inventory files, and the calculation was conducted mainly by the members of Output 1. When selecting the priority order of the Measures, the priority order of the Measures to be planned was identified by referring to the concentration map of ground level air quality and the calculation results of the contribution assessment by the simulation modeling. Regarding consideration of target air pollutants, the AQMSs data were analyzed and compared with the environmental standards for air quality, and it was determined that PM_{10} had a high priority.

In the future, it is also necessary to continue studying the Measures based on various scientific and technological evidences. At that time, the Measures should be studied in consultation with persons in charge of their respective specialized fields, and a place for collaboration should be assigned in order to jointly work on the progress of policy making for air quality. In addition, when foreign donors provide support for government activities in Kosovo, the provision of such a place should be actively incorporated in the function of the process as a whole.

(2) Establishment of institutional framework for Measures

In the future, when studying and evaluating the Measures, the priority order and evaluation of the Measures should be carried out with reference to the emission inventory and concentration maps calculated by using simulation modeling. In order to do so, the roles and responsibilities of the following entities should be identified: 1) entity for emission inventory preparation and calculation of emission reductions, 2) entity for calculation of simulation modeling, 3) entity for monitoring of air quality, and 4) entity for planning, studying, and evaluating the Measures, etc. In addition, it is necessary to assign a place for collaborative examination and comprehensively create and implement the strategy for air quality and action plan for air quality as MESPI/MESP.

(3) Utilization of the evaluation sheets for drafting the Action Plan

C/Ps have understood that the evaluation sheets drafted in the Project are the fundamental information and data based on scientific and technical evidences for drafting the Action Plan. At the same time, C/Ps have understood the administrative procedure that, after drafting it, the Action Plan should be finalized through the consultation with the Working Group for the Action Plan. At the same time, they have also understood that it is easy to compare the effectiveness of measures by utilizing the evaluation sheets. There is almost no such approach in projects by other donors, and at this moment, it is not easy to carry out this approach independently. The Kosovo side is seeking a support for drafting the Action Plan and requesting more support for planning and evaluating additional air pollution control measures such as for using the evaluation sheets conducted in the Project.

The support for several measures to be able to reflect them into policies based on the understanding of policy making procedures is recommended for similar projects as the Project. Each indicator used in the evaluation sheets is a common item to be able to be applied to not only in Kosovo but also other countries, and this method should be used as an approach to summarize the studied measures.

(4) Preparation of memo for each discussion and seminar

JET prepared the memo of every remote meeting and discussion for Output 1 from November 2020 to March 2021. These memos were very useful for C/Ps, because C/Ps and JET shared the contents of discussion and conclusions. Especially, through remote activities, these memos were very important for confirming the progress of our activities. This is one Lessons Learned. In the future, C/Ps should prepare such memos after discussions with other organizations including foreign donors, in order to share ideas and ensure that there are no discrepancies in the outcomes of discussions.

(5) Establishment of preparation procedures for the Measures

In the future, when studying and evaluating the Measures, the priority order and evaluation of the Measures should be carried out with reference to the emission inventory and concentration maps calculated by using simulation modeling. Since C/Ps learned “How to identify and address the reasons underlying this 'gap' in implementation of the air quality policy”, DEPW shall prepare new evaluation sheets based on the emission inventory for the whole Kosovo and pass them to the working group for policies to consider them during the amendment of the action plan.

(6) Establishment of implementation procedures for the Measures

Since C/P learned “How to better understand the implementation of policies needed to underpin both the current and any revised air policies; first, by identifying the implementation challenges, and second, by improving the knowledge on the policy tools that can address these challenges”, DEPW shall do the following.

DEPW shall prepare the revised air policies through support of foreign donors including JICA in accordance with the Evaluation sheets developed by the Project. DEPW shall collaborate with the Inspectorate in order to identify the implementation challenges, which will be considered in drafting/amendment of strategic documents (Strategy/ Action Plan on Air Quality).

(7) Establishment of collaborative work for the Measures

Since C/P learned “How to establish a more collaborative work between different bodies to develop capacities and knowledge, in order to deliver policies more effectively in pursuit of the agreed objectives”, DEPW shall develop better channels to identify most relevant organizations and bodies to be part of the working group for policies during the drafting/amendment of strategic documents.

5. Evaluation of Achievements of the Project and Future issues and Recommendation

5.1 Achievement of the Project purpose and the overall goal

Overall goal and Project purpose are described below again.

Overall Goal:

Kosovo side develops capacities for sound air pollution control and air quality management based on technical evidence.

Project Purpose:

Kosovo side technical capabilities are developed to control emission sources in the Project target area.

(1) Achievement for the Project purpose

The Project targeted the Pristina Area and strengthened the technical capacity for air quality management of the Kosovo side in the three fields that are emission inventory and modeling, air quality monitoring and measurement and emission reduction measures. This enabled the activity of Assessment for Decision Making (the fourth field), and the capacity for proposal and evaluation of air pollution control measures was enhanced. The Project made the present situation of air quality understandable through the development of the emission inventory and the air quality simulation for the Pristina Area. At the same time, the air pollution control measures were quantitatively evaluated through the utilization of the concentration distribution map of pollutants on the ground level obtained by emission inventory and simulation. In the field of air quality monitoring, the Project collaborated with MCC/MFK, and organized the air quality monitoring system in Kosovo, and established the system to provide accurate information to citizens. At the same time, provision of the data to citizens has started. In measurement and emission reduction measures, the Project proposed the concrete measures for TPP Kosovo A, and part of them have been put into practice. As for other stationary sources, general knowledge on emission reduction measures has been transferred through lectures.

The evaluation of the Objectively Verifiable Indicators for the Project purpose is described below. The evaluation of the Objectively Verifiable Indicators for each output is described in each explanation for outputs in Chapter 3.

Objectively Verifiable Indicators for the Project purpose in the PDM are as follows.

1) Concrete emission reduction measures are initiated at the Large Combustion Plants (LCPs).
2) Air pollution control measures for other emission sources are elaborated.
3) Priority pollutants and emission sources including LCPs, other stationary sources and other emission sources are identified based on air quality monitoring, emission inventory and simulation modeling and revised twice during the Project for decision making.

As for LCPs, as described in “3-8 Output 7: Emission control measures are developed at LCPs”, Emission reduction measures were proposed for TPP Kosovo A, and in these proposals, Dust reduction measures have been put into practice and have become a big outcome.

As for air pollution control measures for other emission sources, as described in “3-9 Output 8: Capabilities for evaluating air pollution control measures of Kosovo side are developed.”, eight concrete air pollution control measures have been studied including the calculation of emission reduction, the estimation of cost effectiveness, the way of implementation of measures, etc.

As for priority pollutants and emission sources, development of emission inventory and simulation calculation based on the emission inventory is conducted twice, and through this revision, pollutants and emission sources contributing to air pollution have been specified. Based on the study, as described “3-9 Output 8: Capabilities for evaluating air pollution control measures of Kosovo side are developed.”, air pollution control measures were studied along with emission reduction measures for other emission sources, and evaluation sheets were developed for feasible measures where measures were evaluated qualitatively.

Through the above mentioned activities, the Project purpose has been achieved.

(2) Achievement for the overall goal

Through the Project activities, the system to acquire basic data for studying air pollution control measures has been organized. The Project listed air pollution control measures and selected some of the measures which had a high feasibility, and evaluated the emission reduction amount and cost effectiveness, the effect of air quality improvement, the study of implementation method, etc. for each measure. In the future, it is desirable to establish the air quality management cycle shown in Figure 1-2 where the Kosovo side selects the measures, puts them into action, evaluates the effect based on the air quality monitoring results and the revised database, and reviews and renews the plans.

The following shows the prospect to achieve the Objectively Verifiable Indicators for the overall goal. The Objectively Verifiable Indicators for the overall goal in the PDM are as follows.

1) MESPI issues periodic/annual report on air quality including emission inventory, air quality assessment and emission measurement results.
2) Kosovo side’s action plan is revised based on technical evidence.

Emission inventory for the Pristina Area was developed and the Kosovo side acquired the capacity. At the same time, the Kosovo side acquired the capability to conduct air pollution simulation based on the emission inventory. As for air quality data, analyzers in AQMSs all over Kosovo were rehabilitated with the support from JICA and MCC/MFK collaboration, and not only the accuracy of air quality data was improved but also the proper storage and quick disclosure of air quality data was realized. As for exhaust gas measurement, the Kosovo side has acquired the technology. Through these activities, the system to publish air quality data for annual reports based on the technical evidences has been established.

In Kosovo, annual reports are drawn up for the calendar year. Since the emission inventory has been just completed, and due to the effect of COVID-19, the results have not been reflected to the reports yet. The results of air pollution simulation has not been disclosed or reflected to the reports yet, since the adequacy of the calculation has not been validated yet, and MESPI/MESP is considering the disclosure as attention is necessary to the publication contents. Air quality data has not been reflected to the report yet, since the rehabilitation of analyzers in AQMSs was completed just in November 2019, but the data started to be reported in monthly report[35] from KHMI. Disclosure of exhaust gas measurement results are under consideration in MESPI/MESP, since there are some results which do not meet the ELVs.

As for emission inventory, it is necessary to improve the accuracy of the data through the acquisition of actual measurement data, the collection of more detailed activity data, etc. As for the evaluation of the air quality, acquisition of systematic air quality data has become possible, but from now, it is necessary to promote securement of the reliability of data and the evaluation of air quality based on the data, where the establishment of data management system is strongly recommended. As for exhaust gas measurement, it is desirable to actively carry out the exhaust gas measurement since the Kosovo side has acquired the technology, and it is expected to strengthen the enforcement of the regulations on emission sources by this acquired capability.

As mentioned above, data collection and acquisition system, etc. has been established but it is necessary to strengthen the effective utilization of these data.

The present Action Plan was issued as “Action Plan on Air Quality 2017-2019” based on “Strategy on Air Quality 2013-2022”, and this is the target for the Project. Next Action Plan is delayed due to COVID-19 pandemic, and the schedule is not settled yet. The Project has recommended the system to provide the draft Action Plan in Figure 3-58. After the Action Plan is drafted, it is sent to the Prime Minister’s Office, etc. in order to have opinions and then it is approved by the Government. It is expected that study results by the Project is reflected to the next Action Plan. At the same time, it is desired for the Kosovo side to carry out concrete activities from now.

5.2 Future issues and proposals

The Project achieved the original purposes and the key activities were the transfer of basic technology and knowledge. The Kosovo side has acquired the knowledge and technologies, and it is important for the Kosovo side to utilize them sustainably and effectively and to raise the level of activities.

In the field of Emission Inventory and Modeling, the Kosovo side has learned the basic knowledge

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[35] https://www.ammk-rks.net/?page=1,163

and technologies but it is still questionable whether the Kosovo side can go through a series of works from the development of the emission inventory to the implementation of the simulation including data collection, etc., and it is necessary to gain more experience in the future. In the field of Air Quality Monitoring, the air quality data system is secured by the cooperation between JICA and MCC/MFK, and the systematic structure for measurement and data collection for air quality has been established. However, it is hard to say that the data management system is established, and it is necessary to establish the O&M system for maintaining analyzers and systems properly and the data management system for securing the reliability of air quality data. As for the laboratory analysis, it is required to improve many basic problems such as the establishment of the basic analysis system, laboratory management system, etc. In the field of Measurement and Emission Reduction Measures, the emission reduction measures for TPP Kosovo A was studied and implemented, which became one of the big outcome of the Project. On the other hand, many issues are found in other stationary sources through exhaust gas measurement such that many facilities do not conduct proper exhaust measurement and reporting, and there are cases of facilities in which emissions do not comply with ELVs. The Kosovo side has acquired the exhaust gas measurement technology, and therefore, it is desirable for the Kosovo side to actively implement the exhaust gas measurement, and aim at strengthening the regulations and disseminating the exhaust gas measurement.

At the same time, based on the findings of the Project, it is hard to say that the number of the staff and the budget to implement transferred technology is sufficient, and future improvement is expected.

When considering the future development in Kosovo, there are issues remaining as mentioned above. The Project summarized the proposals for improvements on these issues and the requests from the Kosovo side. These issues should be prioritized in order to support the capacity development for Kosovo side, taking into consideration the understanding of quantitative evaluation of the air pollution problems in Kosovo, progress of air quality management, needs for the accession to the EU, etc. Furthermore, it is important to receive support from the foreign donors through classification and organization of activities in order not only to avoid duplication of the contents but also to coordinate in a synergic manner. In this case, it is important for the Kosovo side to actively classify and organize the activities, and to confirm that these activities can support independent and sustainable administrative activities of the Kosovo side in the future.

In addition, there is a proposal from the Kosovo side that the Project should actively inform the activities to the public. The Kosovo side said that daily activities, etc. such as lectures on emission inventory, OJT, etc. should be introduced to the public through web site, etc. Other donors utilize Facebook, etc. and try to widely publicize the activities. It is necessary to study the possibility of the use of web-site in MESPI/MESP and/or contents to be publicized.

5.2.1 Future issues and proposals for Emission inventory and Modeling (Output 1 and 5)

Output 1: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

Output 5: Capabilities for air quality simulation modeling are developed.

(1) Summary and evaluation of the Project activities

In the emission inventory and simulation modeling activities of the Project, emission inventory was prepared and air quality simulation modeling was conducted on the basis of this inventory. This was prepared as a method for planning and evaluating measures against the severe air pollution, especially in winter season.

In this activity, two emission inventories were prepared, the first emission inventory and the second emission inventory. C/Ps initiatively worked on establishing the second emission inventory through OJT, in gathering the latest statistical data, arranging input data, and calculating the activity data and emission amounts. The simulation modeling based on the emission inventories has been carried out.

In addition, other outputs have been achieved, such as progress in the institutional framework for establishing emission inventory and emission inventory manual. This means that the groundwork has been laid for C/Ps to be able to make emission inventory independently.

In general, there are two approaches to make emission inventories: the top-down approach and the bottom-up approach. In the top-down approach, total emission is calculated based on national statistical data and it will be allocated into a target area using indices such as population and land area. The bottom-up approach is a method of calculation by accumulating the emissions calculated based on detailed activity data collected from local governments in the target area. An example of the bottom-up approach is to calculate emission amount from each factory, and accumulating those emission amount from every factories in the target area, in order to know industrial emission amount. The Top-down approach has the following features: it is often easy to calculate the emission amount, and the gap become small between the national emission amount and summation of emission amount from each region of the country. The bottom-up approach enables us to understand the characteristics of the areas to be calculated more accurately and to consider measures in more detail. EMEP/EEA guidebook provides guidance on the range of calculation methods, from simple (Tier 1) to detailed (Tier 3). In general, a simple calculation method is a top-down approach, and a detailed calculation method is a bottom-up approach. Therefore, bottom-up approach should be used for important emission sources sub-categories for which air pollution measures need to be considered.

The members of the C/P of Output 1 participated in the activities of Output 8, which enabled them to learn how to use emission inventory in the process of planning, reviewing and evaluating measures. As a result, they were able to deepen their understanding of the importance of the bottom-up approach, which was used in this project.

The following are proposals obtained from the activities, and requests from the Kosovo side.

(2) Proposals from the Project activities

1) Proposals from the Project activities (Output 1)

In order to prepare the air pollutant emission inventory in the future, it is necessary to develop the institutional framework. According to the EMEP/EEA Guidebook, the emission inventory is required to have 'Accuracy', 'Comparability', 'Completeness', and 'Consistency'. For the purpose of establishing them, it is necessary to continuously improve the quality of the emission inventory as follows.

i) Support for the willingness of C/Ps for the capacity development for the preparation of emission inventory

Key members of C/Ps working group were highly motivated for the preparation of emission inventory preparation, and they participated in almost all the activities in the Project. JET judged that they improved their capacity a lot through the Project activities. One of the reasons of their willing attitude is presumed to be the coincidence between the needs of C/Ps and the activities supported by the Project. The capacity of C/Ps was strengthened much by the activities where C/Ps with the assistance of JET became the main body to prepare the data necessary for the emission inventory and carry out the actual calculation for the preparation of the emission inventory, especially through the implementations of research by students, many seminars, trainings through OJT, etc. In the future similar projects supported by foreign donors, the projects should be established in the way that capacity of C/Ps are enhanced by making C/Ps a main body of the activities based on their needs.

ii) Collaboration between KEPA and DEPW/DIPM

The collaboration between KEPA and DEPW/DIPM was an issue, but they were able to collaborate closely on the data collection activities for emission inventory preparation, the compilation of emission inventory, and planning of measures and calculation of emission reductions. Through these activities, the capacity of C/Ps was developed. KEPA should be able to prepare the emission inventories, but DEPW/DIPM only needs to know an overview of emission inventories and how to utilize them. Each has its own role, and what is important is to work together within the field of atmospheric air administration. In order to continue to collaborate in environment air administration in the future, it is desirable to establish an institutional framework and to carry out continuous collaboration between KEPA and DEPW/DIPM.

iii) Preparation of the emission inventory by the bottom-up approach

Regarding the emission inventory prepared by the Project, the data were collected and emissions were estimated from each sub-category level emission sources in the Project area. This is the calculation through the bottom-up approach and it is indicated that this methodology of the emission inventory can be sufficiently utilized for planning the Measures. As for the municipalities in regards to the air pollution, it is better to prepare the emission inventory that can be utilized for the knowledge and approach adopted in the Project, and they should study and evaluate air pollution control measures for the Action Plan.

iv) Future Application of Emission Inventory Preparation Manual

In accordance with the emission inventory preparation manual, the emission inventory should be prepared every year. Through the sustainability of these activities, it is supposed that the ‘Accuracy’ and ‘Consistency’ of the emission inventory required by EU will be met.

v) Development of Kosovo own emission factors for the future

There are not sufficient emission factors for exhaust gas from vehicles, household emission sources and stationary sources from tertiary industry, and therefore, the Project has used the emission factors from the EMEP/EEA Guidebook. Because of this reason, especially for household emission sources and stationary sources from tertiary industry, Kosovo side should develop its own emission factors in some categories by conducting exhaust gas measurement for these emission sources in order to improve the accuracy of the emission inventory. Actual measurement should be conducted in collaboration with emission measurement group, by utilizing measurement equipment handed over from the Project and making use of experience and the knowledge for the measurement of LCPs and other stationary sources. Emission factors derived from the actual measurement can be used for the evaluation of measures, and based on the measurement results, information for low emission equipment can be provided.

vi) Understandings of detailed information on kinds of fuels through the statistics

As for household stationary emission sources, the emission was estimated by the census in 2011. However, since these data is pretty old as statistical data, emission data should be revised based on the data of the new census scheduled in 2021 and/or next statistic research method for fuel consumption status for households should be developed. Especially, in collaboration with KSA, it is very important to understand new fuels such as pellet, which did not exist in the previous census of 2011. These data can be utilized not only for the emission inventory but also for the forecast of future emissions, and this also can correspond to NEC directive.

vii) Development of annual emission data for stationary sources

GoK already established the IPPC Permit and Environment Permit (Permits). These data contribute to not only the improvement of the accuracy and the completeness of the emission inventory but also the utilization of study and evaluation of the Measures. As a result, it is possible to correspond to the requirement by EU such as the preparation for the NEC directive and national emission ceiling target, etc.

Kosovo side should elaborate the data collection procedures from the Permits every year. In order to do so, the application form for the Permits should be improved, and the inventory compiler should request to promote the implementation and reporting of the exhaust gas measurement, since the measurement has not yet been disseminated in the actual facilities.

viii) Development of activity data for tertiary industry

For stationary emission sources in the tertiary industry, there is a need for basic information such as the number of offices, gross floor area of buildings, actual energy consumption, etc. However, even though the system for registration and emission reporting described in vii) is established, it is still difficult to find all emissions, as there are still many other small businesses which are not included in the system. Usually such small emission sources are often estimated from various kinds of statistical information, but Kosovo is not in the situation to have sufficient statistical data.

The Project has tried to collect various kinds of data such as the number of the offices, etc. but the data were limited, and it is necessary to obtain more detailed and accurate data. Such data will be utilized not only for the emission inventory but also for the forecast of future emissions, and to be able to meet the EU directive on NEC.

In this situation, sharing various kinds of statistical data should be promoted among relevant institutions. At the same time, statistics should be enhanced more by introducing new statistical data as necessary. MESPI/MESP should request from the government and/or KSA the improvement of statistical data for studying the air pollution control measures. In addition, MESPI/MESP should prepare the decision for collecting these detailed data by referring to GHG AI.

ix) Development of calculation method for not estimated sub-categories

In order to improve the completeness and comparability of the emission inventory, calculation method for Not-Estimated (NE) sub-categories such as fugitive emission from vehicles, construction and demolition works, off-road equipment, quarrying, etc. should be developed. Furthermore, as for the sub-categories which are Not-Occurring (NO) and Not-Applicable (NA), they should be reviewed again, and emission should be calculated as necessary. These recommendations will improve the accuracy of the emission inventory.

x) Improvement of emission calculation for the IPPU sector

In order to improve the emission inventory of air pollutants for the IPPU sector, not only fuel consumption data but also raw material data in manufacturing industry should be collected by using the Permits. Data of the product use is also required for calculation of emissions from product use. Such data collection activities will improve quality of activity data and calculation of emission from the IPPU sector will be improved. At the same time, the use of the data will be expanded to the GHG inventory, etc. and will lead to the capacity development of administrative activities in environmental field. It is desirable to conduct these activities in parallel with those in ix).

xi) Improvement of emission calculation from the waste sector

In order to improve the emission inventory of air pollutants from the waste sector, the information on the amount of municipal solid waste such as waste generated, waste handled, waste disposed, waste recycled, and waste illegally collected and treated should be collected or estimated. The collection of these data will improve the quality of the activity data and calculation results of air pollutant emission in the waste sector. As a result, the activity not only improves the quality of the emission inventory for air pollutants but also expands its use to the GHG inventory, which will lead to the capacity development of administrative activities in the field of environment.

xii) Self-reliant and sustainable improvement of the emission inventory by the Kosovo side

In order to improve the quality of the emission inventory sustainably, the emission inventory preparation manual should continue to be improved based on the experience and know-how from the revision of emission inventory preparation. At that time, attention should be paid not only to the improvement of accuracy but also the completeness, comparability and consistency. Especially, in case when the calculation methodology is improved, it is required to review the past methodology at the same time, which guarantees the consistency.

xiii) Consistency with the reporting form of the EU

Reporting form to EU requires not only concrete numerical data but also notation keys as information for no data obtained such as (NE, NO, NA, etc.) and the data origins, and it is necessary to write clearly values, notation keys and data origins for all emission sources in sub-categories. These actions guarantee the completeness and comparability of the emission inventory.

xiv) Classification of the activity fields

Kosovo side should take initiative on classification of the activity fields, since it is expected that from now onwards capacity for the implementation of environment air administrative measures will be enhanced with the support of various donors.

2) Proposals from the Project activities (Output 5)

Due to the lack of reliability of air quality monitoring data, it is difficult to prove the validity of the simulation results carried out under the Project, and therefore, the simulation model has not been validated completely. On the other hand, more reliable monitoring data have been available since November 2019 due to the rehabilitation of the analyzers installed in AQMSs across Kosovo in November 2019 and the establishment of the data network. At the same time, the meteorological instruments at each AQMS were installed and the system for obtaining weather information is ready now.

i) Approach to C/P Capacity Development

Strengthening the calculation capability of a simulation model requires scientific and technical knowledge as well as basic IT skills. Although they are aware that they have not yet reached the level where they can carry out the calculation on their own, they were able to improve their abilities and to deepen their understanding of the simulation model, by working on their own initiatively through OJT and discussion. Since OJT is very effective for capacity development, it is important for C/Ps to have more opportunities to build simulation models practically in various regions in the capacity development projects by donors.

ii) Establishing Simulation Models

Due to the lack of reliability of air quality monitoring data, it is difficult to prove the validity of the simulation results carried out under the Project, and the simulation model has not been validated completely. On the other hand, more reliable monitoring data have been available since November 2019 due to the rehabilitation of the analyzers installed in AQMSs across Kosovo in November 2019 and the establishment of the data network. At the same time, the meteorological monitors at each AQMS were installed and the system for obtaining weather information is ready now.

To prove the validity of the simulation results, it is desirable to compare them in at least four seasons of air quality monitoring data through a year (if possible, for a few years). Although the concept of validation was transferred to C/Ps through the lectures, it is necessary to validate the simulation model with reliable air quality monitoring data, in order to utilize its result for evaluation of measures.

iii) Utilizing Simulation model for revising the Strategy on Air Quality/Action Plan

As the Kosovo side had no experience in implementing simulation models, there is currently no provision for their use. An administrative action procedure should be established so that the simulation model can be utilized for preliminary evaluation of proposed measures and provision of information to decision makers in the next revision of the Action Plan.

A lot of work is required to build a simulation model, including collecting meteorological data, emission data, and air quality data. However, once the simulation model is established, the model can be used in next few years just by updating the emission information unless there is no major change in weather conditions. For example, the simulation model can be established once in every five years, in the year when the Strategy on Air Quality/Action Plan is drafted. In these five years, only emission changes will be considered and corrected from statistical data. The process of managing the progress of air quality Strategies/Action Plans should incorporate the use of simulation models.

iv) Improvement of the simulation model by improving the quality of upper air monitoring data

In Kosovo, the lack of upper air monitoring data is an issue for improving the quality of simulation model calculations in the Prishtina area. The meteorological conditions, including upper layer, have a significant impact on air pollution. However, since upper air meteorological data was not monitored in Kosovo, the data from neighboring countries were used for the simulation modeling. Upper air monitoring by Kosovo itself can be a solution, but this is not immediately feasible due to the costs and staff training. An alternative solution is to use a weather model such as the Weather Research and Forecasting Model (hereinafter referred to as "WRF") to calculate the upper air meteorological data.

v) Improvement of the simulation model by expansion of air quality monitoring in the Prishtina area

The lack of sufficient air quality monitoring data in the Pristina is an issue for improving the quality of simulation model calculations.

There are five AQMSs in Prishtina Area, but three of them are located near the city of Obiliq, where the power plants are located, and two of them are located within the city of Prishtina. There is no AQMS in Fushe Kosovo, where have large retails and transportation hub, and in the eastern Prishtina, where air pollution is supposed to be serious due to the large population and spread of detached houses, and that can limit the accuracy of the simulation model.

Therefore, JET proposed the installation of new AQMSs in these areas. Another possibility is for KHMI to acquire new air quality measurement technologies, such as through rehabilitation of the mobile monitoring station, purchase of small portable measurement devices implementation of official measurement method (batch measurement), etc. Once this technology is acquired, it can be effective tool since air quality can be monitored anywhere in Kosovo, so the expansion to such complementary tool as an alternative is recommended.

vi) Establishment of the framework for sustainable implementation of simulation

As described in iii), once the simulation model is established, it is possible to follow up policies such as Action Plan, etc. For this purpose, it is necessary to establish the framework for the continuous implementation of simulation. The simulation modeling group, in coordination with KEPA and DEPW, established the table of the roles and responsibilities for the simulation modeling. As the next step, KEPA will organize the WG composed of:

- Officials from the air monitoring sector and meteorological sector, KHMI;
- Officials from the GIS sector and Emission Inventory, DEA
- Officials from the Division for Industrial Pollution Management/DEPW

Since the new government has been organized, KHMI is going to send a proposal for decision to the new minister on defining the responsibilities for the simulation modeling.

KHMI insisted that they need four additional officials (two for KHMI, and two for Inventory) in order for them to carry out simulation modeling independently.

JET agreed with the proposed table of roles and responsibilities, and asked the Kosovo side to increase the staff number and resources to satisfy the sustainable framework for simulation modeling.

vii) Capacity development by establishing the simulation model in other cities

As noted in the proposals in Output 8, if MESPI/MESP have a chance to establish the simulation model for other polluted cities in Kosovo, it will be good experience for the staff in charge to experience the whole process of preparing emission inventories and collecting meteorological and air quality data, which will be beneficial in maintaining and enhancing the capacity of the C/P.

viii) Utilization for the information disclosure and public awareness

The Air pollutant concertation map calculated from simulation model is a very useful communication tool for disclosing information to the public and raising awareness of the public, because it can show the situation of air pollution visually and easy to understand. When the simulation model can be validated sufficiently, it is expected that its result will be used to provide information to the public and raise awareness.

(3) Request from the Kosovo Side

1) Request on Output 1

As described in 1-6, Republic of Kosovo and the EU signed the SAA. Therefore, Kosovo needs to transpose every EU directive into domestic laws. This includes directives for Air Quality, and in this field there is the NEC directive which requests for Kosovo to meet the EU target for reducing national emissions of certain air pollutants.

NEC Directive imposes the obligation to member states to reduce five certain pollutants (Sulphur dioxide (SO_2), nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOC), ammonia (NH_3) and fine particulate matter ($PM_{2.5}$), which have significant negative impacts on and risks to human health and the environment. Consequently, based on article 8 and 10 of the Directive, Kosovo is required to report the national emission inventory every year and the national emission projection every two years to the European Commission and the European Environment Agency. The Member States should comply with the National Emission Ceilings set in the NEC Directive. The pollutants covered by EU National Emission Ceilings legislation and their 2030 targets are SO_2 -79%, NH_3 -19%, NMVOC -40%, NO_X -63%, and $PM_{2.5}$ -49%%.

Kosovo has not yet begun transposing this Directive into domestic laws, but it is important to respond to this Directive. The preparation of the national emission inventory of and national emission projections are fundamental information to start this process. Since it is necessary to consider measures for all sectors, development of future scenarios, preparation of future emission inventories, implementation of emission projections and then setting of national emission ceiling, the needs of the Kosovo side for the national emission inventory preparation are increasing.

Under these circumstances, Kosovo side requested following contents.

i) Support for the NEC Directive

Kosovo side requests the support for annual national emission inventory preparation and the forecast of the national emission every two years. The emission inventory for air pollutants prepared by the Project was the first trial for the Kosovo side, and its target area was only the Pristina area, and the targeted pollutants were limited. In order to meet the demands of the EU and promote the air pollution control measures for tackling serious problems in Kosovo, the Kosovo side hopes to have the support to prepare the emission inventory focusing the eye on the NEC Directive

In order to correspond to the requirements by EU, it is necessary to increase the number of the targeted pollutants, and expand the targeted area to the whole Kosovo. MESPI/MESP must also apply environmental air administration to the whole Kosovo. Officials in MESPI/MESP have gained a certain level of knowledge on the emission inventory preparation through lectures, OJTs, etc. implemented in the Project. However, they do not have any experience to complete the emission inventory independently. Therefore, Kosovo side wishes to have sustainable support from foreign donors. Kosovo side hopes to have the supports for the quality improvement of the emission inventory, especially for issues such as the development of independent emission factors for facilities and equipment based on the exhaust gas measurement, establishment of data collection system on emissions from stationary sources, quality improvement of activity data, etc.

ii) Support for setting target for National Emission Ceiling

In order for Kosovo to respond to the setting of the national emission ceiling required by the EU, the emissions from all the sources showed in the calculation method in the EMEP/EEA Guidebook must be calculated and the emissions from large emission sources need to be calculated with high accuracy. Then, future emissions should be estimated. In order to do so, information on emissions from coal-fired thermal power plants, information on emissions from stationary emission sources such as manufacturing, tertiary industries and households, and information on emissions from vehicles are important. Since the national emission inventory is the basic data for setting the national emission ceiling, Kosovo side is requesting support for setting the national emission ceiling. The method of calculating emissions for the national emission ceiling should be considered from the EU requirements and Kosovo's emission situation.

iii) Development of future scheme for emission inventory preparation

Kosovo side is seeking a support for improving the quality of emission inventories and further strengthening the institutional framework for preparing emission inventories. The Kosovo side is also requesting support for EU requirements such as above i) and ii). For example, emission data collection systems for stationary emission sources used in the manufacturing and tertiary industries are important data for not only setting national emission ceiling and emission inventories, but also for planning and evaluating measures. The information on household emissions, automobile emissions and NERP is also important.

By incorporating the collection of information and data and analysis activities into the emission inventory preparation scheme, MESPI/MESP will be able to carry out the estimation of future emission projection based on the preparation of the emission inventory and planning of measures in the future. Through environment air administrative activities in a comprehensive and integrated manner as mentioned above, MESPI/MESP will be able to efficiently carry out the work. The Kosovo side is requesting support for developing a system that contributes to the improvement of such activities.

iv) Building a support system from the academic community

Regarding the calculation of vehicle emissions, etc., MESPI/MESP and MESPI/KEPA's own resources are limited, and Kosovo side believes that support from academic community such as universities is necessary. Therefore, Kosovo side is seeking support such as examining and practicing how the activities of the academic community should be regulated within the institutional framework for preparing emission inventories.

2) Requests on Output 5

Since there are individual differences in the level of achievement of technical competence, and the situation whether the simulation will be used in the future or not is not yet clearly defined, it is suspected whether transferred technology of the simulation modeling will be continuously implemented or not after the Project.

i) Support for the development of a system for the continuous implementation of simulation modeling

Kosovo side requests support to create a step to use the simulation model in administrative process and to continue to enhance the capacity to implement the simulation modeling.

ii) Stipulation of the responsibility regarding implementation of the simulation modeling in the job description

Only limited number of C/Ps has the ability to implement the simulation model by their own because the progress of acquisition of technical skills varies from person to person. In order for the staff in charge to acquire and maintain the capacity of simulation modeling implementation, C/Ps think it necessary to specify the implementation of the simulation modeling in the job description and to define the roles and responsibilities of related organization such as KHMI. As a response to the request by CPs, the Project supported the development of the institutional framework in the additional activities in the third period.

iii) Development of academic support for the establishment of simulation models

In the construction of the simulation model, MESPI/MESP and KEPA need support from academic organization such as universities. KHMI would like to set up its own implementation system in the future, but it is difficult to realize it immediately due to the lack of staff and so on. Therefore, it should be considered for the academia to be involved in the institutional framework for the systematic implementation of the simulation model.

5.2.2 Future issues and proposals for Air Quality Monitoring (Output 3 and 4)

Output 3: Capabilities to elaborate emission inventory for LCPs and other sources are developed at Kosovo side.

Output 5: Capabilities for air quality simulation modeling are developed.

(1) Summary and evaluation of the Project activities

In the field of air quality monitoring, KHMI is in the center of the activities. In this field, the main duties are to monitor air quality through measurement, collection and management of the air quality data. These data becomes the base for all studies regarding air quality, and here KHMI has an important role.

As for air quality data, all the necessary duties to establish the system such as rehabilitation of analyzers, renewal of meteorological instruments, construction of data network, etc. have been completed in November 2019. KHMI and contracted O&M companies also have acquired the O&M capabilities for analyzers to some extent. The Kosovo side has thought that the reliability of the air quality data has reached 100%. However, it is very important to strengthen data management such as checking and finalizing daily data, and calculating and finalizing statistical data as well as to sustain proper O&M for the system in order to provide accurate data. This is a big future issue. The Kosovo side does not seem to recognize the significance of the data management, but the data management is an important element for provision of the accurate data. As the second additional activities, the Project held a lecture on data management, but the training by foreign donors is still required for establishment of the system.

As other activities in the field of Air Quality Monitoring, the Project installed the air quality data displays, carried out the drill for air quality measurement for emergency cases and proposed the optimum placement of AQMSs.

As for laboratory analysis, in addition to the AAS already operating in KHMI, the IC was re-functionalized, and furthermore, the ICP-MS was going to start the operation.

The re-functionalization of the IC enabled the exhaust gas analysis by Standard Reference Method demanded by the EU Directive which is the base of the NERP. However, since in Kosovo the IC is possessed only by KHMI and the application of the Standard Reference Method is limited only to TPP Kosovo A and TPP Kosovo B, it is required for KEK and KHMI to collaborate in exhaust gas measurement for Standard Reference Method

Furthermore, KHMI is hoping for the re-functionalization of the GC-MS, acquisition of certification for the laboratory (ISO/IEC17025), etc. However, through the Project activities, it has become clear that the management of the laboratory conditions such as improvement of laboratory environment, construction of the analyses system, etc. is not sufficient.

Furthermore, there is another issue that the re-functionalized analyzers have no other plan for use, except the work developed by the Project (IC: exhaust gas analysis by Standard Reference Method, ICP-MS: analysis of heavy metals in PM). More frequent use of the analyzers is desirable, which will enable the Kosovo side to further acquire the operation of analyzers by themselves, and this should be a priority. Furthermore, in order to secure the quality of measurement and analyses, it is desirable to acquire the quality management system (ISO 9001). The certification for the laboratory (ISO/IEC1702) has a special aspect such as an approval of analysis of components one by one. However, once the quality management system is established, it is possible to acquire an approval for the necessary component at the time when it is required. The quality management system is the base for quality control and assurance, and this acquisition will make the approval for the necessary components in ISO/IEC1702 easier in the future.

As for monitoring heavy metals in PM in the air, some of the heavy metals were found to exceed the Japanese guideline values for samples sampled both in Mitrovica and Drenas. The operation of ICP-MS, which is planned to be trained by MCC/MFK, will make it possible to analyze heavy metals in PM and to monitor them from now on. However, there is an issue how to disclose the analysis results, although Kosovo side plans to disclose the data after explaining and discussing them with both municipalities.

Considering above mentioned conditions, the following proposals are listed, but at the same time, it is indispensable to reinforce staff in order to solve these issues.

(2) Proposals from the Project activities

1) Strengthening of air quality data management (Output 3)

Air quality data is the data for monitoring the air quality condition, and they become the base for all air quality activities, and therefore, the provision of accurate data is the main mission of KHMI.

At this moment, KHMI relies on the automatic abnormality judgement system introduced by MCC/MFK and is not able to conduct activities such as checking daily air quality data by expert knowledge, deleting abnormal data and correcting data as necessary. In this meaning, data management is not carried out, data reliability seems to be weak, and therefore, it is necessary to establish data management system through support by donors.

Data management consists of following elements.

i) Finalization of measurement data: Daily check, consideration of O&M records into data, data screening, treatment of abnormal data and data deleting procedure, data correcting method, etc.

ii) Preservation of the measurement data: It is necessary to preserve raw measured data as well as finalized data through the procedure of 1) Finalization of measurement data

iii) Treatment of measurement data: Finalization of hourly, maximum daily 8 hours mean, daily, monthly and annual mean data

iv) Provision of data: Publishing of reports including statistical data, etc. after finalization of data

Air quality data is constantly observed data and they must have not only high quality but also continuity. Therefore, analyzers require an appropriate maintenance. However, measurement data may have abnormality because of analyzer failure etc. and it is necessary to have procedures to handle these data.

Concretely, it is necessary to establish systematic O&M structure such as making equipment management ledger which has the production date, records of repair, calibration records, records of abnormal data, memorandum on anything taken notice around the AQMSs, etc. In Kosovo, at the present the management mentioned above is not established yet, and this a big issue.

OJT training is the most appropriate way to strengthen data management. The training will transfer the technology of not only how to check the data but also how to respond to emergency repair, etc.

It is indispensable to reinforce the staff with at least one more person for conducting data management. In some countries, it is often found that the government entrusts these duties to private companies, but in Kosovo, such a company cannot be found, and KHMI must learn how to do it on their own. At the same time, the securement of the budget is also important in order to keep stable maintenance for the future.

2) Other activities for Air Quality Monitoring (Output 3)

As for the air quality data displays, normal functioning of air quality data network is prerequisite. It is also desirable for air quality data displays to be maintained by experts because of the importance of O&M for instruments, data communication and software management. The Project constructed the framework for leaving the maintenance to experts, and handed over all the systems to C/P. Therefore, it is very important for the Kosovo side to secure the budget for O&M from now on.

As for the drill of air quality measurement for emergency cases, it is recommended to conduct the drill once a year through collaboration between KHMI and KEK. In Kosovo, there are no large factories such as chemical factories, factories with big storage of chemicals, etc. and it is effective to conduct measurements as responses to complaints from residents by carrying out the measurement of PM_{10}, $PM_{2.5}$, SO_2 and NOx under the wind of such factories.

3) Preparation for next rehabilitation and/or renewal of analyzers in AQMSs (Output 3)

From 2018 to 2019, observation of air quality and meteorological conditions has become possible and has been operating normally due to the collaboration work between JICA and MCC/MFK. However, these analyzers and meteorological instruments have their expected lifetimes. In case of analyzers, there will be individual differences, but the lifetime will be twelve to thirteen years if they are well maintained. Analyzers in AQMSs in the Pristina area will need renewal in 2024 to 2025, and analyzers in other areas will need overhauls in 2026 to 2027 and then renewals in 2032 to 2033. Staff in charge of analyzers must prepare for these activities in advance by planning, securing budget, etc. and carry them out on their own.

4) Construction of the system as the laboratory (Output 4)

At the starting time of the Project, the conditions in KHMI laboratory where such that the samples could be contaminated and affect the analysis results, for example strong acid and/or strong alkali were stored in the room where analyzers were located, and much dust was found in the room, etc. In the Project, these issues were solved one by one along through the Project activities. However, as future issues, laboratory management is the priority such as arranging laboratory equipment, keeping the room for analyzers as clean as possible, inspecting the preparation and analyzer conditions before analyses, recording the implementation of analyses results, etc.

Accuracy is the essence of measurement and analyses. Laboratory management is indispensable in order to guarantee the analysis results, regardless of the number of analyses. The acquisition of laboratory management system in the future is the main purpose of KHMI, but the present situation is far from it. The first step is to start to establish laboratory management system through acquisition of quality control system (ISO9001).

In addition, in order to operate analyzers properly, procurement of standard solutions, reagents, and auxiliary materials such as argon gas for ICP-MS, etc., as well as periodical maintenance of analyzers are very important. It is necessary to make procurement and maintenance plan for analyzers, and to secure the budget for it.

5) Expansion of the application range of analyzers (Output 4)

EU donated five kinds of analyzers around 2012, but only the AAS was working at the starting time of the Project. In the Project, the IC and ICP-MS were re-functionalized in response to the necessity of the Project activities as well as strong request from the Kosovo side. In general, these kinds of analyzers can be kept in good condition by operating them at least once a month, if possible, once a week. However, at this moment, the operation of both analyzers is limited to the duties developed by the Project such as the exhaust gas measurement by Standard Reference Method for the IC and heavy metal analysis in PM for the ICP-MS. Since the frequency is once in three to six months, it is difficult to maintain the analysis technology and furthermore, the analyzers can become non-operational because of the low frequency of operation same as before. This can become an issue again.

On the other hand, the IC operation enables the exhaust gas analysis by Standard Reference Method, but the issue remains that at the time of exhaust gas measurement the analysis results by Standard Reference Method show larger values than the results recorded by the automated analyzer. It seems to be necessary to conduct the analysis and measurement for the same exhaust gas, and to compare the results. In the third period, the Project carried out this test. However, no clear results have been obtained, and it becomes a future issue.

The IC can analyze sulfate ion, nitrate ion, etc. in water, and the ICP-MS can be also applied to heavy metals in water. Both analyzers have wide range of application. Clarifying the needs for environmental analyses can expand the application for these analyzers. The increase of the analysis frequency can improve handling and analysis technology.

It is expected that the by improving analysis technology and laboratory environment in parallel, advance steps such as the re-functionalization of GC-MS will be realized. On the other hand, there is substantially only one staff in KHMI who can carry out the analysis, and it is indispensable to reinforce the staff with at least one person.

6) Strengthening air quality data collection

Through the cooperation between the Project and MCC/MFK, it has become possible for the Kosovo side to collect data from all twelve AQMSs in Kosovo that are installed at fixed locations. On the other hand, KHMI possesses one mobile station (SO_2, NO_X, PM_{10}, $PM_{2.5}$, O_3, CO) that enables the air quality monitoring at any location. However, analyzers in the mobile station are not sufficiently maintained and must be rehabilitated. This station is very effective for continuous monitoring of air quality at locations without AQMS, and rehabilitation of analyzers is preferable.

Moreover, as for air pollutants such as SO_2, NO_X, NH_3, etc. and heavy metals in the air, it is desirable to enhance the capacity for analysis technologies such as sampling corresponding to the EU Directive and analysis by using IC and ICP-MS, in order to enable data collection at arbitrary locations. These technologies will not only give the data at arbitrary locations but also provide the confirmation of obtained data in line with the EU Directive. Furthermore, it will lead to the improvement of the analysis technology by IC and ICP-MS.

For the future, it will also become necessary to study installation of new AQMSs. The Project also proposed suitable places for their installation.

7) Monitoring heavy metals in PM in the air

As for the monitoring of heavy metals in PM in the air, it was decided to monitor heavy metals continuously in Drenas and Mitrovica. Since the values should be evaluated as annual average in both EU standard and Japanese guideline values, sampling should be conducted at least four times a year or if possible once a month in order to calculate the average annual value. Before long, through the training of the ICP-MS operation by MCC/MFK, it is expected for KHMI to be able to conduct analysis of heavy metals in PM in the air.

KHMI hopes to conduct the evaluation of heavy metals in PM_{10} sampled by the low volume sampler, but it takes time for KHMI to procure the low volume sampler because of the securement of budget and procurement, and the Project proposed to use the high volume sampler handed over by the Project. The analysis results in heavy metals in TSP sampled by the high volume sampler always evaluate the heavy metal contents on the safer side than the ones evaluated in heavy metals in PM_{10} sampled by the low volume sampler. Therefore, there will be no problems for a while. It is desirable to introduce the low volume sampler in the future.

It is desired for the above mentioned results to be published as early as possible considering the future measures.

8) Analysis of components in $PM_{2.5}$

$PM_{2.5}$ is one of the most harmful substances to the human health which causes respiratory disease. In Kosovo, $PM_{2.5}$ as well as PM_{10} are the pollutants exceeding limit values most, and become a big concern. Analysis of components in $PM_{2.5}$ will support the analysis of emission sources considering the second generation of the $PM_{2.5}$, which will lead to the identification of emission sources and the planning of effective measures.

If this activity is carried out, Sampling schedule for four seasons should be planned, and based on the plan, $PM_{2.5}$ should be sampled (approximately 300) and analyzed based on its components. Analysis results will support the effective analysis for specifying the $PM_{2.5}$ emission sources. In this case, analysis will be carried out in Japan since Kosovo side does not have the capability for analyzing components and studying the results.

9) Reinforcement of staff and securement of the budget in KHMI (Output 3 & 4)

As mentioned above, reinforcement of staff and securement of the budget are crucial elements for establishment of O&M for air quality data and construction of laboratory analysis system. KHMI is responsible for these tasks, and without reinforcement of staff and budget securement these tasks cannot be implemented.

When summarizing the aforementioned remarks in the field of Air Quality monitoring, the following activities are recommended. At the same time, the necessary number for reinforcement of staff, equipment, etc. are listed.

Major future issues are the establishment of data management system, and the capacity development for analysis technology, as well as the establishment of laboratory management system.

Field	Point of Issues	Priority	Pre-condition and equipment, etc.	Remarks
Establishment of data management system	Data management system for finalizing measured data	High	・Reinforcement with one more staff is indispensable (Data management system) ・No equipment is required	It has been said that the data collection system provided by MCC/MFK has the function of automatic data judgement. Therefore, Kosovo side tends to think that the management system is not necessary. However, this is an important issue.
	Enhancement of data analysis ability	High	・This is a set of work with data management system ・No equipment is required	Kosovo side tends not to be concerned on the analysis ability, but this is an important issue.
Data sampling system	Air Quality Analysis at locations without AQMS	High	・It is possible for the present formation to be able to deal with this activity. ・A big budget is required.	
	Installation of new AQMSs	Low	・A big budget is required.	The priority of the Kosovo side will be high, but it is a big issue how to secure the budget.
	Replacement of analyzers in AQMSs in the Pristina Area	Medium	・A big budget is required.	The priority for the Kosovo side will be high, since these analyzers will pass their lifetime in a few years. However, it is a big issue how to secure the budget.
Laboratory Analysis	Enhancement of analysis technology	High	・Recruiting staff to replace the staff that will retire soon (two staff) ・At least reinforcement with one staff for analysis work is indispensable ・Some equipment are necessary	Make the acquired technologies more secure and sustainable
	Support for the establishment of laboratory management system	High	・Recruiting staff to replace the staff that will retire soon (two staff) (Ditto) ・At least reinforcement with one staff for the establishment of the analysis management system is indispensable ・No equipment is necessary	The establishment of the quality control system becomes the basis for the acquisition of the laboratory management system (ISO17025) in the future.

	Increase of the number of analysis items (re-functionalization of GC-MS)	Low	・There are two GC-MSs, and for operation, reinforcement with one staff /one GC-MS is necessary ・Rehabilitation work and operation training for GC-MS are necessary,	It is highly probable that KHMI will strongly request the re-functionalization of GC-MS. However, it should be carried out after two items mentioned above are completed and then, it will become feasible. It is too early to implement this activity.
	Analysis of components in $PM_{2.5}$	High	・Sampler and analysis cost is necessary	Analyses are carried out in Japan. Support by the Kosovo side is necessary

Priority (recommended by JET)

High: Activities with high priorities that should be adopted with reinforcement of staff.

Medium: Activities that should be carried out when conditions are met

Low: Activities that should be carried out when conditions are met and the Kosovo side’s need becomes high

(3) Request from the Kosovo side

Since the measurement and collection system for the air quality data in Kosovo has been established, the Kosovo side seems to think that the system has been completed, and therefore, there is no special request from the Kosovo side. However, aforementioned significant issues remain.

As for the field of Air Quality Monitoring, KHMI hopes not only for the re-functionalization of GC-MS but also the acquisition of certification for the laboratory (ISO/IEC17025) in the future. However, existing conditions are far from being suitable for acquiring the certification. The first thing to do is to establish analysis system and laboratory management system through the process of the acquisition of Quality Management system (ISO9001), etc. In order to realize this, it is necessary to increase the number of staff, train them and establish the management system through support from foreign donors, etc. In parallel, KHMI should reinforce the staff, then increase analysis components, and have knowledge and experience for measurement and analyses. This may enable KHMI to acquire ISO17025 in the future. It is indispensable to reinforce the staff and accumulate knowledge and experience, and even if everything goes well, it will take at least five years to acquire ISO17025. It is desirable for KHMI to make an Action Plan, and to make a foundation step by step in line with the Action Plan.

As for monitoring of heavy metals in PM, the Project analyzed the heavy metals in PM (TSP) sampled by the high volume sampler supplied by the Project, but KHMI wishes to analyze the heavy metals in PM_{10} sampled by the low volume sampler, since the EU regulation requires the analysis of heavy metal content in PM_{10}.

5.2.3 Future issues and proposals for Measurement and Emission Reduction Measures (Output 2, 7 and 6)

Output 2: Capabilities for emission measurements are developed for LCPs and for other sources.

Output 7: Emission control measures are developed at LCPs.

Output 6: Decision making by Kosovo side is improved based on the technical evidence for air pollution control.

(1) Summary and evaluation of the Project activities

Technology transfer of the exhaust gas measurement and the capacity development for emission reduction measures for LCPs are the activities following the Precedent Activities, and the activity was expanded to the other stationary sources.

As for exhaust gas measurement, original target was to form a measurement group and to strengthen the surveillance mechanism for emissions of stationary sources. Although it has taken five years since the Precedent activity, the measurement technology has been transferred to mainly KHMI, and at the same time KEK also has acquired the technology. Both groups have become able to conduct measurement independently. However, MESPI/MESP has not reached the target to strengthen the surveillance mechanism as an administration yet. The Project aimed at establishing institutional framework for the exhaust gas measurement, but no private agency has been fostered during the Project period. Exhaust gas measurement technology has been transferred. However, it is a big concern that currently the dissemination of exhaust gas measurement is be very low, since there is no mechanism to utilize this technology in MESPI/MESP and the way has not been found to disseminate the implementation of measurement and reporting.

As for emission reduction measures for LCPs, the Project has studied them for TPP Kosovo A as a target for four years from the Precedent Activity to the second period of the Project. It is important to understand the condition of exhaust gas in order to study emission reduction measures for Dust, SO_2 and NOx. C/P have reached the level to be able to study emission reduction measures without JET, since through OJT they have learned a series of work such as the installation of measurement holes, preparation of measurement equipment at site, cooperation with related parties at the measurement, tidying up of the measurement equipment, data arrangement after the measurement, etc. Although the activity is limited to TPP Kosovo A, the Project carried out several kinds of tests and proposed some measures. Out of proposals, Dust reduction measure was accepted and the measure is under implementation. This has become one of the big outcomes of the Project. As for the improvement of ESP performance as Dust reduction measures, members in TPP Kosovo A, the University of Prishtina, MESPI/MESP and JET, through the industry-academia government collaboration, studied and proposed the measure for improvement of flow distribution inside the ESP through a series of the works such as the measurement of the flow velocity distribution inside the ESP and the flow analysis by CFD based on the measurement results. It was a big outcome to be able to transfer the process to tackle and solve the problems, and it is desirable for problems to be handled in the same way in the future. Emission reduction measures for SO_2 and NO_X requires not a little investment, and therefore, the adoption is not easy, but the capacity of KEK as a main C/P can be developed through these activities. At the same time, through seminars the Project has provided principles of emission reduction equipment and points of attention when they are actually adopted and offered useful information for the case when the emission reduction equipment is introduced.

There is no renovation plan for any equipment since TPP Kosovo A is scheduled to be stopped, and therefore, there is no activity to be carried out. However, it is desirable to support in case that the introduction of intermittent energization control to ESP is applied.

As for emission reduction measures for other stationary sources, through the exhaust gas measurement it was found that private facilities have many issues. As a result, it has been found that almost all these facilities are not in compliance with ELVs. The issues are that exhaust gas measurement is not conducted and therefore, results are not reported, and at the same time, MESPI/MESP cannot interpret the measurement results even if they are submitted and cannot instruct private facilities properly, private facilities do not recognize the significance of the implementation of the exhaust gas measurement, etc. Many issues are piled up and the capacity development of MESPI/MESP is needed.

(2) Proposals from the Project activities

1) Enhancement of the capacity of MESPI/MESP officials to instruct private facilities based on the exhaust gas measurement (Output 2 and 6)

It is effective for MESPI/MESP (Inspectorate, DEPW/DIPM, etc.) to instruct private facilities by making full use of the exhaust gas measurement technology acquired by KHMI. Usually large scale private facilities have staff in charge of environmental issues and monitor the emissions, but middle and small scale private facilities seldom have such a staff and do not have any management of the emissions.

MESPI/MESP should actively carry out the exhaust gas measurement for private facilities. In case that the emissions are not in compliance with regulations, MESPI/MESP should undertake the process mentioned below where MESPI/MESP and private facilities inspect the causes, study measures and put the measures into practice. This process will support both sides to enhance their knowledge and experience.

In this case, MESPI/MESP should instruct private facilities by undertaking the steps of administrative procedure as follows. This is the Japanese example.

i) To request for the facility to explain causes and propose the measures through documents (in case of no proposals, the suspension of the operation can be undertaken)

ii) To give temporary permission for operation when MESPI/MESP studies the measures and judges them as reasonable

iii) To set the deadline within which the facility undertakes measures
iv) To approve the continuation of the operation when MESPI/MESP judges that the measures are appropriate based on the measurement results submitted before the deadline
v) To confirm the measures by conducting the exhaust gas measurement as necessary

This activity also strengthens the enforcement of the law.

In order to carry out the procedures mentioned above, it is necessary for MESPI/MESP (DEPW/DIPM and Inspectorate) to enhance knowledge on the understanding of the measurement results and emission reduction measures, and to improve the capacity to instruct facilities.

The most effective way for this activity is the OJT, where MESPI/MESP inspects an actual facility and carries out the exhaust gas measurement since usually each private facility has its own process and equipment. The OJT is desired to be implemented through the support of donors. The officials in charge in MESPI/MESP must specialize in this work during this activity, and the officials and donors should carry out this work in an integrated manner.

It is desirable for the aforementioned process to be documented and institutionalized. However, such documentation and institutionalization should be stipulated taking into consideration the present situation in Kosovo examined via emission study activities through OJT.

As an example, in Kosovo petroleum coke is permitted to be used as fuel, and in reality petroleum coke is consumed because of its cheap price. Petroleum coke contains high level of Sulphur and it is usually impossible to be consumed without any desulfurization equipment. The consumption of petroleum coke inevitably makes the SO_2 concentration in the exhaust gas very high, and therefore, the implementation of exhaust gas measurement and strengthening of the instruction automatically and drastically will restrict the use of petroleum coke. In Japan, petroleum coke is treated as a waste, and it is necessary to review the law from this point of view.

However, the number of the officials in charge is not sufficient at this moment, and it is necessary to reinforce the staff with at least one more person, if possible two, in order to expand the activity domestically for the Inspectorate.

It is expected that the Kosovo side, through the support from donors will become able to instruct the private facilities based on the exhaust gas measurement results in a self-sustaining way.

It is also expected that the exhaust gas measurement is disseminated as a result of the recognition of the significance of the measurement for private facilities. Even though, for a while, exhaust gas measurement must rely on KHMI or foreign agencies, it can be established as a business when the recognition of the exhaust gas measurement is spread and increased in Kosovo.

2) Strengthening of the capacity and structure of the exhaust gas measurement (Output 2)

The Project conducted the measurement for LCPs and four other stationary sources in Kosovo. Based on these experiences, C/Ps have gained a lot of knowledge. However, the technology can be lost if the measurement is not carried out sustainably. At the same time, it is necessary to accumulate experiences such as specifying measurement method and locations in response to the process and process flow for each facility. In this meaning, it is very effective to carry out the process 1) mentioned above. On the other hand, there are only two staff in charge for the exhaust gas measurement in KHMI, and it is indispensable to reinforce the staff with at least one more employee. KEK also has acquired the measurement technology and it is expected to continue measurement activity, but KEK also has only two staff in charge of measurement, and reinforcement of staff is required too. At the same time, it is also important to procure various consumables and keep maintenance of instruments. It is necessary to make procurement plan and secure the budget for it. Furthermore, KHMI has to procure a vehicle to carry the measurement equipment.

As a further development of exhaust gas measurement, there is an activity of the evaluation for emissions from household heating by using solid fuel, etc. This activity will support the calculation on emission factors for heating equipment, which enables more concrete effect to the air. More expected impact is that emissions from various equipment and kinds of solid fuels will be evaluated, and then, the information on better combination of heating equipment and fuel for the air quality will be provided to the public. This activity will contribute to the improvement of air quality. In order for the Kosovo side to carry out this activity sustainably, it is desirable that Kosovo side installs the test facility and acquires the evaluation technology.

On the other hand, emissions from vehicles are evaluated through EMEP/EEA Guidebook. However, there are many old vehicles in Kosovo, and it is effective to measure emission during the time vehicles are actually running. In order to learn this technology, it is necessary to introduce the measurement equipment (Portable emission measurement system: PEMS) and have a training to operate the equipment. At the same time, three staff are indispensable to carry out this measurement.

3) Study on the emission reduction measures for LCP (TPP Kosovo A) (Output 7 &2)

TPP Kosovo A is scheduled to stop its operation in 2023, and the investment is very restricted. However, the plan for the new power plant (TPP Kosova e Re) is now pending, and it is necessary to watch the response by the Kosovo side. However, TPP Kosovo A is very obsolete, and the power generation efficiency is low. If the investment for TPP Kosovo A is considered, it requires not only the study of the emission reduction measures but also the comprehensive study such as on the renovation of equipment, life-extension, increase of power generation efficiency, etc.

Therefore, the investment is very difficult to be implemented.

The boilers are very old as they have been installed approximately fifty years ago. It is very hard to find measures to improve emissions since properties of the raw material (lignite) are not stable and it affects the exhaust gas a lot. However, the Project transferred the test procedures such as making test plans and test procedures, establishing test system, arranging test data, examining test results, etc. and it is necessary for C/P to continue this kind of procedure in order to study emission reduction measures for the future. However, the number of members who can conduct the activities is limited. In order to continue these activities requires not only nurturing young engineers but also the continuity of the exhaust gas measurement.

If the emission reduction measures for TPP Kosovo A are carried out, it is necessary to make the investment as small as possible in order to avoid over-specification and meet the optimum specification through understanding of the existing facility capacity and operation conditions.

In order to improve the exhaust gas, combustion management of boilers and the maintenance of equipment are necessary. The Project proposed the following short-term issues. If investments are allowed, those measures are feasible, but it is necessary to study considering the whole picture of plans for TPP Kosovo A. At the same time, if the measures mentioned below are applied, it is necessary to conduct exhaust gas measurement and evaluated their effect.

i) Completion of the on-going Dust reduction measures
  - The improvement by application of intermittent energization control system to ESPs
  - The improvement of ESP inlet guide vane (for ESPs where it has not been implemented)

ii) Additional investment to make the Dust reduction measures surer and more sustainable
  - Reduction of air leakage from air side to exhaust gas side in the air preheater (adjustment of air- exhaust gas sealing apparatus or renewal of sealing apparatus)
  - Clean-up of heat transfer surface of boilers (inspection, cleaning and installation of additional soot blowers)

iii) Improvement of exhaust gas from the boiler
  - Improvement of heat exchange in the air preheater (inspection of heating element and/or replacement)
  - Establishment of better operation for SO_2 reduction by improvement of equipment (remote control of burner damper opening, installation of additional thermometer, etc.)

iv) NO_X reduction measures

Installation of two stage combustion and low NO_X burner is required in order to reduce NO_X. However, since combustion condition and furnace temperature will change by the installation of NO_X burner, and optimum boiler operation must be found through the observation of the boiler operation condition. At the same time, the installation of NO_X burner has a possibility to reduce SO_2. However, in order to find the SO_2 reduction condition, in addition to the measures already tested in the Project, it is necessary to conduct additional tests such as change in burner damper opening (the damper opening must be controlled remotely after the low NO_X burner installation), change in the amount of secondary air for two stage combustion, etc. because of the change in combustion condition and furnace temperature.

v) SO_2 reduction measures

The installation of de-sulfurization equipment is indispensable to ensure the reduction of SO_2. However since the investment is very large, careful consideration is necessary. On the other hand, inferred from the knowledge in the Project, SO_2 reduction is possible if the combustion conditions such as the temperature and O_2 in the combustion gas in the de-sulfurization zone is controlled. If the improvement mentioned above such as two stage combustion and low NO_X burner, remote control of burner damper opening, installation of additional thermometer, etc. can enable the control of the combustion, and at the same time, if the change in lignite property can be controlled to some extent, SO_2 reduction may be realized.

If the improvement mentioned above is implemented, confirmation of SO_2 reduction should be confirmed. However, if SO_2 still cannot be reduced, the installation of de-sulfurization equipment is the only other measure to be undertaken.

4) Response to TPP Kosovo B after the rehabilitation (Output 7 &2)

As for TPP Kosovo B, renovation and installation of the new exhaust gas treatment equipment is planned to be carried out at the time of its rehabilitation by the EU. However, after the installation, the exhaust gas measurement by the Kosovo side is indispensable and the performance of the new equipment should be confirmed. Installation of the exhaust gas treatment equipment does not guarantee the performance, and the exhaust gas measurement is the only way to confirm the performance of the exhaust gas treatment equipment. It is very important to continue with the exhaust gas measurement.

When summarizing mentioned above, in the field of Measurement and Emission Reduction Measures, the following activities are recommended. At the same time, the necessary number for the reinforcement of staff, equipment, etc. are listed.

Major future issues are utilization of exhaust gas measurement, dissemination of measurement implementation and reporting by facilities, and the improvement of the knowledge and strengthening of instruction capacity for emission reduction measures.

Field	Point of Issues	Priority	Pre-condition and equipment, etc.	Remarks
Performance evaluation technology	Evaluation of performance and emissions from solid fuels for heating of households, etc.	High	・Reinforcement with one staff for analysis work is indispensable ・Provision of testing site, purchase of heating equipment, etc. are necessary	Test and measurement equipment must be newly installed, and the staff must be trained. However, target substances are limited to SO_2、NO_X and Dust.
	Evaluation of the exhaust gas from vehicles	High	It is a precondition that the Kosovo side arranges a team for measurement (Three (3) members are required) ・Measurement equipment: requires a big budget.	This activity installs measurement equipment in various vehicles, and evaluates the exhaust gas.
Exhaust gas measurement and Emission Reduction Measures	Dissemination of the exhaust gas measurement	High	・Reinforcement with two staff is indispensable: one for Inspectorate and one for measurement ・Participation from DIPM is strongly recommended ・No additional equipment is required	Inspector, staff from KHMI, staff from DIPM must engage in this work full-time during this activity. The activities are carried out for five facilities or so. ・The number of persons required for measurement is three (3)
	Learning of fundamental knowledge and skills for exhaust gas measurement and Emission reduction measures	High	・Participants in the item described above must attend the lectures carried out through this activity.	This activity is carried out along with the item described above. Through lectures, participants will learn fundamental knowledge on exhaust gas.
	Exhaust gas measurement	Low	・There is currently no concrete activity, and contents of	Rehabilitation of TPP Kosovo B is planned to start from the next

	at TPP Kosovo A & TPP Kosovo B		implementation cannot be settled. ・ No equipment is required	year. However, Japanese side cannot get involved in this work since the rehabilitation is carried out by EU.
	Introduction of intermittent energization control for ESPs	High	・ The priority will be high when intermittent energization control for ESPs is actually introduced.	Introduction of intermittent energization control for ESPs is recommended by the Project.

Priority (recommended by JET)

High: Activities with high priorities that should be adopted with reinforcement of staff.

Medium: When conditions are met, activities that should be carried out

Low: When conditions are met and the Kosovo side's need becomes high, activities that should be carried out

(3) Request from the Kosovo side

The Kosovo side has acquired the technology of the exhaust gas measurement and calculated and wrapped up the measurement results. Therefore, the Kosovo side does not have a specific request. From now onward, it is important to keep maintenance of the equipment and to secure the procurement of the auxiliary equipment.

As emission reduction measures for TPP Kosovo A, C/P (especially TPP Kosovo A) have learned several kinds of emission reduction measures, but only the Dust reduction measure has been put into practice because of the restriction of the budget. However, if approved, C/P hopes to apply more measures for improvement. However, TPP Kosovo A is quite old, and therefore, if there is any investment, it is necessary to carefully consider the priorities.

As for other stationary sources, MESPI/MESP desires to regulate emissions from them, but the situation is not as it should be because of the lack of knowledge and experience of the exhaust gas measurement and emission reduction measures. Further capacity development and enhancement of the capabilities of MESPI/MESP to give instructions is required.

5.2.4 Future issues and proposals for Assessment for Decision Making (Output 8)

Output 8: Capabilities for evaluating air pollution control measures by Kosovo side are developed.

(1) Summary and evaluation of the Project activities

The Kosovo side has learned the step to plan measures and evaluate the effect of measures.

The Project, in the second period, reviewed measures in Strategy/Action plan on the air planned by Kosovo, and, in the third period, broke down them to measures with scenarios which makes concrete evaluation possible and prepared the evaluation sheets.

In particular, activities were to identify target air pollutants, to select emission sources to be studied through use of ground-level pollutant concentration map based on the emission inventory and simulation calculation, to create scenarios of measures and calculation condition based on the emission inventory data, to provide emission reduction amount calculated from the emission inventory, to calculate ground-level pollutant concentration map before and after the measures, to estimate cost effectiveness, to study implementation method of measures, to list issues on implementation of measures, to evaluate measures from the technical and social point of view, etc.

In addition to the members of Output 8 in charge of the activities, members of Output 1 participated in the activities. This makes the establishment of the institutional framework go forward, since members could discuss measures deeper in the process of planning, study, evaluation, etc. and the concrete procedures, roles and responsibility became clearer.

On the other hand, it became clear that the measures for other sources were not sufficiently studied. It is necessary to understand emission condition from vehicles, small combustion plants, etc. and to study measures for reduction of these emissions. The need of the Kosovo side is increasing regarding the revision of the Action Plan, etc. through the study and evaluation of measures.

(2) Proposals from the Project activities

It is very important to plan and evaluate measures from the information and data based on scientific and technical evidences. In Kosovo, other ministries and municipalities collect many kinds of information and therefore, it is necessary to enhance the collaboration with them and establish system to collect necessary information. It is also necessary not only to organize information and study how to collect emission information but also to study how to construct new information system as necessary.

The proposals obtained from the Project activities are as follows.

1) The will of C/Ps for the Project activities

C/Ps managed their schedule and gave priority to participating in the meetings. Especially in the third period, when the Project intensively discussed on the study of measures, they gave priority to participating in the meetings of the Project by managing their schedule according to the presented schedule. As a result of highly motivated activities, capacity of C/Ps for study and evaluation of measures has been strengthened and the output of evaluation sheets which are the basic materials for the revision of the Action plan has been obtained. From now on, in case of the projects supported by other foreign donors, activities should be matched and met with the needs of host countries and C/Ps, which increases the will of C/Ps for their works and enhances their capacity.

2) Support for strengthening the mechanism for information exchange and active participation in air pollution control measures

In Kosovo, air pollution in winter season is especially serious, and the collaboration among ministries, relevant institutions and municipalities are important. Therefore, it is required to set the platform for exchange and provision of information and share and disclose information actively to the public.

In order to plan measures, it is necessary to investigate what kinds of information ministries, relevant institutions and municipalities have, and to understand what they are. Based on the information, it is desirable to recognize insufficient information and data for planning measures, and to seek other collection methods or new data preparation methods

In order to get things go forward, it is necessary to strengthen the mechanism for information exchange and active participation in the work, and taking responsibilities for implementation of the measures. It is also necessary to settle roles and responsibilities of above-mentioned relevant institutions about the plan of the institutional framework for planning, studying, evaluating and implementing measures studied in the Project. In addition, in the process of MESPI/MESP activities such as the revision of the Action Plan, air pollution control measures should be planed, studied, evaluated and implemented through the established institutional framework.

Although measures were studied by the Project, the main issue is how to implement the evaluated measures. It is desirable to conduct a series of works such as plan, study, implement and evaluate measures based on the established institutional framework including the follow-up and feed-back of detailed implementation study, and the results.

3) Support for research regarding information and data collection and collection method of necessary data

Air quality data, emissions from category of manufacturing, emissions from small combustion such as residential stationary and tertiary industry stationary sources, etc. are very important basic information for planning measures. Although this time the air quality data was organized, at this moment other data did not reach the level to be judged in regards to their reliability.

Kosovo side requires more support in identification of the best option for reducing air pollution from households, as a major contributor to air pollution.

4) Application of Evaluation Sheet for developed Measures

The evaluation sheets developed by the Project should be used as materials for study and discussion in the Working Group established at the time of preparing the Action

Plan in accordance with the Air Quality Strategy in Kosovo. In the Project, the discussion with traffic police within MIAPA/MIA, etc. was carried out, which is similar to the Working Group.

Kosovo side requires further support for capacity development on the preparation of the evaluation sheets through OJT by foreign donor support projects on calculation of emission reduction, cost estimation, and concentration maps in cooperation with other bodies.

It is desirable to draft an Action Plan by taking steps on preparing the evaluation sheets based on technical evidences utilizing the knowledge and approach in the Project and studying measures quantitatively.

5) Utilization of various Administrative Tools

Kosovo side has acquired various administrative tools such as air quality data, emission inventory, simulation, exhaust gas measurement, analysis, etc. through the Project. Air quality data and emission inventory are the very important tools for planning, studying and evaluating measures, and they should be utilized a lot. In order to improve data quality for the emission inventory, exhaust gas measurement and analysis technology is indispensable. Improvement and utilization of these technologies sustainably are very important. At the same time, when measures are planned based on the technical evidences, the reliability and effectiveness of measures will be high. The quality of policy for air pollution control should be raised in parallel with sustainable improvement of quality of these tools.

6) Implementation of study on emission reduction measures for Manufacturing Industries

In the Project, many issues have been found for other stationary sources through the exhaust gas measurement and study on emission reduction measures. Kosovo side should identify emissions from the manufacturing industry, and study and evaluate air pollution control measures in the manufacturing industry through the emission inventory preparation.

Further Capacity development for inspectors is necessary through OJT of exhaust gas measurement for stationary sources through support of foreign donors like JICA. For the Kosovo side it is required to improve the ability of officials to instruct operators on exhaust gas measurements and emission reduction measures through support from foreign donor projects. In addition, Kosovo side requires more support for the capacity development of officials on understanding the results of exhaust gas measurements and emission reduction measures for stationary sources.

At the same time, the emission reductions from manufacturing industries should be carried out by the fuel shift, improvement of industrial process etc. Therefore, Kosovo side should develop Fuel Tax and Subsidy schemes for the purpose of emission reductions from stationary sources by referring to the evaluation of measures carried out by the Project. This is one of emission reduction measures as administrative activities, by using not only the regulation but also the market mechanism. In regards to this, Kosovo side, at present, requires more support from foreign donors.

7) Implementation of study on emission reduction measures for vehicles

According to the vehicle registration information, etc. it is found that many vehicles with old emission EU regulation are used. The Project especially found high NO_X emissions from vehicles. However, appropriate measures in line with the actual situation cannot be studied since vehicle emission factors in Kosovo have not been obtained. It is necessary to identify emissions more accurately based on the emission measurement, and to study and evaluate measures for vehicle emissions through the emission inventory.

Kosovo side requires support for the capacity development for exhaust gas measurement from vehicles and analysis of emissions from the transport sector.

It is also necessary to study and evaluate measures to reduce emissions from vehicles by introducing modal shift such as expansion of public transportation, decrease of traffic volume, etc. In order to evaluate the effect, it is necessary to collect data, which are required to set the traffic volume by category type and traveling speed before the implementation of measures.

8) Establishment of administrative procedures for drafting the Action Plans

When the concrete Action Plan is studied, core content will be the evaluation sheets prepared by the Project. In order to revise the Action Plan, MESPI/MESP with the assistance of foreign donors should utilize the evaluation sheets and expand the study of measures and make a plan not only to lead to the solution of air pollution problems in Kosovo but also satisfy the EU requirements.

Kosovo side requires support in revising the Air Quality Strategy and Action Plan, through the capacity development for identifying measures based on analysis of emissions sources.

9) Support for the enforcement of the law on “Air Protection from Pollution”

MESPI/MESP has drafted the law on “Air Protection from Pollution” in line with the EU directives, and the law is going to be enforced soon.

Kosovo side requires additional capacity development of officials at Municipality level on understanding and identifying the Measures including the analysis of emissions sources. DEPW/DIPM should support preparation of the local level Action Plan, but at the same time DEPW/DIPM needs more support from the foreign donors such as JICA.

In addition, the actual enforcement of the law still has many issues. Issues are the acquisition of ISO17025 by KHMI, implementation of exhaust gas measurement and reporting by private agencies, instruction to the private facilities by inspectors, etc. and every issue needs to foster staff through education and training, institutionalization of implementation mechanism, etc., and this takes time. Therefore, it is desirable to make an Action Plan and proceed with the plan in a planned manner by using support from foreign donors, etc.

(3) Request from the Kosovo side

Through the Project, Kosovo side was able for the first time to quantitatively consider the measures using technical evidence. Therefore, the knowledge and experience gained from the Project will be utilized for application of the revised Action Plan for air quality, preparation for implementation of various measures in Kosovo, requested by the EU, etc.

The Kosovo side is requesting further support for these activities.

1) Implementation of reduction measures for $PM_{2.5}$

The term $PM_{2.5}$ is well known to the citizens of Kosovo, and as a MESPI/MESP, it is an essential substance to be examined in order to deal with the problem of air pollution. Therefore, Kosovo side is requesting the study of comprehensive measures including source contribution analysis for PM such as PM_{10} and $PM_{2.5}$.

Therefore, JET makes the following recommendations in response to this request from the Kosovo side. When it is necessary to consider such PM produced by a chemical reaction in the environmental atmosphere (secondary generation), air pollutants such as volatile organic compounds (VOC) and ammonia (NH_3) are also presumed to be important. When air pollutants such as ammonia are the subjects of consideration, it is expected that it will be important to consider measures for the agricultural sector and waste sector.

Support of the contents such as the $PM_{2.5}$ source contribution analysis, etc. should be studied based on the lessons learned by the projects such as 'Capacity Development Project for Air Pollutant Control in Ulaanbaatar City Phase 3' and 'Capacity Development Project for Air Pollutant Control in Tehran City' that are currently being implemented.

2) Implementation of study on reduction measures for a wider range of emission sources

In order to revise the Action Plan, MESPI/MESP needs to consider measures for the whole of Kosovo and for all sectors, categories and subcategories. The Kosovo side is requesting support for such activities. If PM needs to be considered as described above, not only emissions from fuel combustion sources in the energy sector but also other air pollutants must be considered. It is expected that it will be necessary to consider and evaluate measures for all sectors as necessary.

Therefore, Kosovo side should independently revise the Action Plan while receiving support from foreign donors. If the quality of the emission inventory such as the actual emissions based on the actual measurement results from major emission sources and the quality of activity data are improved, then measures based on higher quality scientific and technological evidence can be proposed. Therefore, Kosovo side should carry out environment air administrative activities in an integrated manner such as emission performance researches, emission inventory preparation, simulation calculations and the evaluation of measures working together with foreign donors as necessary.

3) Implementation of air pollution control measures in other regions

AQMSs rehabilitation was completed in November 2019 and the accuracy of data from nationwide AQMSs has been improved, and the problem of air pollution in winter in other cities such as Prizren, Gjilan, and Peja is turning out to be similar to that of Pristina city. Therefore, the Kosovo side is requesting support for the examination of air pollution control measures for other municipalities since it is expected that action plans will be required.

Therefore, JET makes the following recommendations in response to this request from the Kosovo side. The technology of emission inventory preparation and simulation modeling acquired through the Project can also be applied to the analysis of the situation in other municipalities. Therefore, using the Project as a model project, Kosovo side should independently consider measures for these cities by collecting and analyzing information. Since some municipalities can have their own specific issues, it is assumed that Kosovo side should implement specific measures for some cities.

In addition, since there is also the issue of monitoring heavy metals in PM in the air at Drenas and Mitrovica, it is desirable to continuously monitor heavy metals in PM and publish the values associated with the measurement and analysis.

4) Support for Preparation of NEC

The GoK, especially the MESPI, should prepare the NEC in accordance with EU requirement. However, since the preparation of NEC needs many administrative procedures, the procedure should be carried out step by step with support by foreign donor projects.

The NEC needs future scenarios and future action plans, because NEC is future emission reduction target. For the preparation of emission reduction target, WOM, WEM and WAM scenarios is necessary. These are also technical evidences.

By referring to these technical evidences, the MESPI should prepare the administrative documents such as the AI, the necessary regulation, and the Action plans. Kosovo side requires these supporting activities for the target area of the future project.

From the view point of air quality management, MESPI/MESP needs the collaboration activities with other relevant organizations for establishment of NEC.

Through the collaboration with relevant organizations, the MESPI/MESP will finalize the future scenarios such as WOM, WEM, and WAM, and will set the emission reduction targets of the target years as NEC.

Annex and Appendix List

ANNEX-1 Joint Coordinating Committee Meeting related documents

Appendix-1 Output materials of the Project
Appendix-2 Capacity Assessment
Appendix-3 Newsletters