

Thailand
Ministry of Natural Resources and Environment
(MONRE)

**Project for Sustainable Management of
PM_{2.5} Prevention and Reduction
Measures, Thailand**

Project Completion Report

September 2025

Japan International Cooperation Agency (JICA)

SUURI-KEIKAKU CO., LTD
Nippon Koei Co., Ltd.
Japan Environmental Sanitation Center

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Project Completion Report

Project Name: Project for Sustainable Management of PM_{2.5} Prevention and Reduction Measures, Thailand

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Submission Date: 30 June 2025

I. Basic Information of the Project

1. Country:

Thailand

2. Title of the Project:

Project for Sustainable Management of PM_{2.5} Prevention and Reduction Measures

3. Duration of the Project (Planned and Actual):

Planned duration of the Project: July 2022 to July 2025

Actual duration of the Project: July 2022 to July 2025

4. Background (from Record of Discussions (R/D))

In recent years, Thailand has been experiencing serious air pollution from PM_{2.5} (fine particulate matter), which has an increasingly negative impact on the health and quality of life of the people. The sources are assumed to be diverse, including slash-and-burn

agriculture, industrialization, urbanization, and transboundary haze, however, due to a combination of meteorological and geographical conditions, serious air pollution by PM_{2.5} has been observed during certain periods of the year (e.g., January to February in Bangkok and March to April in northern area of Chiang Mai). According to the "Thailand State of Pollution 2020" published by Pollution Control Department (PCD) of the Ministry of National Resources and Environment (MONRE), annual average of PM_{2.5} concentration in 2020 was 23 µg/m³, which is below the Thai air quality standard¹ (annual average of 25 µg/m³ or less), while the north experienced 112 days of exceeding air quality standard due to slash-and-burn farming and forest fires in the dry season, recording up to 366 µg/m³ in 24-hour average, which was worse than in 2019.

In Thailand, the Enhancement and Conservation of National Environmental Quality Act (1992) stipulates the authority of National Environment Board (NEB) and the MONRE/PCD to formulate environmental policies and to coordinate environment-related activities among relevant agencies and provinces. Based on the Act, the National Primary Ambient Air Quality Standards (NAAQS) was established, taking the latest information on human health effects into account. NEB has the authority to set overall environmental standards, including ambient air quality standards, and PCD is responsible for making recommendations on environmental standards to the NEB.

PM_{2.5} air quality standard was set in 2010 and its monitoring started in 2011 (initially only at one location in Bangkok), and the countermeasure against the air pollution caused by PM_{2.5} has been positioned as one of top priorities of the Thai government. In the National Action Plan for the Reduction of Particulate Matter (PM), which was approved by the Cabinet in October 2019, short- and long-term action plans were established for each of the main sources considered: transportation, agriculture, industry, urban planning and construction, and households, with efficient and timely actions and initiatives. Since the establishment of air quality standards² in 1995, Thailand has been promoting the development of the monitoring system, and as of January 2021, 73 air quality monitoring stations (14 in the north, 6 in the northeast, 12 in the east, 3 in the west, 30 in the center, and 8 in the south) and 6 mobile stations were established throughout the country. The results of measurements obtained at these monitoring stations are published on a

¹ It indicates the PM_{2.5} environmental standard at the submission stage of the request form, and the new standard has been applied since June 2023 (see 2.5.2).

² CO: 30 ppm (1 hour value) 9 ppm (8 hour value), NO₂: 0.17 ppm (1 hour value), SO₂: 0.3 ppm (1 hour value) 0.12 ppm (24 hour average value), 0.04 ppm (annual average value), O₃: 0.1 ppm (1 hour value), TSP: 0.33 mg/m³ (24 hour value) 0.1 mg/m³ (annual average value), PM₁₀: 0.12 mg/m³ (24 hour average value) 0.05 mg/m³ (annual average value)

regular basis on the website operated by the MONRE/PCD (Air4Thai (www.air4thai.pcd.go.th)), which is used on a daily basis to check the atmospheric conditions, and is also effective in raising public awareness. However, the emission inventory based on the data and information obtained from the monitoring, clarification of the causes of emissions, and simulations based on the relationship with meteorological and geographical conditions have not been sufficiently conducted.

Furthermore, as the signatory nation of the ASEAN Transboundary Haze Pollution Agreement, Thailand is expected to play an important role in supporting the prevention of the forest fire and the mitigation of the transboundary haze in Mekong River basin, particularly in Cambodia, Laos, Myanmar, and Vietnam (CLMV), and promote enhanced efforts in ASEAN member countries.

Based on the above, to identify emission sources of air pollution caused by PM_{2.5} in Thailand and to study and implement countermeasures according to the cause, it is necessary to clarify the causes and structure of air pollution based on air quality monitoring, and to plan and evaluate effective air pollution mitigation measures based on such information and data.

Under these circumstances, in 2020, the Government of Thailand requested Japan and JICA to implement “Project for Sustainable Management of PM_{2.5} Prevention and Reduction Measures, Thailand” (the Project) with MONRE as the counterpart (C/P), and MONRE/PCD and JICA signed Record of Discussion (R/D) for the Project on 25 February 2022. The main objective of the Project is to promote sustainable management of air quality by strengthening the capacity of PCD and relevant agencies for planning and evaluating policy and measurements to prevent and reduce air pollution caused by PM_{2.5} through the Project activities.

5. Overall Goal and Project Purpose

Overall Goal and Project Purpose is shown in Table 1. At the first Joint Coordinating Committee (JCC) meeting held on 27 September 2022, the Project Purpose was revised—from “Capacity of PCD for PM_{2.5} prevention and reduction measures is strengthened” to “Capacity of PCD and relevant agencies for PM_{2.5} prevention and reduction measures is strengthened” based on suggestions from JCC members, in order to broaden the scope of target organizations for capacity development.

Table 1 Overall Goal and Project Purpose

Overall Goal	Sustainable management of PM _{2.5} is promoted through appropriate PM prevention and reduction measures in Thailand.
Project Purpose	Capacity of PCD and relevant agencies for PM _{2.5} prevention and reduction measures is strengthened.

6. Implementing Agency (from Record of Discussions (R/D))

Pollution Control Department (PCD) of the Ministry of National Resources and Environment (MONRE) (July 2022 to July 2025)

II. Results of the Project

1. Results of the Project

1-1 Input by the Japanese Side (Planned and Actual)

(1). Dispatch of Japanese Experts: 11 people

Eleven short-term experts were dispatched during the Project implementation period. The overview of the dispatch of Japanese experts to Thailand by July 2025 is shown in Table 2. The list of dispatched experts is shown in Appendix 1-1.

Table 2 Dispatch of Japanese experts

Dispatched Period	From July 2022 to June 2025
Number of dispatched Japanese Experts	11 people
Total M/M	55.29 man/month (M/M)
Number of total dispatched times	106 Times

(2). Number of Trainees in Japan: 6 people

A total of six C/Ps and JCC members participated in the three training programs in Japan. These six participants took part in the JICA Knowledge Co-Creation Programs in Japanese Fiscal Year (JFY) 2022, 2023, and 2024. The outline of the training programs is shown in Table 3 below.

Table 3 Number of Trainees in Japan

Training course	Training program title	Training period	Number of Participants
JICA Knowledge Co-Creation Program (KCCP)	Capacity Development towards Air Quality Management JFY2024	24 November 2024 to 21 December 2024	3
	Capacity Development towards Air Quality Management JFY2023	23 January 2024 to 22 February 2024	2
	Capacity Development towards Air Quality Management JFY2022	8 March 2023 to 5 April 2023	1
Total			6

(3). Procured Equipment: 3,976,437 Yen

3,976,437 yen was spent on high performance PC. The list of equipment procurement in the Project is shown in Table 4. The procured equipment is shown in Appendix 1-2.

Table 4 Procured equipment

Output	Item of Equipment	Quantity	Using Period	Progress
Output 2	High performance PC for simulation model	1 set	1 st year	Procurement and installation of equipment was completed in March 2023. UPS (Uninterruptible Power Supply) was installed by PCD.

1-2 Input by the Thai Side (Planned and Actual)

(1). Allocation of Counterpart

1) JCC Chairman, Project Director, Project Manager, Project Coordinator

In accordance with R/D, PCD assigned JCC Chairman, Project Director, Project Manager and Project Coordinator as shown in Table 5 (1).

Table 5(1) Allocation of counterpart (JCC Chairman, Project Director, Manager, Coordinator)

JCC Chairman	Mr. Pinsak Suraswadi	Director General of PCD, July 2022 to September 2023
	Ms. Preeyaporn Suwannaked	Director General of PCD, October 2023 to now
Project Director	Mr. Pornsak Phuim	Deputy Director General of PCD, July 2022 to June 2023
	Ms. Kanchalee Navickabhun	Deputy Director General of PCD, July 2023 to now
Project Manager	Mr. Pansak Thiramongkol	Director of Air Quality and Noise of PCD, July 2022 to September 2024
	Mr. Teeraphong Wimoljitrannon	Director of Air Quality and Noise of PCD, October 2024 to now
Project Coordinator	Ms. Pateeya Ketsin	Director of Planning and Processing Sub-Division of PCD

2) C/P Organizations

Table 5 (2) shows relevant organizations and agencies in Thailand for the Project as the Counterpart (C/P), the Counterpart Working Group (C/P-WG), and Cooperating members. Refer to Appendix 1-3 for detailed information on C/P.

Table 5(2) C/P, C/P-WG, and Cooperating Members

Item	Relevant Organizations
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Counterpart (C/P)	Pollution Control Department, Ministry of Natural Resources and Environment (MONRE/PCD)
Counterpart Working Group (C/P-WG)	Project Team (JICA Expert Team (JET) and 17 persons from Air Quality and Noise Management Division of PCD as follows) 1) Director of Air Quality and Noise Management Division: 1 person 2) Expert on Air Quality and Noise Management: 1 person 3) Director of Ambient Air Quality Sub-Division: 1 person 4) Director of Automotive Air Pollution Sub-Division: 1 person 5) Director of Industrial Pollution Sub-Division: 1 person 6) Director of Transboundary Air Pollution Sub-Division: 1 person 7) Director of the Air Quality and Noise Innovation Sub-Division: 1 person 8) Director of Planning and Processing Sub-Division, Secretary: 1 person 9) Other environmentalist of senior professional level and professional level under Air Quality and Noise Management Division officially appointed by PCD order No.146/2022.: 9 persons
Cooperating members	1) Bangkok Metropolitan Administration (BMA) 2) Provincial Offices of the Ministry of Natural Resources and Environment in the pilot areas ³ 3) Regional Environment Offices in the pilot areas 4) Relevant agencies from JCC member

(2). Provision of Necessary Office Space

The Thai side provided the office on the 9th floor of PCD building from July 2022 to July 2025 in conjunction with air conditioning, electricity and internet for the Project.

(3). Other In-kind Contributions by the Thai Side

The Thai side contributed the following items as in-kind;

- Securing the space for storing the equipment in the computer room on the 7th floor of PCD building,
- Providing network access (including network access from Japan for activities of Output 1 and Output 2)
- Using meeting rooms, and
- Electricity, water supply, and clean-up and other operation of the Project

³ The pilot area is the Bangkok Metropolitan Region, which consists of the Bangkok Metropolitan Administration (BMA), and the provinces of Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan, and Samut Sakhon.

1-3 Activities (Planned and Actual)

(1). Plan of Operation

Plan of Operation (PO) is shown in Appendix 1-4.

(2). Effect of COVID - 19

At the beginning of the Project, there were cases where the return of Japanese experts was postponed due to COVID-19 infection, but there was no significant impact throughout the Project period.

(3). Addition of Activities

Based on the request from PCD, activities related to the evaluation of co-benefit effects in Output 4 and the study of open burning monitoring method using JAXA-HIMAWARI monitor and Mekong seminar in Output 6-2 were added.

1) Evaluation of co-benefit effects (Output 4 and Output 1)

A. Conduct reviews on the synergy effect between Thailand's major climate change measures and PM pollution control measures such as the National Action Plan for PM Reduction (2019-2024) (hereafter referred to as "NAP").

Regarding the air pollution control measures proposed in the second NAP, the effect of reducing greenhouse gas emissions was evaluated.

B. In the policy proposal report that contributes to improving the effectiveness of the "National Action Plan for PM Reduction (2025-2029)" currently being formulated by the MONRE/PCD, the promotion of co-benefit measures that balance PM reduction and promotion of climate change measures was included.

2) Study of open burning monitoring method using Himawari monitor for Policy Analysis (Output 4 and Output 2)

A. Study of effective methods and data utilization methods for open burning monitoring using Himawari monitors was conducted. At that time, a visualization tool using actual data from Himawari monitor was prepared, and measures to prevent open burning and cross-border pollution throughout Thailand were also arranged.

B. As part of the "public communication and publicity of the results of activities", an introduction panel was created at the exhibition space of Thailand Space Week 2024 to be held in Bangkok from November 7 to 9, 2024, and support was provided

for the exhibition on the day.

3) Mekong seminar (Output 6)

Hosted by JICA and the MONRE/PCD, the “Seminar on Sustainable Management of PM_{2.5} Prevention and Reduction Measures in Mekong Region” was held in Bangkok on May 20–23, 2025, inviting Mekong countries to Thailand to share the knowledge and experiences obtained from the Project.

2. Achievement of the Project

The degree of achievement of the Project and that of the achievement of the Project purpose were evaluated on a four-point scale of very high, high, medium, and low.

2-1 Outputs and Indicators

Table 6 below shows the achievement and progress against the Obviously Verifiable Indicators (OVIs) for each Output described in the PDM.

Table 6 Achievement of Outputs

Output 1: PM emission inventory in the pilot areas is improved.	
Evaluation: High (Set OVIs were achieved.)	
1-1 Modified emission inventory in the pilot areas is being properly functioned.	Emission inventory for simulation modeling in the pilot areas was developed in July 2024. Report on emission inventory for simulation model was finalized in February 2025.
1-2 Recommendations for improvement of nationwide emission inventory is developed and presented to C/P-WG.	Nationwide emission inventory report including recommendations was finalized in February 2025.
Other accomplishments - Improved inventory of stationary sources, road transport, and field open burning in the Bangkok Metropolitan Region (BMR) was developed, which can be used for air quality simulation modeling. - Stationary sources and road transport emission amount accuracy were improved. Field open burning temporal pattern close to actual situation was identified by using satellite products. - By aggregating the emission inventory by province from grid-based emission data, PCD can consider which air pollutant amounts are high in which province.	

<ul style="list-style-type: none"> - PCD reviewed the recommendations in the inventory report needed to improve the inventory and discussed the necessary structure for estimating the inventory. 	
<p>Output 2: Preliminary simulation modeling for air quality management in the pilot areas is developed.</p>	
<p>Evaluation: High (Set OVI's were achieved.)</p>	
<p>2-1 Simulation model for air quality management in the pilot areas is being utilized for early analysis and analysis of pollution structure and effectiveness of PM_{2.5} prevention and reduction measures.</p>	<p>Simulation model was utilized for pollution structure analysis and effectiveness of PM_{2.5} prevention and reduction measures in the pilot areas.</p>
<p>2-2 Guidance for simulation model implementation is developed and presented to C/P-WG.</p>	<p>Guidance was developed by summarizing presented materials to simulation training in May and June 2025.</p>
<p>Other accomplishments</p> <ul style="list-style-type: none"> - Guidance for simulation model was finalized by C/P-WG in May 2025. - PCD and JET discussed the implementation framework to utilize the simulation model in line with functions of air quality management by PCD. 	
<p>Output 3: Capacity to assess pollution structure in the pilot areas is strengthened.</p>	
<p>Evaluation: High (Set OVI's were achieved.)</p>	
<p>3-1 PM_{2.5} pollution status report in the pilot areas are developed and presented to C/P-WG</p>	<p>PM_{2.5} pollution status report in the pilot areas was finalized in June 2024.</p>
<p>3-2 Population-weighted average PM concentration in the pilot areas can be analyzed by use of monitoring data and the simulation model.</p>	<p>Map of population-weighted average of PM concentration in the pilot areas was described in PM_{2.5} pollution status report.</p>
<p>Other accomplishments</p> <ul style="list-style-type: none"> - The ability of individuals and organizations to analyze air quality monitoring data has been improved. - From 2020 to 2025 monitoring data in dry season has been analyzed by the same method of the status report for 2019 data. - The analysis of the 2019 status report confirmed the significant evaluation of secondary particles. - The analysis of the 2019 status report revealed the basic structure of PM_{2.5} 	

<p>pollution in the BMR.</p> <ul style="list-style-type: none"> - The results of the status report analysis in 2019 found that, since the distribution of measurement stations is biased to BMA and its periphery, it is necessary to properly re-arrange the representative monitoring stations to understand primary and secondary particles in BMR. - The monitoring of the additional parameters which are considered as the possible precursors are crucial. - As for the evaluation of PM_{2.5} pollution in BMR, the collaborative implementation of the monitoring with BMA is practically significant. 	
<p>Output 4: Capacity to develop and evaluate PM prevention and reduction policies and measures is enhanced.</p>	
<p>Evaluation: Very High (Set OVIs were achieved and beyond the level which was set at the detailed planning survey stage.)</p>	
<p>4-1 Proposals of priority measures for PM_{2.5} prevention and reduction are developed and presented to C/P-WG</p>	<p>Proposals of measures (recommendations for 2nd NAP) were developed and presented. The report was finalized with C/P in March 2025.</p>
<p>4-2 Guidance for formulation and implementation of PM_{2.5} prevention and reduction measures is developed and presented to C/P-WG</p>	<p>Guidance for formulation and implementation of PM_{2.5} prevention and reduction measures was developed and finalized based on policy recommendations in June 2025.</p>
<p>Other accomplishments</p> <ul style="list-style-type: none"> - Through the activities under Output 4, process of evidence-based policymaking and evaluation for PM prevention and reduction measures was supported, utilizing the outcomes of Output 1 (Inventory), Output 2 (Simulation), and Output 3 (Pollution Structure Analysis). This process was aligned with the review of the 1st National Action Plan (NAP) (2019–2024) and the formulation of policy recommendations for the 2nd NAP (2025–2034). These results were consolidated into the “Recommendations on Policy and Countermeasures for PM Reduction and Prevention in the Bangkok Metropolitan Region” (hereinafter referred to as the “PM Policy Recommendation”). - The draft 2nd National Action Plan for PM Reduction (2025-2027 and 5-Year continuing) was approved by the National Environmental Board of Thailand in January 2025 and the National Economic and Social Development Council of Thailand in February 2025. JET contributed to it by providing inputs through preparation of PM Policy Recommendation. 	

<p>- These efforts have contributed to achieving the Overall Goal of the Project.</p>	
<p>Output 5: Results of capacity development activities in the pilot areas are shared with other provinces for capacity building.</p>	
<p>Evaluation: High (OVIs were achieved.)</p>	
<p>5-1 Training plans with curriculum and materials are developed and presented to C/P-WG.</p>	<p>Training plans with curriculum and materials were developed and presented to C/P-WG.</p>
<p>5-2 Trainings are conducted for MONRE regional/provincial offices and provincial governments at least 6 times.</p>	<p>Six times trainings were conducted as below. <Overall training (PCD, BMA, DIW)> 1) First training: 4 Sep. 2024 (EPO 13 & Provinces) 2) Before Crisis Season training: 2 Dec. 2024 (EPO 5, 6, 13 & Provinces) 3) After Crisis Season training: 16 May 2025 (EPO 5, 6, 13 & Provinces) DIW: Department of Industrial Work EPO: Environment and Pollution Control Office <Thematic training (PCD, BMA, DIW)> 4) Emission Inventory: 28 to 29 Jan. 2025 5) Air Quality Monitoring: 18 to 20 Feb. 2025 6) Simulation: May – June 2025 (9 days training)</p>
<p>Other accomplishments</p> <p>- The implementation of the training has increased the capacity of personnel at relevant agencies/ regional and provincial organizations for inventory, simulation model, air quality monitoring data analysis and PM control measures.</p> <p>- In addition to the above, through the implementation of the training, the capacity of personnel at PCD headquarters was increased too. (Training of Trainers)</p>	
<p>Output 6: Knowledge and experience are disseminated to Mekong countries.</p>	
<p>Evaluation: High (OVIs were achieved.)</p>	
<p>6-1 Seminars are held to share lessons to Mekong countries by use of the developed materials and others at least 1 time.</p>	<p>The PM_{2.5} Mekong seminar was conducted from 20 to 23 May 2025. Progress of the Project activities were shared at international workshop and policy dialog</p>
<p>Other accomplishments</p> <p>- A regional dialogue mechanism focusing on air quality management at a national</p>	

agency level was established and strengthened through preparation and organizing the PM_{2.5} Mekong Seminar.

- A common tool (open burning detection system by JAXA-Himawari) to be utilized for Mekong countries were developed and shared in the PM_{2.5} seminar. Some countries expressed interests to utilize the developed tool.

2-2 Project Purpose and Indicators

Table 7 shows the achievement and progress against Objectively Verifiable Indicators (OVIs) of the Project Purpose described in the PDM.

Table 7 Status of Achievement of the Project Goal

Project Purpose: Capacity of PCD and relevant agencies for PM _{2.5} prevention and reduction measures is strengthened. Evaluation: Very High (Set OVIs were achieved, and the achievement level for Indicator 4 is beyond the one set at the detailed planning survey stage.)	
Indicator 1: Modified emission inventory in pilot area is being utilized for analysis and development of plans/measures for PM _{2.5} prevention and reduction by PCD including regional/provincial offices and governments in pilot area.	[Achieved] Modified emission inventory in the pilot areas has been utilized in Output 4 for inputting the 2nd National Action Plan for PM prevention and measures.
Indicator 2. MONRE started to take actions for the recommendations on improvement of nationwide emission inventory.	[Achieved] ^{note14} PCD and JET prepared nationwide emission report including recommendations. PCD and JET had a meeting to discuss key points for improvement of nationwide emission inventory.
Indicator 3. MONRE started to take actions for the proposed plan for further implementation of simulation model.	[Achieved]

⁴ PCD and JET interpret the definition of achievement of this Objectively Verifiable Indicator; “MONRE started to take actions for the recommendations on improvement of nationwide emission inventory.” that the report on recommendations for improvement of National Emission Inventory is finalized by C/P-WG and acknowledged by PCD for taking actions to improve emission inventory.

	<p>PCD and JET used simulation model for scenario analysis of policy recommendation on Output 4 and prepared the report including proposed plan to utilize the simulation model for MONRE. PCD and JET discussed policy cases by utilization of the High-performance PC for simulation model which was procured in the Project as starting to take actions.</p>
<p>Indicator 4. MONRE started to take actions for the proposals of policy measures for PM_{2.5} prevention and reduction.</p>	<p>[Achieved and beyond the level set at the detailed planning survey stage]</p> <p>The draft 2nd National Action Plan for PM Reduction (2025-2027 and 5-Year continuing) were approved by National Environmental Board of Thailand in January 2025 and National Economic and Social Development Council of Thailand in February 2025. JET has contributed to inputting the 2nd draft NAP through preparation of PM Policy Recommendation.</p> <p>As of June 2025, the 2nd NAP is waiting for the approval of the Thailand cabinet. The measures in 2nd NAP have been implemented by PCD and relevant agencies. As for directly related to the Project activities, the Department of Agricultural Extension (DOAE) has started to analyze agricultural open burning by the JET-developed preliminary tool for open burning detection system by JAXA-Himawari.</p>

3. History of PDM Modification

PDM has been updated twice from Ver.0.0 to Ver.2.0. Major changes are listed below. In addition, the PDM is shown in Appendix 3.

In the 1st JCC in September 2022, Project Purpose of PDM "Capacity of PCD for PM_{2.5} prevention and reduction measures are strengthened" was revised to "Capacity of PCD and relevant agencies for PM_{2.5} prevention and reduction measures are strengthened"

because cooperation with relevant agencies on the Thai side is essential for PM_{2.5} control. The revision was made to "PM_{2.5} pollution prevention and abatement measures will be strengthened".

In the 2nd JCC in September 2023, since polluting structure analysis in the pilot areas using air quality data is important, the activity of PDM Output 3 "PCD with JICA experts identifies issues and challenges on analysis of pollution structure in the pilot areas, and compiles a recommendation for improvement of analysis of pollution structure in the pilot areas for future consideration." was added as a new activity. The approved PDM and PO are shown in Appendix 3 and Appendix 1-4.

4. Others

4-1 Results of Environmental and Social Considerations

Not applicable.

4-2 Results of Considerations on Gender/Peace Building/Poverty Reduction, Disability, Disease Infection, Social System, Human Wellbeing, Human Right, and Gender Equality

Not applicable.

III. Results of Joint Review

1. Results of Review based on DAC Evaluation Criteria

1.1 Relevance: Very high (Level 4)

(1). Relevance of National Policy

At the outset of the Project, Thailand had already formulated a key air quality management plan—the National Action Plan for PM Reduction (2019–2024) (NAP)—in 2019. Under this plan, relevant government agencies and local authorities have been implementing PM_{2.5} prevention and reduction measures.

In addition, an Ad-hoc Plan for Solving Particulate Pollution Problems (Ad-hoc Plan) has been prepared annually to respond to emergencies and prioritize measures during the high-pollution season (typically from December to May), when PM_{2.5} levels significantly deteriorate since December 2021.

During the Project period, the following air quality-related regulations were established:

- 1) The Government of Thailand announced to enact the new ambient PM_{2.5} standard for annual average (from 25 µg/m³ to 15 µg/m³) in July 2022 and enacted the new PM_{2.5} standard for 24 hours average (from 50 µg/m³ to 37.5 µg/m³) from 1st June 2023 and the associated Air Quality Index.
- 2) Two notifications of the Ministry of Natural Resources and Environment were announced in B.E. 2566 (2023) in the Royal Gazette on 28 August 2023; i) prescribing standards for controlling air emissions from power plants and ii) designating power plants as sources of pollution that must be controlled to release polluted air into the atmosphere.

The draft Second National Action Plan for PM Reduction (2025–2027, with a 5-year continuation) was approved by the National Environment Board in January 2025 and by the National Economic and Social Development Council (NESDC) in February 2025. As of July 2025, toward the end of the Project, official Cabinet approval is expected within several months.

Furthermore, the Clean Air Bill, which aims to strengthen the legal framework for air quality management - including transboundary pollution from neighboring countries - is currently under deliberation in the lower house of Parliament and is expected to be enacted in 2026.

(2). Needs of Target Area

During the detailed planning phase of the Project, the Bangkok Metropolitan Region (BMR) was selected as the pilot area. BMR is Thailand's largest urban region, home to

approximately 17.4 million people, and generated a GDP of USD 248 billion, according to the National Economic and Social Development Council (NESDC).

The NAP (2019–2024) identified BMR as one of the two major PM_{2.5} pollution hotspots in Thailand. PM_{2.5} concentrations in BMR have exceeded the national ambient air quality standard since it was firstly established in 2010.

(3). Evaluation

Based on the above evidence - particularly the strong alignment with Thailand's national policies and the clear needs in the target area—the Project's relevance is evaluated as very high.

1.2 Coherence: Very high (Level 4)

(1). Coherence of Japan's ODA

According to the Country Development Cooperation Policy for the Kingdom of Thailand (2024) by Japan's Ministry of Foreign Affairs (MOFA), "Sustainable economic development and response to a maturing society" is identified as a priority area. This includes laying the foundation for sustainable economic and social development by addressing issues such as environmental and climate change, declining birthrate and aging population, public health, and support for vulnerable groups.

In line with this policy, JICA updated its Country Analysis Paper in 2025, identifying the "Environment and Climate Change Measures Program" as one of the four core programs to achieve sustainable development and support a maturing society in Thailand. This program promotes cooperation on nationally prioritized issues identified by the Thai government, such as air pollution (PM_{2.5} countermeasures) and waste management (e.g., promoting resource circulation through end-of-life vehicle recycling), with an emphasis on cross-ministerial collaboration and engagement with a broad range of stakeholders from government, industry, and academia.

In addition, the Japan–Thailand Environmental Policy Dialogue between Thailand's MONRE and Japan's Ministry of the Environment (MOE) has been conducted since 2018, with ongoing discussions on various topics including air pollution reduction.

(2). Cooperation with JICA's Other Projects

JICA Yokohama Center organized subject-specific training courses titled "Capacity Building for Air Quality Management" in FY2022, FY2023, and FY2024. A total of six officers from PCD, DIW, and BMA participated in these training programs.

(3). Cooperation with Related Projects by Other Japanese Organizations

Under the Japan-Thailand Clean Air Partnership (JTCAP) between Thai MONRE and MOE Japan, which had been implemented until FY2022, source apportionment analysis of PM_{2.5} was implemented by PCD and the Asian Centre for Air Pollution Research (ACAP) at three sites in industrial (Bangna), residential (Phyathai) and roadside (Ding Daeng) sites and one control site (Pathumthani Province) in Bangkok Metropolitan Region. As part of the collaboration with the Project, the results of the PM apportionment study were utilized in pollution structure analysis (Output 3).

To promote PM_{2.5} mitigation through open burning countermeasures led by PCD and DOAE, the Project developed an open burning detection system using data from Himawari-8/9 satellites operated by JAXA (Japan Aerospace Exploration Agency), under the JICA–JAXA partnership agreement. The system was introduced during Thailand Space Week 2024, hosted by GISTDA (Geo-Informatics and Space Technology Development Agency).

To disseminate the Project's outcomes to academic societies in Thailand, JET presented an overview of Project activities at the Symposium on Environmental Pollution Control organized by JAIMA (Japan Analytical Instruments Manufacturers' Association) in November 2024. At the same symposium, PCD presented a session titled "Air Quality Management in Thailand: Policy, Mitigation, Implementation, and Enforcement by PCD."

(4). Cooperation with International Organizations

Under Output 6, the Project engaged in active collaboration with international organizations such as UNEP, UNESCAP, AFD, GIZ, and ADB. Notably, JET presented the Project's outline and outcomes at the Workshop on Air Pollution Mitigation with GHG Co-benefits (organized by UNESCAP and others) in November 2023, and at the Workshop on Air Quality Improvement Program in ASEAN: A Path Forward and Sharing Experiences and Collaborating for a Cleaner Future (under the Air Quality Improvement Program in Thailand, organized by AFD and others) in January 2025.

(5). Evaluation

Based on the coherence with Japan's ODA policies, collaboration with other JICA projects, partnerships with other Japanese organizations, and coordination with international agencies, the Project's coherence is evaluated as very high.

1.3 Effectiveness: Very High (Level 4)

(1). Achievement of the Project Purpose

As mentioned in “Section 2-2 Project Purpose and indicators” of “II. Results of the Project”, all four (4) indicators are evaluated as “Achieved” or “Achieved and beyond the level set at the detailed planning survey stage” as shown in Table 7.

Indicator 1: Modified emission inventory in pilot area is being utilized for analysis and development of plans/measures for PM_{2.5} prevention and reduction by PCD including regional/provincial offices and governments in pilot area.

Indicator 2. MONRE started to take actions for the recommendations on improvement of nationwide emission inventory.

Indicator 3. MONRE started to take actions for the proposed plan for further implementation of the simulation model.

Indicator 4. MONRE started to take actions for the proposals of policy measures for PM_{2.5} prevention and reduction.

Thus, the Project Purpose which stipulates as “Capacity of PCD and relevant agencies for PM_{2.5} prevention and reduction measures is strengthened”, is achieved.

In particular, a capacity related to “Output 4: Capacity to develop and evaluate PM prevention and reduction policies and evaluation” is strengthened more than an expected outcomes at the detailed planning survey stage through the following activities.

- 1) The draft 2nd National Action Plan for PM Reduction (2025-2027 and 5-Year continuing), which was developed by PCD with support of JET were approved by National Environmental Board of Thailand in January 2025 and National Economic and Social Development Council of Thailand in February 2025. JET has contributed to the 2nd draft NAP through preparation of PM Policy Recommendation. As for June 2025, the 2nd NAP is waiting for the approval of the Thailand cabinet. The measures in the 2nd NAP have been implemented by PCD and relevant agencies.
- 2) As for directly related to the Project activities, DOAE has started to analyze agricultural open burning by the JET-developed preliminary tool for open burning detection system by JAXA-Himawari.

(2). Contribution Factors Related to Effectiveness

As mentioned in Section 1.1, the relevance between the Project and national policy/needs of the target area is evaluated as very high, and PCD has had very high commitment to enforce the prevention and mitigation of PM pollution in accordance with their national policies, regulations, and mandates etc. The activities of the Project had been adjusted in line with the enforcement of PCD as much as possible. These high commitment of PCD and adjustment of the Project activities have led to effective

operation of the Project activities and achievement of the Project Goal.

At the beginning of the Project, activities of Output 4 planned to be implemented in the 2nd and 3rd years by utilization of the results of Output 1, Output 2, and Output 3. However, JET and PCD decided to start the activities related to Output 4 from the 1st year because PCD was aiming to launch the 2nd NAP in early 2025 and started to review in 2023, and to draft in 2024. In line with the schedule of preparation of 2nd NAP, JET supported PCD to review the status of 1st NAP implementation by PCD and relevant agencies such as DIW, DOAE, the Department of Land Transport (DLT), the Department of Energy Business (DOEB), and BMA, and develop the “Recommendations on Policy and Countermeasures for PM Reduction and Prevention in the Bangkok Metropolitan Region (the Policy Recommendation)” without waiting for activities of Output 1 and Output 2. In the process of preparation of the Policy Recommendation, some activities related to Output 1 and Output 2 were changed in line with the Policy Recommendation. Such kinds of flexible operations contributed to exceeding the level set for the achievement of the Project Goal.

(3). Evaluation

- Based on effectiveness to achieve the Project Purpose and its contribution factors, the Project's effectiveness is evaluated as very high.

1.4 Efficiency: High (Level 3)

(1). Project Cost

The final cost of the Project was almost the same as the cost estimated at the time of the ex-ante evaluation. The cost for the supplemental activities was just added (see Section (3) below in detail).

(2). Duration of the Project

The Project was planned for a period of three (3) years, from July 2022 to July 2025. It officially started on 4 July 2022 and was completed on 19 June 2025, the date of the final Joint Coordination Committee (JCC) meeting. Thus, all Project activities in Thailand were completed within the planned three-year period.

(3). Consequence between produced outputs and appropriate inputs

All six outputs were generally produced through appropriate inputs within the allocated budget and time frame. In addition, the following supplementary activities were implemented to enhance the achievement of the Project Purpose:

1. Co-benefit study on air pollution and climate change mitigation (Output 4 with 1)
2. Development of an open burning detection system using JAXA's Himawari satellite data (Output 4 with 2)
3. Mekong PM_{2.5} Seminar hosted by PCD and JICA (Output 6)

However, there was a delay of approximately one year in the activities related to inventory improvement (Output 1), as indicated in Monitoring Sheets No. 3, No. 4, and No. 5. This delay led to some rework in Output 2 (Simulation) and Output 4 (Policy). Nevertheless, these issues did not cause any significant delay in the overall Project schedule or hinder the achievement of the Project Purpose. Therefore, although there was some reduction in efficiency compared to the original plan, it did not critically affect the Project's success.

(4). Evaluation

Based on the above evaluations in terms of Project cost, Project duration, consequence between produced outputs and appropriate inputs, the Project's effectiveness is evaluated as high (level 3), even allowing the delay and rework caused by Output 1.

1.5 Impact: Very High (Level 4)

(1). Prospective Achievement of the Overall Goal

The measures in the 2nd NAP, which JET has contributed to inputting some recommendations through the preparation of PM Policy Recommendation, have been implemented by PCD and relevant agencies. As for directly related to the Project activities, DOAE has started to analyze agricultural open burning by the JET-developed preliminary tool for open burning detection system by JAXA-Himawari. On the base of the above information, there is high potential to achieve the Overall Goal; the Sustainable management of PM_{2.5} is promoted through appropriate PM prevention and reduction measures in Thailand (See Table 8 in the Section VI. 1 Prospective achievement of the Overall Goal).

(2). Consequence Between the Overall Goal and Project Goal

Definitely, there is strong consequence between the Overall Goal; "Sustainable management of PM_{2.5} is promoted through appropriate PM prevention and reduction measures in Thailand." and the Project Goal; "Capacity of PCD and relevant agencies for PM_{2.5} prevention and reduction measures is strengthened." (See Section 6 Additionality in detail).

As for important assumptions of the Project Goal; "Relevant policy and legal

framework led by the Government of Thai, such as PM mitigation national action plan and inter-ministerial committee is not drastically changed.”, is not necessary to be changed because the Clean Air Bill is currently under deliberation in the lower house of Parliament and is expected to be enacted in 2026.

(3). Ripple Effect

Expected ripple effects in terms of impact from the Project to address social issues such as reducing health impact, formulating policies/ regulations are as follows:

1) As mentioned above, in addition to implementation of the 2nd NAP, the Clean Air Bill, which aims to strengthen the legal framework for air quality management - including transboundary pollution from neighboring countries - is currently under deliberation in the lower house of Parliament and is expected to be enacted in 2026. The bill is one of triggers to change a social system in Thailand for reduction of air pollution in Thailand if the law is enforced functional. Finally, PM concentration level will be reduced through appropriate measures and health impact will be reduced gradually.

2) During the Project period, local mass media broadcasted the Project seminar on television and posted related news on local websites. Moreover, Japanese broadcasters and newspapers also introduced the Project activities. As a result, the Project activities were recognized by both Thai and Japanese audiences, contributing to increased public awareness.

3) In this Project, PM_{2.5} Mekong seminar was organized to invite the Mekong countries. It is found that there is a potential to expand the outcomes of the Project to Mekong countries such as utilization of open burning detection system by JAXA-Himawari as a common tool. If the tool is expanded, ripple effect to Mekong countries is realized. As for recent activities, a joint plan of action - CLEAR Sky Strategy (2024-2030) was established to guides the implementation of the goals and objectives discussed in the Trilateral Consultation on Transboundary Haze Pollution on 7 April 2023, between the Leaders of the Lao People's Democratic Republic, Myanmar, and Thailand. The joint plan of action was endorsed on 22 August 2024 among Laos, Myanmar, and Thailand.

(4). Evaluation

Based on the above evaluations in terms of prospective achievement of the Overall Goal, consequence between the Overall Goal and Project Goal, and ripple effect, the Project's impact is evaluated as very high (level 4).

1.6 Sustainability: High (Level 3)

(1). Policy and Institution

In the 2nd National Action Plan (NAP) for PM Reduction (2025–2029), the Government of Thailand clearly defines the roles of PCD and relevant agencies in implementing PM_{2.5} measures. The main goals of the 2nd NAP are to achieve compliance with the 24-hour PM_{2.5} concentration standard and to reduce burned areas by 50% compared to the past five-year average. These policy directions and institutional arrangements are expected to continue in the coming years.

(2). Organizational Framework of Implementing Agency

As mentioned in Section 1.2, PCD has shown strong commitment to the prevention and mitigation of PM pollution in accordance with national policies and regulations, under its existing organizational structure. This structure is expected to be maintained.

Furthermore, if the Clean Air Bill—currently under deliberation in the lower house of Parliament—is enacted, PCD plans to restructure its Air Quality and Noise Management Division and regional Environmental Protection Offices (EPOs) to enhance enforcement capabilities.

(3). Technical Aspect

During the final training session in the 2024/2025 PM crisis season under Output 5, most technical content was presented by PCD and other relevant agencies. PCD can now reference technical documents produced under Outputs 1–4 for tasks such as analyzing air monitoring data and reviewing PM reduction policies. In addition, PCD will continue to utilize the simulation model to plan the placement of ambient air quality monitoring stations using the high-performance PC procured through the Project.

PCD also has sufficient capacity to outsource and manage quality control of inventory updates, based on the report on model inventory developed in Output 1..

(4). Budgetary Aspect

PCD has secured sufficient funding to maintain its core operations related to PM reduction and prevention, including the use of outputs from this Project. However, there are ongoing pressures from the Government to reduce the operational budget, particularly for air quality monitoring station maintenance (e.g., consumables, repairs, and equipment replacement). In response, PCD has begun optimizing the location and monitored parameters of existing stations to stay within budget constraints.

As for Output 1, the raw data of the improved emission inventory is currently held by King Mongkut's University of Technology Thonburi (KMUTT), where the Project's

technical team is based. Therefore, PCD will need to secure additional funds to request updates or scenario changes (e.g., for years beyond 2019) if PCD needs.

Once the Clean Air Bill is enacted, it is expected that dedicated budget allocations will be made to strengthen enforcement and support PCD operations.

(5). Evaluation

Based on the above evaluations in terms of policy and institution, organization and framework of implementing agency, technical aspect, and budget aspect, the Project's sustainability is evaluated as high (level 3), taking into consideration that PCD faces budgetary constraints for monitoring operations but PCD has started to optimize the location and parameters among the existing air quality monitoring stations to maintain the operation within the budget limitation.

2. Key Factors Affecting Implementation and Outcomes

As described in “1.4 Efficiency” above, there was no negative impact on the Project due to external factors.

3. Evaluation of the Results of the Project Risk Management

(1). Evaluation of Risk Management

There was no high risk to operate the Project activities as shown in Section 2.

(2). Utilization of Lessons learnt from Other Projects

At the time of the ex-ante evaluation, the following three key points from lesson learnt from other JICA technical cooperation projects were recommended to utilize the Project activities.

1. Capacity development based on the air quality management cycle,
2. Application of cost-effectiveness analysis as a method for evaluating air pollution countermeasures, and
3. Establishment of counterpart working groups (C/P-WG)

At the beginning of the Project, PCD issued PCD order No.146/2022 to establish C/P-WG officially.

Through the Project Activities with established C/P-WG, evidence-based policy-making and enforcement through the application of the PDCA cycle were realized, in alignment with the review of the 1st National Action Plan (NAP) (2019–2024) and the development of policy recommendations for the 2nd NAP (2025–2034), contributing to the achievement of the Overall Goal (See Section 6 Additionality).

In the process of development of policy recommendation for the 2nd NAP, the evaluation of air pollution countermeasures included not only cost-effective analysis, but also feasibility and impacts on air quality, climate change, and socio-economic conditions.

4. Lessons Learnt

(1). Collaboration with Relevant Agencies

In order to implement effective measures against air pollution, the Project established C/P-WG and promoted cross-cutting initiatives involving BMA and Ministries such as DIW and other relevant agencies as JCC members. Using C/P-WG network, the Project has provided opportunities to share technical knowledge and exchange opinions on PM_{2.5} measures with relevant agencies at the BMR and national levels. As a result, the Project activities have proceeded smoothly.

C/P-WG network contributes to the evaluation and selection of PM_{2.5} measures. Through the annual JCC, Thai and Japanese sides were able to exchange opinions on their respective requests.

On the other hand, collaboration between PCD and provincial governments - which play an important role in implementing PM policies and measures - was limited, partly due to vertical administrative structures. While such vertical structures exist in many countries, more proactive collaboration with provincial governments can lead to the development of not only a comprehensive national action plan, but also realistic and practical local action plans with clear policy guidance. The draft Clean Air Bill clearly defines the roles and responsibilities of PCD and provincial/district governments, suggesting that such collaboration may be facilitated under the new legal framework.

(2). Flexible Operation of the Project Activities

At the beginning of the Project, activities of Output 4 planned to implement the 2nd and 3rd years by utilization of the results of Output 1, Output 2, and Output 3. However, JET and PCD decided to start the activities related to Output 4 from the 1st year because PCD was aiming to launch the 2nd NAP in early 2025 and started to review in 2023, and to draft in 2024. In line with the schedule of preparation of the 2nd NAP, JET supported PCD to review the status of 1st NAP implementation by PCD and relevant agencies such as DIW, DOAE, DLT, DOEB, and BMA, and develop the “Recommendations on Policy and Countermeasures for PM Reduction and Prevention in the Bangkok Metropolitan Region (the Policy Recommendation)” without waiting for activities of Output 1 and Output 2. In the process of preparation of the Policy Recommendation, some activities related to Output 1 and Output 2 were changed in line with Policy Recommendation.

Such kinds of flexible operations contributed to going beyond the level set for the achievement of Project Goal.

5. Performance

Several times during the Project period, the JICA headquarters visited PCD to have a discussion for smooth operation of the Project. Thai and Japanese sides of the Project contributed to recognizing the current progress and issues of the Project. As a result, the Project proceeded smoothly to achieve results.

JICA Thai office often join the events not only JCC but also trainings, and seminars. This is also a good factor to strengthen the operation of the Project among PCD, JET, and JICA.

6. Additionality

(1). Realization of Sustainable Management of Air Quality Through the Project Activities

The approaches of this technical cooperation project shown in Figure 1 are a good reference for strengthening capacities to realize sustainable management of air quality, including transboundary issues caused by PM_{2.5}.

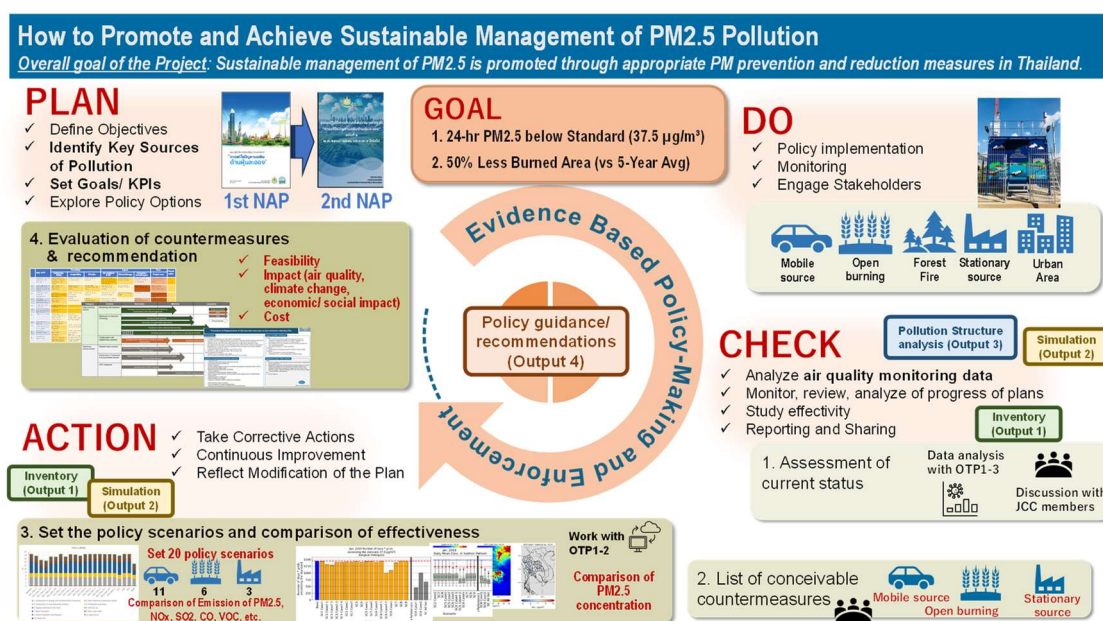


Figure 1 Consequence between the Overall Goal and Project Goal

At the beginning of the Project, the Overall Goal was defined as follows: "Sustainable management of PM_{2.5} is promoted through appropriate PM prevention and reduction

measures in Thailand." This refers to a goal that is expected to be achieved within 2–3 years after the completion of the Project.

Throughout the Project, JET had supported PCD in realizing **Evidence-Based Policy-Making and Enforcement** through the application of the PDCA cycle, in alignment with the review of the 1st National Action Plan (NAP) (2019–2024) and the development of policy recommendations for the 2nd NAP (2025–2034) as follows.

Plan & Do:

Before the Project officially began in July 2022, PCD and related agencies had already implemented various measures based on the 1st NAP, including mobile source control, open burning and forest fire control, stationary source control, and urban area management to prevent PM emissions.

Check:

In the first year of the Project (2022–2023), JET supported PCD in assessing the implementation status of the 1st NAP using several technical tools, such as: Emission Inventory development (Output 1), Simulation modeling for policy analysis (Output 2), and Air quality monitoring data analysis and pollution structure understanding (Output 3).

In the second year (2023–2024), JET and PCD identified and listed feasible countermeasures focused on three key sources: mobile sources, open burning, and stationary sources. This process was carried out through collaborative discussions with relevant agencies including DIW, DLT, DOAE, and DOEB.

Action:

Based on the results, JET and PCD developed policy scenarios, evaluated their effectiveness, and compiled the “Policy Recommendation Report for the 2nd NAP.” This report was presented at the 3rd JCC meeting held in September 2024 and included comparative evaluations of countermeasures and policy guidance.

Plan (Second Round):

At the end of the Project, the 2nd NAP is expected to be officially approved by the Cabinet in the near future.

Through this sequence of activities—from planning to action—the Project has significantly contributed to Thailand’s progress toward sustainable PM_{2.5} management.

The Project could conclude that it has largely achieved its Overall Goal by embedding a continuous improvement process rooted in the PDCA cycle.

This structured approach ensures that PM_{2.5} management in Thailand is: Systematic (guided by data), Adaptive (open to regular updates), and Sustainable (linked to long-term policy mechanisms such as the Clean Air Bill and the 2nd NAP).

Ultimately, maintaining and enhancing the PDCA cycle beyond the Project period can be the key to achieving truly sustainable PM_{2.5} management in Thailand.

(2). Evaluation of Co-Benefit Effects from Integrating Air Pollution Control with Climate Change Mitigation

As part of the activities under Output 4, policy recommendations for 2nd National Action Plan for PM Reduction (2025-2027, and 5-year continuing Framework) were developed, including 21 scenarios aimed at reducing air pollution emissions. The emission reductions for each scenario were estimated using the emission inventory developed under Output 1.

Meanwhile, in August 2023, MONRE underwent an organizational restructuring, establishing a new Department of Climate Change and Environment (DCCE), which reflects the growing demand for climate change measures within the Thai government.

In this context, JICA proposed that JET and PCD also assess the co-benefit effects of implementing air pollution control measures (see Figure 2) in conjunction with climate change mitigation efforts. This included examining the linkages between measures in the national climate change strategies and air pollution control policies, as well as quantifying greenhouse gas (GHG) reductions, specifically CO₂, CH₄, N₂O, based on the 21 air pollution emission reduction scenarios, and documenting the results. The analysis confirmed that various air pollution control measures generate co-benefit effects for climate change mitigation. In particular, stationary source control measures that contribute to reducing fossil fuel consumption demonstrated significant co-benefit effects, as shown quantitatively. (For further details, refer to the attached document “Evaluation of Co-benefit Effect between Air Pollution Control and Climate Change Mitigation Measures” which is included in the policy recommendation report developed under Output 4.)

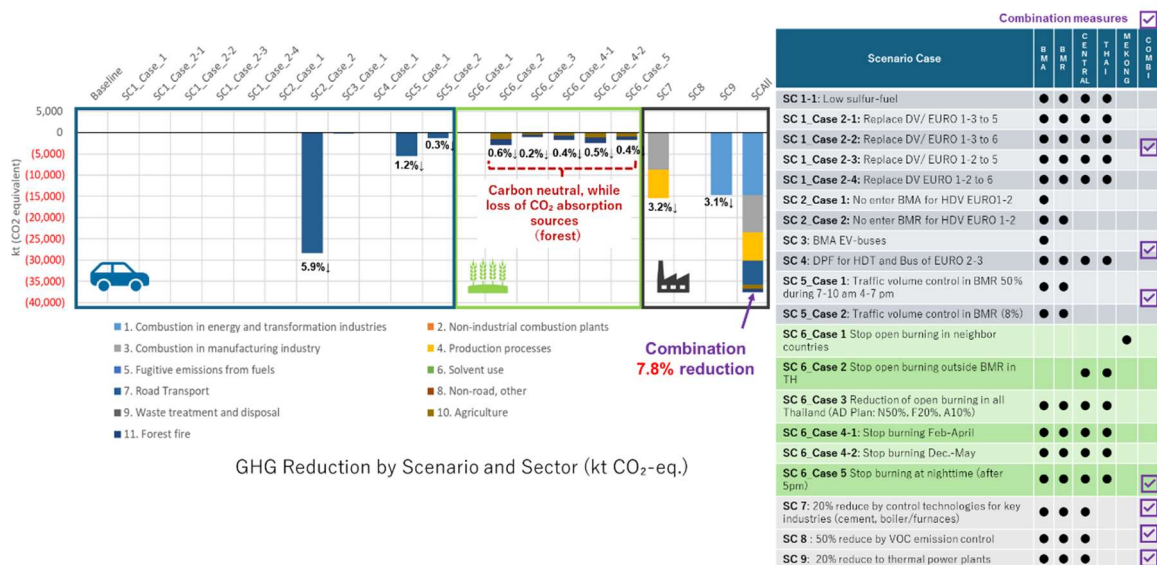


Figure 2 GHG Emission Reduction Effects of 21 Air Pollution Control Scenarios in Comparison with Baseline Scenario

This activity represented a noteworthy additional achievement of the Project, as it addressed specific needs of counterpart by quantifying and documenting the co-benefit effects within the Project period.

IV. For the Achievement of the Overall Goal After the Project Completion

1. Prospects to Achieve the Overall Goal

The Overall Goal, objectively verifiable indicators, means of verification, and achievement status of the Project are shown in Table 8. The measures in the 2nd NAP, which JET has contributed to inputting some recommendations through preparation of PM Policy Recommendation, have been implemented by PCD and relevant agencies. As for directly related to the Project activities, DOAE has started to analyze agricultural open burning by the JET-developed preliminary tool for open burning detection system by JAXA-Himawari. On the base of the above information, there is high potential to achieve the Overall Goal; the Sustainable management of PM_{2.5} is promoted through appropriate PM prevention and reduction measures in Thailand.

Table 8: Status of Achievement of the Overall Goal of the Project

Overall Goal	Objectively Verifiable Indicators	Means of Verification	Achievement at the end of Project
Sustainable management of PM _{2.5} is promoted through appropriate PM prevention and reduction measures in Thailand.	1. The recommended plans on emission inventory, simulation model and PM _{2.5} prevention and reduction measures by the Project are being implemented. * At least part of the plans should be implemented.	- Status of emission inventory - State of PM prevention and reduction measures	[Partially achieved] The recommended plan on PM _{2.5} prevention and reduction measures by the Project has been implemented. As of June 2025, the 2nd NAP, which JET has contributed to inputting some recommendations through preparation of PM Policy Recommendation, is waiting for the approval of the Thailand cabinet. The measures in the 2nd NAP have been implemented by PCD and relevant agencies. As for directly related to the Project activities, DOAE has started to analyze agricultural open burning by the JET-developed preliminary tool for open burning detection system by JAXA-Himawari.

2. Plan of Operation and Implementation Structure of the Thai Side to Achieve the Overall Goal

As the plan of operation and implementation structure of the Thai side to achieve the Overall Goal, utilization of Project's outputs for strengthening enforcement of air quality management policies for clean air is summarized in Figure 3.

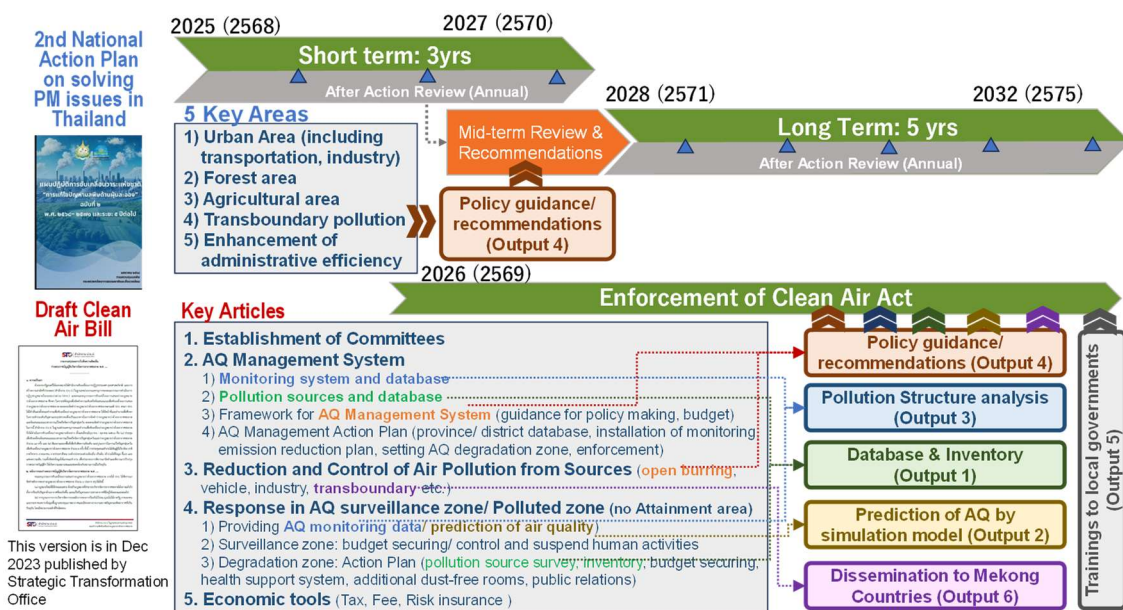


Figure 3 Strengthening Enforcement for Air Quality Management Policies for Clean Air after the Project

The 2nd NAP divides implementation into two phases: Short term: 2025 to 2027; Long term: 2028 to 2032. A mid-term review is planned for 2027. At that time, PCD can refer to the Policy Guidance and Policy Recommendations developed under Output 4 of this Project.

Moreover, the Draft Clean Air Bill, currently under deliberation in the lower house of Parliament, incorporates several technical elements that directly align with the Project's outputs, including:

- Policy guidance and recommendations (Output 4)
- Pollution structure analysis based on monitoring data (Output 3)
- Development of databases and emission inventories (Output 1)
- Air quality simulation modeling (Output 2)
- Dissemination to Mekong countries (Output 6)
- Capacity-building training for local governments and relevant agencies (Output 5)

These connections highlight the potential of the Project's achievements of the Overall

Goal to serve as a foundation for strong, evidence-based enforcement under future Thai air quality laws.

3. Recommendations for the Thai Side

(1). Recommendation 1: Strengthening the Capacity to Implement PM_{2.5} Policies Throughout Thailand

Figure 4 shows a recommendation for strengthening the capacity to implement PM_{2.5} policies throughout Thailand.

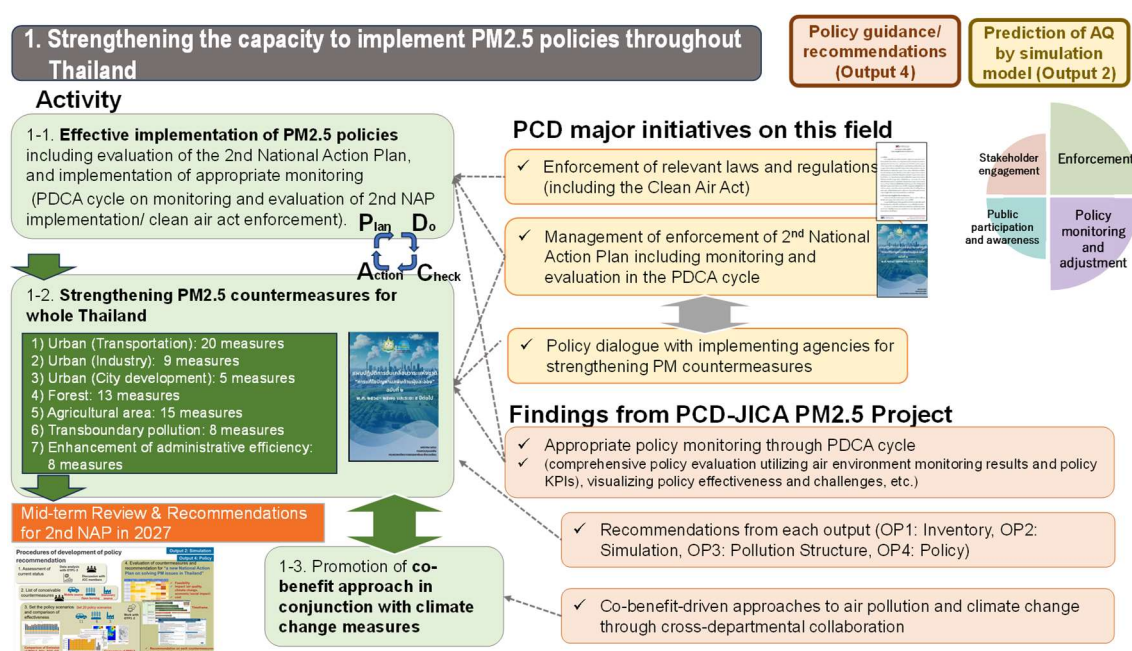


Figure 4 Strengthening the Capacity to Implement PM_{2.5} Policies throughout Thailand (Recommendation 1)

To effectively reduce PM_{2.5} pollution nationwide, Thailand must enhance its capacity to implement air quality policies through comprehensive planning, monitoring, and enforcement. Central to this effort is the implementation of the 2nd National Action Plan for PM Reduction (2025–2027 and beyond), which requires a structured PDCA (Plan–Do–Check–Action) cycle. This includes the evaluation of policy performance using air quality data and key performance indicators (KPIs), enabling timely adjustments and continuous improvement.

The enforcement of the upcoming Clean Air Bill will provide a legal foundation for stronger regulatory actions. Nationwide implementation of PM_{2.5} countermeasures—covering urban transport, industry, agriculture, forest areas, and transboundary

pollution—must be promoted in collaboration with relevant agencies. The co-benefit approach, integrating air pollution control with climate change mitigation, is also essential.

Key outputs from PCD–JICA Project support these goals. For example, simulation models help visualize future air quality scenarios, and policy recommendations were developed based on multi-sectoral dialogues. Active public participation and stakeholder engagement are also emphasized to ensure the effectiveness and sustainability of these measures.

In summary, strengthening institutional capacity, ensuring cross-sector collaboration, and applying evidence-based policy management are vital steps toward achieving clean air throughout Thailand.

(2). Recommendation 2: Strengthening Pollution Structure Analysis of PM_{2.5} Pollution Throughout Thailand & Optimization of Monitoring Stations

Figure 5 shows a recommendation for Strengthening Pollution Structure Analysis of PM_{2.5} pollution throughout Thailand & Optimization of Monitoring Stations.

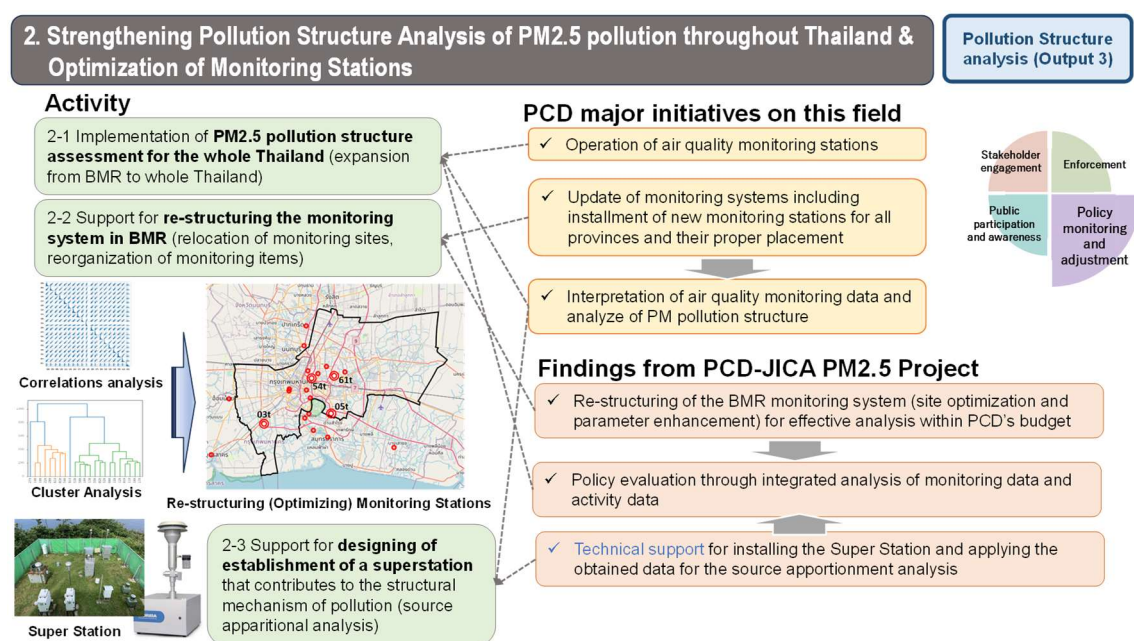


Figure 5 Strengthening Pollution Structure Analysis of PM_{2.5} Pollution throughout Thailand & Optimization of Monitoring Stations (Recommendation 2)

A precise understanding of PM_{2.5} pollution sources is critical for developing targeted and effective countermeasures. This recommendation emphasizes strengthening

Thailand's analytical capacity to assess the pollution structure and optimizing the national air quality monitoring network e.g. the expansion of pollution structure analysis from the Bangkok Metropolitan Region (BMR) to the national level, contributing to more comprehensive policy planning.

Key actions include re-structuring the monitoring network in BMR by optimizing the location of monitoring stations and updating the monitored parameters. In addition, technical support was provided to design a "Super Station" capable of conducting advanced analyses such as source apportionment. Enhanced monitoring will allow PCD to better interpret the relationship between emission sources and PM_{2.5} levels across diverse environments—urban, industrial, roadside, and background sites.

The integration of air quality monitoring data with activity data has enabled more accurate pollution structure assessments. Techniques such as cluster and correlation analysis, combined with data from new monitoring stations, have improved understanding of pollution patterns. These insights support more effective enforcement, stakeholder engagement, and policy adjustments.

Strengthening analytical capacity and optimizing monitoring infrastructure are foundational steps toward data-driven air quality management and more effective implementation of the 2nd NAP.

(3). **Recommendation 3:** Strengthening Technical Capacity Related to Emission Inventory

Figure 6 shows a recommendation for Strengthening Technical Capacity related to Emission Inventory.

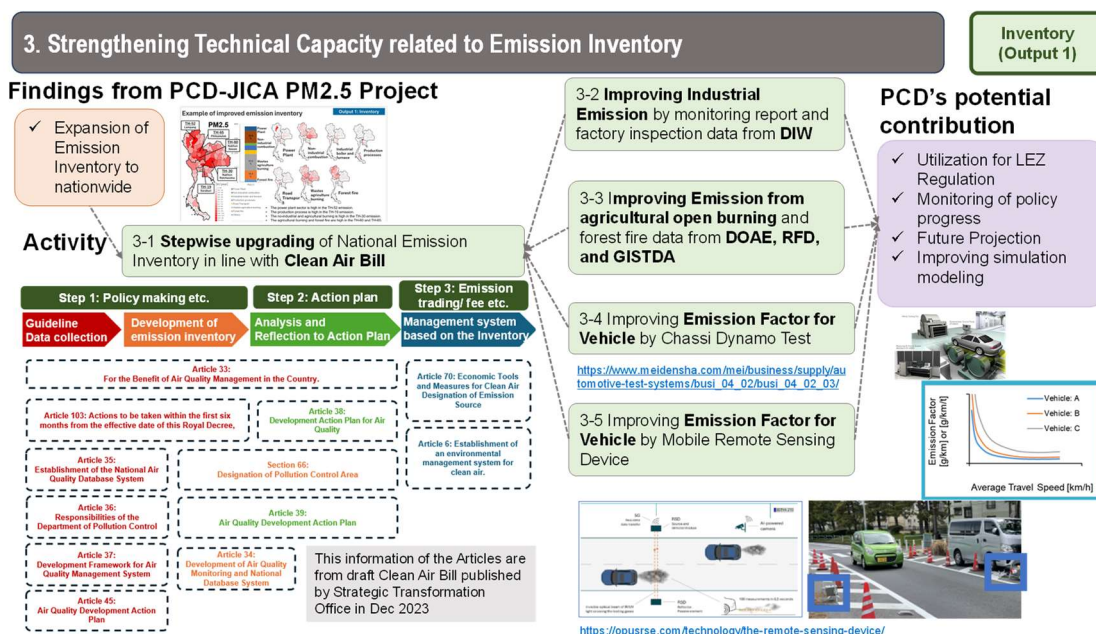


Figure 6 Strengthening Technical Capacity related to Emission Inventory (Recommendation 3)

An accurate and regularly updated emission inventory is fundamental to effective air quality management. This recommendation focuses on enhancing Thailand’s technical capacity to develop a comprehensive national emission inventory aligned with future requirements under the Clean Air Bill. The Project has contributed to expanding the emission inventory from the Bangkok Metropolitan Region to nationwide coverage.

To ensure data accuracy and applicability, improvements are proposed across key sectors. For the transport sector, emission factors are being refined using mobile remote sensing devices and chassis dynamometer testing. For industrial sources, data from DIW’s inspection reports and monitoring systems are being integrated. Agricultural and forest emissions, a significant contributor to PM_{2.5}, are being addressed using data from DOAE, the Royal Forest Department (RFD), and GISTDA.

These inventory improvements support the development of low-emission zones (LEZs), facilitate simulation modeling, and allow for more precise policy impact assessments. The updated inventory will also be critical for monitoring the implementation of future mechanisms under the Clean Air Bill, including emissions trading schemes and pollution fees.

By enhancing the technical foundation of emission data, Thailand will be better equipped to simulate pollution, enforce targeted policies, and evaluate their effectiveness in reducing PM_{2.5} pollution.

(4). **Recommendation 4: Strengthening PM_{2.5} Countermeasures Cooperation in Thailand and the Mekong Region**

Figure 6 shows a recommendation for Strengthening PM_{2.5} countermeasures cooperation in Thailand and the Mekong region.

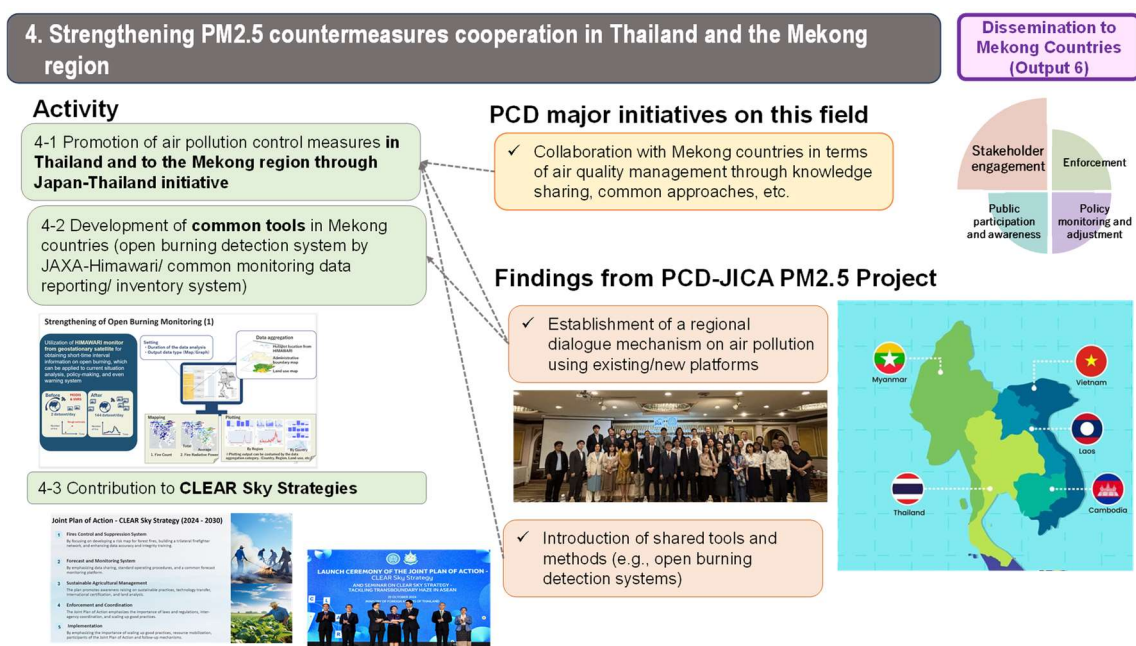


Figure 7 Strengthening PM_{2.5} Countermeasures Cooperation in Thailand and the Mekong Region (Recommendation 4)

Regional cooperation is essential to address the transboundary nature of PM_{2.5} pollution and to promote coordinated air quality management. This recommendation highlights the importance of strengthening collaboration both within Thailand and across the Mekong region through the Japan–Thailand initiative and related platforms. The Project played a key role in establishing knowledge-sharing mechanisms and introducing common tools to facilitate cooperation.

Within Thailand, multi-stakeholder engagement has been promoted across national and local levels, supported by data-driven tools such as open burning detection systems developed in partnership with JAXA (Himawari-8/-9). These tools have been showcased and disseminated through platforms like Thailand Space Week, demonstrating their utility in early detection and response to pollution sources such as agricultural and forest fires.

At the regional level, the Project supported the development of shared systems for emission inventory, monitoring data reporting, and policy coordination among Mekong

countries. These efforts align with Thailand's contribution to broader initiatives such as the CLEAR Sky Strategies.

By fostering policy dialogue, sharing technical tools, and building capacity through international partnerships, Thailand can strengthen its leadership role in regional air pollution control. Continued collaboration will enhance the effectiveness of domestic measures while addressing cross-border pollution challenges.

4. Monitoring Plan from the end of the Project to Ex-post Evaluation

An ex-post evaluation will be carried out three years after from the completion of the Project. In the ex-post evaluation, the continuation of Project Purpose and results and the status of activities will be verified, and the achievement of Overall Goal will be confirmed. Even after the Project is completed, it is desirable for JICA and the relevant agencies in Thailand to work closely to confirm the status of implementation of the countermeasures for PM reduction and prevention including the status of implementation of the 2nd NAP as well as enforcement of the Clean Air Bill.

Appendix 1: Results of the Project

- 1. List of Dispatched Experts**
- 2. Procured Equipment**
- 3. List of Counterparts,**
- 4. PO**

Appendix 2: List of Products (Report, Manuals, Guidelines)

Appendix 3: PDM

Appendix 4: R/D, M/M, Minutes of JCC

Appendix 5: Monitoring Sheet