Information Collection and Verification Survey for Municipal Solid Waste Management in Ukraine

FINAL REPORT

AUGUST 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
JAPAN ENVIRONMENTAL SANITATION CENTER
EIGHT-JAPAN ENGINEERING CONSULTANTS INC.

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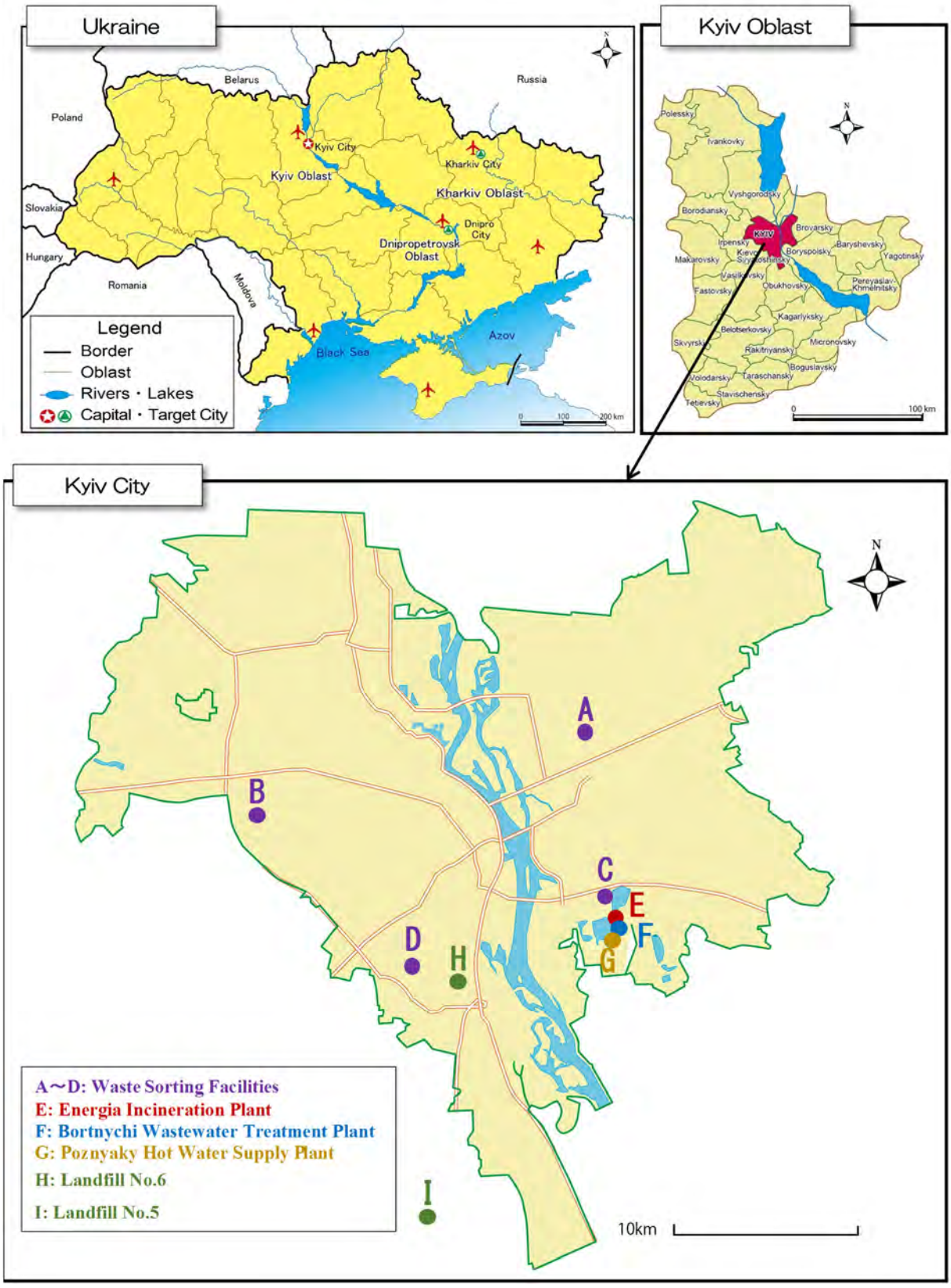
Map of Target Areas



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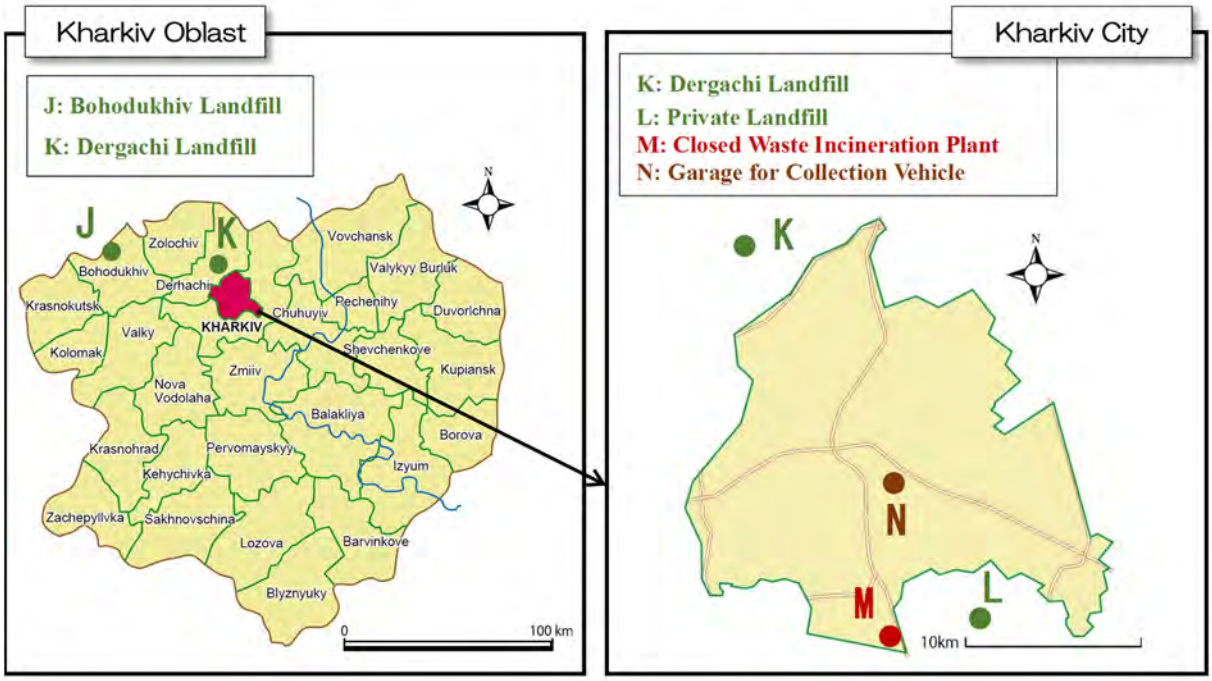

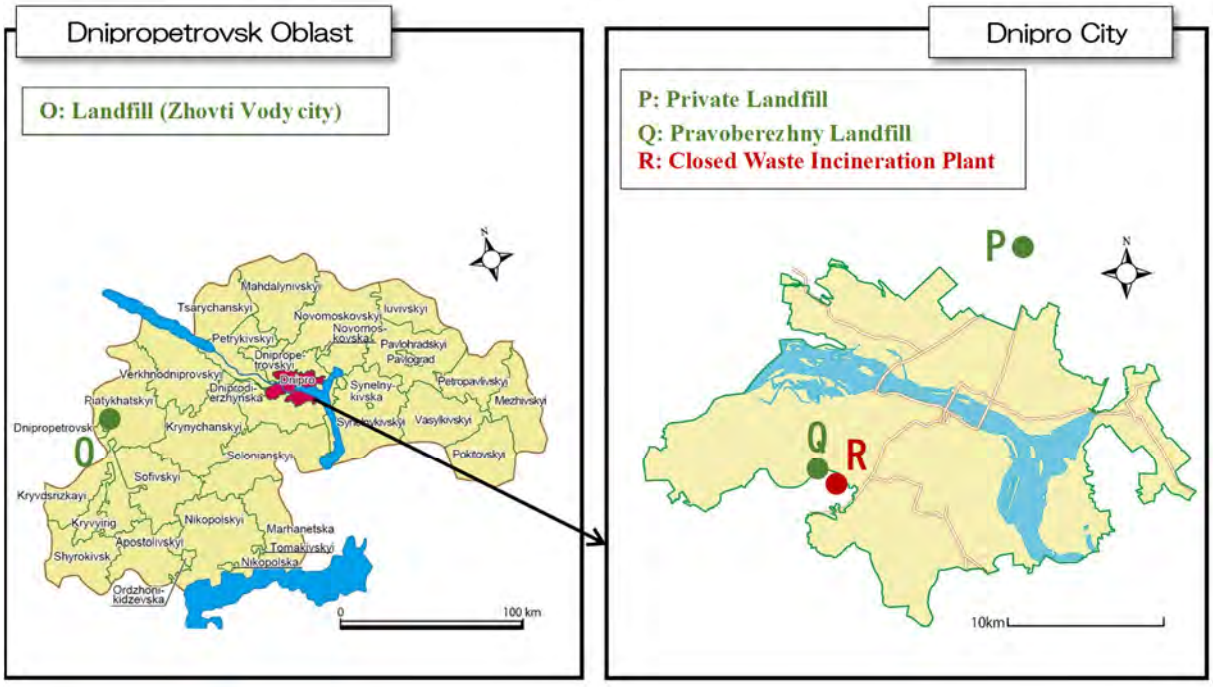

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Municipal Solid Waste Management in Ukraine

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ABBREVIATIONS and ACRONYMS

Organizations

AB	Administrative Building
CBOs	Community Based Organizations
CE	Communal Enterprise
CTF	Clean Technology Fund
EBRD	European Bank for Reconstruction and Development
EC	European Community
EEC	European Economic Community
EIB	European Investment Bank
EU	European Union
GIOC	Main Information and Calculation Center
GIZ	German Federal Enterprise for International Cooperation
HMMC	Housing Maintenance & Management Company
IBRD	International Bank for Reconstruction and Development
IMF	International Monetary Fund
ILO	International Labor Organization
JICA	Japan International Cooperation Agency
KCSA	Kyiv City State Administration
KKS	Kyivkomunservis
KVBO	Municipal Enterprise of Complex on Municipal Waste Removal
MEDT	Ministry of Economic Development and Trade of Ukraine
MENR	Ministry of Ecology and Natural Resources of Ukraine
MKPV	Municipal Company for Solid Waste Management
MRDCHCS	Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine
NEFCO	Nordic Environment Finance Corporation
NGO	Non-Governmental Organizations
OECD	The Organization for Economic Co-operation and Development
SAEE	State Agency on Energy Efficiency and Energy Saving of Ukraine
SE	State Expertise
SRDF	State Regional Development Fund
WB	World Bank
ZHEK	Housing Management Section

Technical Terms

B/D	Basic Design
BOO	Build Own Operate
BOT	Build Operate Transfer
BREFs	Best Available Techniques Reference Document
CAPEX	Capital Expenditure
CHP	Combined Heat and Power Plant
CMU	Cabinet of Ministers of Ukraine
CPI	Consumer Price Index
DB	Design Build
DBO	Design Build Operate
D/D	Detailed Design
DF/R	Draft Final Report

EIA	Environmental Impact Assessment
EPR	Extended Producer's Responsibility
FIT	Feed-In-Tariff system
F/R	Final Report
F/S	Feasibility Study
FY	Fiscal Year
GDP	Gross Domestic Product
GRP	Gross Regional Products
IC/R	Inception Report
IFC	International Finance Corporation
IT/R	Interim Report
JSC	Joint Stock Company
LLC	Limited Liability Company
MBT	Mechanical-Biological Treatment
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organization
O&M	Operation & Maintenance
ODA	Official Development Assistance
OJSC	Open Joint Stock Company
OPEX	Operating Expenditure
PJSC	Private Joint Stock Company
PPP	Public Private Partnership
R&D	Research and Development
RDF	Refuse Derived Fuel
RE	Renewable Energy
SDF	Secondary Recovered Fuel
SEA	Strategic Environmental Assessment
SWM	Solid Waste Management
TEO	Technical Economical Basis Justification
TPP	Thermal Power Plant
UIP2	Second Urban Infrastructure Project
WEEE	Waste Electrical and Electronic Equipment
WTE	Waste to Energy

Currency

EUR	Euro
JPY	Japanese Yen
UAH	Ukrainian Hryvnia
USD	United States Dollar

List of Appendices

Chapter 1 Outline of the Survey

1.1 Background and Outline

In Ukraine, which is a country with more than 40 million people, 48 million cubic meters of municipal solid waste (MSW) are generated annually. Ninety-four percent of MSW is disposed of at more than 6,000 landfill sites mostly without any reduction. Based on the current situation, the Ukrainian government established the National Waste Management Strategy with the assistance of the German Federal Enterprise for International Cooperation (GIZ) and the European Bank for Reconstruction and Development (EBRD) under association agreement with the European Union (EU). Under the strategy, reduction of landfilled waste through inhibition of waste generation, recycling, volume reduction of generated waste, and basic direction of roles of the national government, state governments, and municipalities were set as a policy for a period of up to 2030.

Many landfill sites must receive waste even if they are beyond their designed capacities, and are about to be totally full. In addition, landfill sites, which are not compliant with relevant EU standards, are planned to be closed. Because of this, reduction of waste volume to be landfilled is an urgent issue in Ukraine. In Kyiv, there is the Energia Incineration Plant, which is the only incineration plant being operated at the moment. The plant was constructed in the 1980s and is aging.

On the other hand, the Ukrainian government expects various assistance in the solid waste sector such as construction of waste to energy plants and other facilities through a soft loan project from the Japanese government.

Because of such background, This survey has been conducted to identify specific needs through basic information and discussion with stakeholders in the target cities and to study necessity and feasibility of introduction of waste to energy plants and the possibility of further assistance in the future.

In the form of the survey, the Japan International Cooperation Agency (JICA) has dispatched JICA Survey Team to Ukraine three times during the period from February 2018 to August 2018, to conduct the field survey together with the meeting with concerned authorities, then has concluded the result of survey in this Final Report (F/R) .

1.2 Objectives

The objectives of the survey are as follows:

- To collect basic information about current situations of the Municipal Solid Waste Management (MSWM) systems (generation, collection, transportation, intermediate treatment/recycling, and final disposal) in the target cities of Kyiv, Kharkiv, and Dnipro in order to understand their processes, operation and maintenance systems including financial systems, and the status of the existing incineration plants; and
- Based on the results above, to analyze plans of the national government, oblast governments, and municipalities; to identify specific needs; to study necessity and feasibility of introduction of waste to energy plants; to select priority projects; and to propose an assistance direction and scenario through Japanese soft loan project and accompanying technical cooperation.

1.3 Target Area

The main target areas of the survey are Kyiv City, Kharkiv City, and Dnipro City in Ukraine.

1.4 Concerned Organizations

The concerned organizations of the survey are as follows:

- National government: Ministry of Regional Development, Construction, Housing and Communal Services (MRDCHS), Ministry of Ecology and Natural Resources (MENR), and Ministry of Economic Development and Trade (MEDT);
- Local government: Three target cities and oblast governments where these cities located in; and
- International Donors: European Bank for Reconstruction and Development (EBRD), German Federal Enterprise for International Cooperation (GIZ) and the World Bank (WB).

Chapter 2 Outline of the Field Survey

2.1 Survey Schedule

The schedule of field surveys is shown in Table 2.1. The JICA Survey Team had been dispatched to Ukraine from 21 February 2018 to 15 April 2018 for the first field survey. During the first survey, The JICA Survey Team had kick-off meetings with the Ministry of Ecology and Natural Resources (MENR), Ministry of Regional Development, Construction, Housing, and Communal Services (MRDCHCS), Ministry of Economic Development and Trades (MEDT), Kyiv Oblast State Administration, Kyiv City State Administration, Kharkiv Oblast State Administration, Kharkiv City Council, Dnipropetrovsk Oblast State Administration, and Dnipro City Council. As for the donors, the JICA Survey Team had meetings with GIZ and the EBRD. Together with the kick-off-meetings, the JICA Survey Team visited waste facilities in each city, which are Energia Incineration Plant, Landfill No. 5 and No. 6 for Kyiv City, Dergachi Landfill for Kharkiv City, landfill site at Bohodukhiv City in Kharkiv Oblast, Pravoberezhny Landfill for Dnipro City, and landfill site at Zhovti Vody City in Dnipro Oblast. The meetings on confirmation of questionnaire answers were conducted in March with the concerned ministries, city councils, and other organizations such as the State Agency on Energy Efficiency and Energy Savings (SAEE), Kyivspetstrans, Energia Incineration Plant, Kompania Eko Stok, Municipal Enterprise of Complex on Municipal Waste Removal (KVBO), Municipal Company for Solid Waste Management (MKPV), and EcoDnipro. In Kharkiv City and Dnipro City, the waste composition survey was conducted.

As for the second field survey, the JICA Survey Team had been dispatched to Ukraine from 9 May to 6 June 2018. During the second survey, the JICA Survey Team had meetings with MENR, MRDCHC, MEDT, Kyiv City State Administration, Kharkiv City Council, and Dnipro City Council to discuss about the contents of the Interim Report (IT/R) which concluded the result of the first field survey. The meeting was held with other organizations such as SAEE and EcoDnipro. The JICA Survey Team visited Energia Incineration Plant in Kyiv City and Dergachi Landfill for Kharkiv City. The waste composition survey was conducted in Kyiv City. On 1 June, in addition, a solid waste management seminar was held at MENR with the attendance of about 30 people from the concerned ministries, oblasts, cities, and other organizations.

The third field survey had been conducted from 15 July to 31 July 2018. During the third survey, the JICA Survey Team had explained the contents of the Draft Final Report (DF/R) which concluded the result of the survey with the confirmation of identified assistance needs, then had discussed about the pre-conditions for the JICA's future assistances.

The detail of the survey schedule is attached as Appendix 1.

Table 2.1 Schedule of Field Survey

Target City	Month (2018)						
	February	March	April	May	June	July	August
	First Field Survey			Second Field Survey		Third Field Survey	
Kyiv City							
Kharkiv City							
Dnipro City							

Source: JICA Survey Team

2.2 Survey Methods

The JICA Survey Team conducted the field surveys through the following methods:

- Questionnaire survey
- Interview survey
- Field visit survey
- Waste composition survey

2.2.1 Questionnaire Survey

The questionnaire survey was conducted through the distribution of questionnaire sheets to the concerned organizations. The questionnaire sheets, which covers all the survey items for the different governmental levels, ministry level, oblast level, and city level, were prepared by the JICA Survey Team prior to the first field survey.

The outline of questioner is as follows;

- General information (natural condition, population, economic)
- Laws, regulation and plan related to MSWM
- Implementation structures on MSWM
- Municipal solid waste matters
- Waste treatment and energy recovery
- Project implementation method
- Assistance by other donors
- Environmental and social considerations
- Interested fields among Japan's MSWM Experiences

The questionnaire sheets for different governmental level were attached in Appendix 4. These questionnaire sheets were firstly distributed to each concerned organization at the kick-off meeting and then the original electronic files were shared through e-mail so that each concerned organization could provide the answer on the sheet.

After the submission of answers from the concerned organizations, the JICA Survey Team translated them and organized the meetings with them to clarify and confirm their answers.

2.2.2 Interview Survey

In the kick-off meetings, the JICA Survey Team explained the outline of this JICA survey and contents of the questionnaire to the respective Ukrainian concerned organizations. After the kick-off meetings, the specific meetings for interview survey with the organizations and the persons in-charge of MSWM were arranged by the concerned organizations.

The current situation and issues related to MSWM in target cities were analyzed based on the results of the interview survey.

2.2.3 Field Visit Survey

The JICA Survey Team conducted site visits to the related MSWM facilities in each city and oblast arranged by the concerned organizations or the related stakeholders.

The actual situation and conditions on currently operational MSWM facilities such as landfills in the target cities were confirmed and analyzed based on the results of the field visit survey. Table 2.2 shows the list of the related MSWM facilities which the JICA Survey Team visited during the field surveys.

Table 2.2 List of MSWM Facilities Visited in the Field Survey

Classification	Field Name	Responsible Organization	Operational Organization	Date
Incineration plant	Energia Incineration Plant	Kyiv City	Kyivenergo	13 Mar. 31 May 16 Jul.
Waste Collection	Garage for waste collection trucks, and its collection area	Kharkiv City	KVBO	27 Mar.
Landfill site	Landfill No. 5, No. 6	Kyiv City	Kyivspetstrans	8 Mar. 15 May
	Pravoberezhny Landfill	Dnipro City	EcoDnipro	27 Feb. 20 Mar. 20 Jul.

Classification	Field Name	Responsible Organization	Operational Organization	Date
	Zhovti Vody City Landfill	Dnipropetrovsk Oblast	Zhovti Vody City	28 Feb.
	Dergachi Landfill	Kharkiv City	MKPV	3 Mar. 27 Mar. 22 May 23 Jul.
	Bohodukhiv City Landfill	Kharkiv Oblast	EKOBTOP	2 Mar.
Material Recovery Facility	Kompania Eko Stok	Kyiv City	Kompania Eko Stok	12 Apr.
	Obukhivmiskvtorresursy	Located in Kyiv Oblast	Obukhivmiskvtorresursy	25 Jul.

Source: JICA Survey Team

2.2.4 Waste Composition Survey

To grasp the characteristics of the municipal solid waste in the target cities as well as to examine appropriate waste treatment options including waste to energy facility in the target cities, a small-scale waste composition survey was planned as part of this JICA survey. The analysis consisted of field measurement by the JICA Survey Team and the laboratory analysis by the subcontractor.

Table 2.3 shows the specification of waste composition survey. The waste composition survey was conducted in Kyiv City on 15 May, Kharkiv City on 29 March and Dnipro City on 23 March. The detailed methodology and records of waste composition survey were attached as Appendix 5

Table 2.3 Specification of Waste Composition Survey

Item	Specification
Survey duration	Field measurement: March to May 2018 Laboratory analysis: March to June 2018
Target waste	Municipal solid waste in Kyiv, Kharkiv, and Dnipro cities 1 sample for each city (total number of sample is 3)
Sampling location	Municipal waste landfill site of each city
Survey methods and its locations	▪ Field measurement at landfill sites by the JICA Survey Team ▪ Preparation of sample, weight per unit volume, waste composition ▪ Laboratory analysis by Eurofins Ukraine (sent to laboratory in Germany) ▪ Three components (moisture, ash, combustible), gross calorific value, six elements (C, H, O, N, S, Cl)

Source: JICA Survey Team

2.2.5 Other Surveys

The JICA Survey Team also collected and analyzed the existing information and the data provided by the concerned organizations as well as the ones obtained through web searching. This survey method was mostly used to understand organizations and legal system related to MSWM, tariff and financial matters on MSWM in the target cities, as well as public opinions on waste management including incineration.

2.3 Solid Waste Management Seminar

On 1st June 2018, Solid Waste Management Seminar was held by JICA Survey Team at Aarhus Center of MENR. The objective of the seminar was that JICA Survey Team would share with related parties about the result of field surveys and Japanese experiences, having the latest status of development of related laws on MSWM and National Waste Management Plan by MENR. JICA Survey Team invited ministries, oblasts, cities and donors, 26 people except JICA Survey Team conclusively attended the seminar.

Firstly, outline of the survey result was presented by JICA Survey Team, and identified needs of each city were explained. Secondly, MENR explained outline of new National Waste Management Strategy and status of development of National Waste Management Plan and concerned laws. After tea break, Japanese experiences including waste to energy technology was delivered from JICA Survey Team.

JICA Survey Team also introduced JICA assistance schemes. The seminar was closed after a question and answer session. Figure 2.1 shows image of the presentation by JICA Survey Team and MENR. The agenda, presentation materials and attendant list are attached as Appendix 6.

Presentation by JICA Survey Team

Presentation by MENR

Source: JICA Survey Team

Figure 2.1 Solid Waste Management Seminar

Chapter 3 Results of the Field Survey

3.1 Current Status of Ukraine

3.1.1 General Information

(1) Natural Conditions

1) Geographical Features

Ukraine is located in East Europe and is surrounded by seven other countries and two seas. Ukraine shares borders with the following countries: Romania and Moldova on the southwest, Poland, Slovakia and Hungary on the west, Belarus on the north, Russia on the east, and Black Sea and Sea of Azov on the south. Its total area is around 603,700 km^2, and it is the second largest country in Europe. The west part of Ukraine has Carpathian Mountains with a height of 2,061 m above sea level and is the highest peak in Ukraine. The central part of Ukraine is covered by fertile plains and shrub lands. South of the country is covered by the Black Sea Coastal Lowlands. The Dnipro River, which is the longest river in Ukraine and the fourth longest river in Europe, flows from Russia, through Belarus and Ukraine, to the Black Sea. The total length of the river is 2,285 km. The river is part of the border with Belarus.

There were several earthquakes in Ukraine in the past and most of them occurred in the area of Crimea Region including the Black Sea and near the western national border of Ukraine with Romania. The scale of each earthquake was from 2.5 magnitude to 4.9 magnitude in the past ten years and the largest one has 6.7 magnitude in 1927 at Hurzuf of Crimea[1].

In Ukraine, it is reported that earthquake hazard is classified as medium according to the information that is currently available. This means that there is a 10% chance of potentially-damaging earthquake in the country in the next 50 years[2].

2) Meteorological Phenomenon

Ukraine has a continental climate with cold winter and warm summer. The coastal provinces along the Black Sea have Mediterranean climate with dry summer. The average annual precipitation is 1,200~1,600 mm in the west area and 300 mm in the east area.

(2) Population

As of 1 February 2018, the total present population in Ukraine is estimated to be 42,364,933 people[3]. This number excludes the temporarily occupied territories of the Autonomous Republic of Crimea and the city of Sevastopol.

This value explains that Ukraine is sixth in Europe in terms of population (after Germany, France, United Kingdom, Italy, and Spain) and ranks 32nd in the world[4].

The last all-Ukrainian population census was conducted in 2001 and the running of the next census is determined by the decree of the Cabinet of Ministers of Ukraine from 9 April 2008 No. 581-p “On the all-Ukrainian population census conduction in 2020”[5].

Of the present population, 46.3% are males and 53.7% are females. Population under 15 years old is 16.2%; 61.3% are from 16 to 59 years old; and 22.5% are over 60 years old. Another data shows the population pyramid of Ukraine as shown in Figure 3.1.

Average fertility rate in 2016 is estimated to be 1.466. Life expectancy at birth is 71.68 in total; 66.73 for male and 76.46 for female.

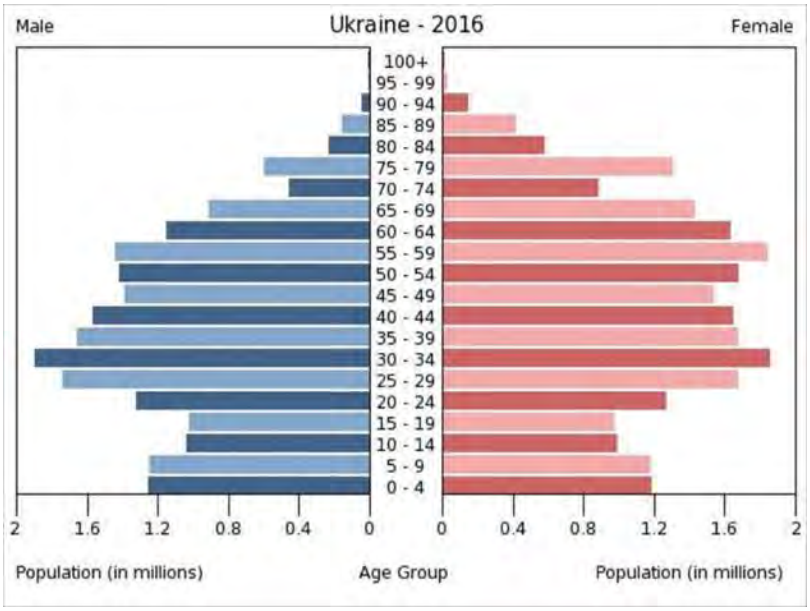
[1] Source: https://www.earthquaketrack.com/p/ukraine/biggest (as of 07 April 2018)

[2] Source: http://thinkhazard.org/en/report/254-ukraine/EQ (as of 07 April 2018)

[3] Source: https://ukrstat.org/en/operativ/operativ2018/ds/kn/kn_e/kn0118_e.html (as of 07 April 2018)

[4] Source: https://tradingeconomics.com/ukraine/population (as of 07 April 2018)

[5] Source: http://www.ukrcensus.gov.ua/eng/ (as of 07 April 2018)

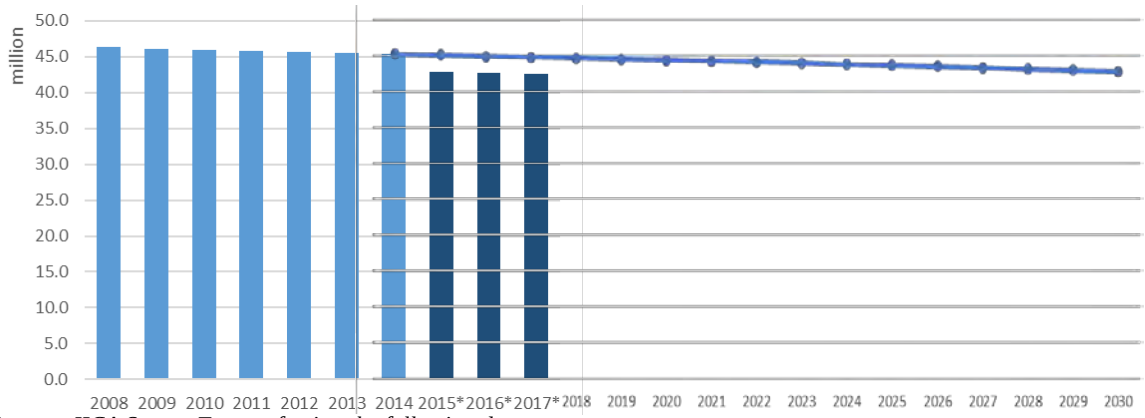


Source: https://www.cia.gov/library/publications/the-world-factbook/geos/up.html (as of 07 April 2018)

Figure 3.1 Population Pyramid of Ukraine

Figure 3.2 shows the population curve in the past ten years excluding the territories of the Autonomous Republic of Crimea and the city of Sevastopol, and its projection curve up to 2030 covering the whole territory of Ukraine.

In any case, it is estimated that the total population of Ukraine will decrease slightly year by year.



Source: JICA Survey Team referring the following data sources.
https://ukrstat.org/en/operativ/operativ2007/ds/nas_rik/nas_e/nas_rik_e.html (as of 07 April 2018)
http://www.idss.org.ua/forecasts/nation_pop_proj_en.html (as of 07 April 2018)

Figure 3.2 Population Curve of Ukraine (2008 – 2030)

(3) Economic and Industrial Conditions

1) Economic Overview of Ukraine[6]

Due to the turmoil caused by the conversion to market economy after independence, Ukraine experienced decline of production and hyper-inflation in the 1990s. The International Monetary Fund (IMF) and other international financial institutions cooperatively have taken economic reforms, but in 1998, Ukraine has suffered a slump in the international financial markets and faced problems such as a decline in foreign reserves.

In the 2000s, the economic growth rate turned positive, and the country realized a high growth rate due to steady steel exports and expansion of domestic demand. However, since the summer of 2008, in

[6] Source: http://www.mofa.go.jp/mofaj/area/ukraine/data.html#section4 (as of 07 April 2018)

addition to the peak out of steel demand and the global economic and financial crisis, the decline in stock prices and outflow of foreign capital began and the financial situation of Ukraine worsened.

The economy recovered steadily from 2010 to 2011. President Yanukovych, who took office in 2010, underwent various economic reforms, including tax reform, pension reform, land system reform, etc., with support from the IMF. In June 2012, Ukraine co-hosted the European Football Championship with Poland, which provided economic support through the development of infrastructure such as roads and airports. However, in the same year, steel production in the mainstay industry declined, and gross domestic product (GDP) growth rate remained low at 0.2% due to a decrease in exports, etc. In 2013, exports of steel and railways to Russia declined and the growth rate was 0%.

In 2014, the deterioration of the economic situation became serious, e.g., the trade value and industrial output greatly declined due to the deterioration of the eastern situation. As a result, the economic growth rate turned negative. Since fiscal conditions such as external debt and decrease in reserves of foreign currency became serious, from April of the same year, the Ukrainian government received much support from international financial institutions such as IMF, World Bank, G7, and Western countries.

In March 2015, the IMF approved a new economic program incorporating the provision of about USD 17.5 billion to the Ukrainian government over a period of four years. While the Ukrainian government increased its foreign reserves by receiving funds, in order to satisfy the conditions of the program, further results are required through reform of many fields such as fiscal, taxation, pension, energy, public service, etc.

The economic growth rate, which was negative in 2015, turned positive again in 2016, and is expected to remain positive in 2017. However, continued support from donor countries/institutions is required.

2) Industrial Situation of Ukraine

Table 3.1 shows composition of major industrial production. Major industries of Ukraine are manufacturing (28.8%), agriculture, forestry, and fishing (13.0%), wholesale and retail trade (12.8%), transportation and storage (6.8%), and mining and quarrying (5.0%).

Table 3.1 Composition of Industrial Production

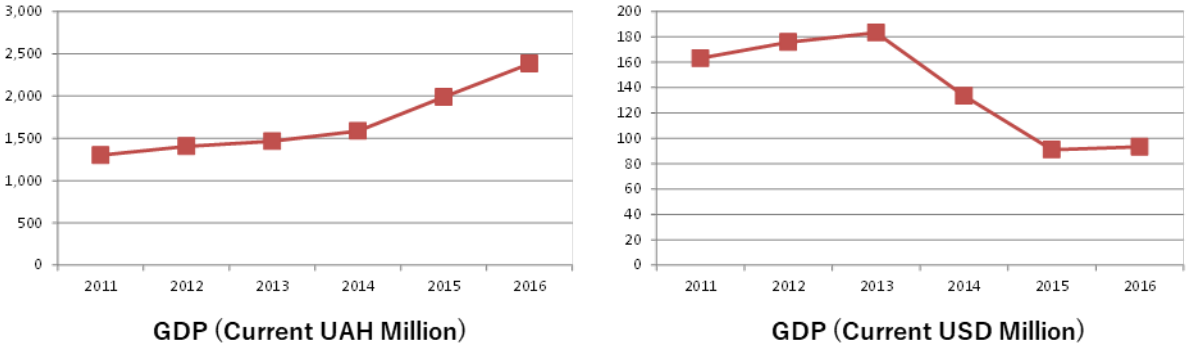
Unit: %

Industries	2010	2011	2012	2013	2014	2015	2016
Agriculture, forestry, and fishing	7.9	8.8	8.6	10.0	11.4	13.3	13.0
Mining and quarrying	5.0	5.4	5.0	5.0	4.7	4.5	5.0
Manufacturing	33.3	33.1	31.3	28.7	29.1	28.8	28.8
Electricity, gas, steam, and air conditioning supply	3.9	4.3	4.5	4.4	4.4	4.2	4.8
Water supply; sewerage, waste management,	1.0	0.9	0.8	0.7	0.7	0.6	0.6
Construction	5.6	5.6	5.9	5.4	4.8	4.5	4.7
Wholesale and retail trade; repair of motor vehicles	11.9	12.1	12.6	12.7	13.2	13.1	12.8
Transportation and storage	6.8	7.2	7.0	7.1	6.5	7.1	6.8
Accommodation and food service activities	0.8	0.8	0.7	0.7	0.6	0.6	0.6
Information and communication	2.9	2.8	2.9	3.2	3.1	3.4	3.6
Financial and insurance activities	4.1	3.3	3.2	3.4	3.5	2.6	2.1
Real estate activities	3.8	3.8	4.0	4.4	4.2	4.2	4.1
Professional, scientific, and technical activities	2.3	2.1	2.8	3.1	2.7	2.6	2.7
Administrative and support service activities	1.0	1.1	1.1	1.2	1.1	1.0	1.2
Public administration and defense; compulsory social security	2.9	2.5	2.7	2.9	3.5	3.5	3.6
Education	3.4	3.0	3.3	3.5	3.2	2.9	2.6
Human health and social work activities	2.4	2.2	2.4	2.4	2.1	2.1	2.0
Arts, entertainment, and recreation	0.4	0.4	0.6	0.6	0.6	0.5	0.5
Other service activities	0.6	0.6	0.6	0.6	0.6	0.5	0.5
	100.0	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: National Accounts of Ukraine for 2016 (State Statistics Service of Ukraine, Kyiv 2018.2.23)

3) GDP

Figure 3.3 shows the annual GDP in local currency UAH and USD, respectively. In UAH, it seems that the Ukrainian economy is growing year by year; however, in USD, it is shrinking from 2013 to 2015 and remains low in 2016 as well. This reverse event is caused by the sharp depreciation of UAH caused by economic crises in 2013-2014.



Source: JICA Survey Team based on the data from World Bank (https://data.worldbank.org/country/Ukraine)

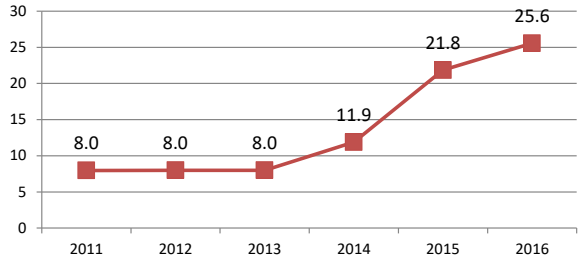
Figure 3.3 Gross Domestic Product in UAH and USD

4) Currency

The Ukrainian local currency, "Hryvnia (UAH)", was pegged at UAH 5.05 to USD 1.00 from 21 April 2005 to 21 May 2008. In December 2008, because of the global financial crisis, the Hryvnia dropped to UAH 7.88 (34%) to USD 1.00. After a period of instability, a new peg at UAH 8.0 per USD 1.00 was established, and remained for several years.

In 2012, this peg was changed to a managed floating system (same as Chinese Yuan) because the Euro and other European countries' currencies weakened against the US Dollar due to the debt crisis in Greece. Following the political instability in Ukraine in February 2014, the National Bank of Ukraine changed the Hryvnia into a floating exchange system.

As of April 2017, the official exchange rate in the Central Bank of Ukraine is UAH 26.67 per USD 1.00, the UAH lost about 70% against the USD from 2013 to 2017. The official exchange rate fluctuation between UAH and US$ is shown in Figure 3.4.



Source: JICA Survey Team based on the data from World Bank (https://data.worldbank.org/country/Ukraine) ,as of 15March 2018)

Figure 3.4 Official Exchange Rate (UAH/USD)

5) Inflation Rate

According to State Statistics Service of Ukraine[7], the consumer price index (CPI) has drastically increased in 2014 (24.9%) and 2015 (43.3%) and still remained more than 10% in 2016 (12.4%) and 2017 (13.7%).

[7] *Source: Social and Economic Development of Ukraine 2017 (State Statistics Service of Ukraine, 2018))*

6) Unemployment Ratio

Unemployment ratio in 2016 was 9.3% (International Labour Organization (ILO) standard) as shown in Table 3.2.

Table 3.2 Unemployment Ratio (ILO Standard)

Employment and unemployment of the population ***(aged 15-70, on average for the period)***	**2014**	**2015**	**2016**	**2017 Q3**
Number of economically active population (million. persons)	19.9	18.1	18.0	18.0
Number of employed population (million persons)	18.1	16.4	16.3	16.4
ILO unemployment rate of the population (y% to economically active population)	9.3	9.1	9.3	8.9

Source: Basic Social and Economic Indicators of Ukraine for 2017 (State Statistics Service of Ukraine, 2018)

7) Japanese Foreign Direct Investment

According to the State Service of Statistics of Ukraine, as of end of 2017, the accumulated foreign direct investment from Japan to Ukraine was USD 139.2 million. The total number of Japanese companies that have offices in Ukraine was 38[8].

3.1.2 Administrative Structure

(1) National Government

The presidential system of Ukraine is semi-presidential system which is similar to France and Russia. However, the president virtually does not have the right to implement the dissolution of the congress referred to as Verkhovna Rada (Supreme Council), unlike other countries. The appointment of the Prime Minister is subject to the concurrence of Verkhovna Rada while the resolution of the resignation of the Cabinet adopted by Verkhovna Rada is compulsory for the President.

Verkhovna Rada is unicameral with 439 seats. All the representatives are elected based on a nationwide proportional system and if a political party fails to win at least 3% of the ballot of the precinct, the party cannot win even one seat. The term of the representatives is 5 years. The congress is qualified for enactment, ratification of a treaty, state budget resolution, and appointment and dismissal of prime minister and cabinet ministers.

The Cabinet of Ukraine is the outstanding governmental administration and is responsible to the President and Verkhovna Rada. The Prime Minister is nominated by the President and appointed with the consent of a majority of Verkhovna Rada. The Cabinet consists of the Prime Minister, the First-Deputy Prime Minister, five vice premiers (two of the five are assigned from the state ministers), and the state ministers.

The Ministries of Ukraine are listed in Table 3.3. There are 19 ministries in total, and the ministries concerned with municipal solid waste management are Ministry of Regional Development, Construction and Housing and Communal Services, and Ministry of Ecology and Natural Resources which are highlighted in Table 3.3. Ministry of Economic Development and Trade is involved in formation of laws and tariffs related to MSWM and an application window of ODA projects.

Table 3.3 List of Ministries of Ukraine

- Ministry of the Cabinet of Ministers
- **Ministry of Economic Development and Trade**
- **Ministry of Regional Development, Construction and Housing and Communal Services**
- **Ministry of Ecology and Natural Resources**
- Ministry of Temporary Occupied Territories and Internally Displaced Persons
- Ministry of Agrarian Policy and Food
- Ministry of Internal Affairs

[8] *Source: Ministry of Foreign Affairs, Japan (https://www.mofa.go.jp, as of 30May 2018)*

- Ministry of Energy and Coal Industry
- Ministry of Foreign Affairs
- Ministry of Information Policy
- Ministry of Culture
- Ministry of Infrastructure
- Ministry of Youth and Sport
- Ministry of Defense
- Ministry of Education and Science
- Ministry of Healthcare
- Ministry of Social Policy (which covers “European and Euro-Atlantic integration”)
- Ministry of Finance
- Ministry of Justice

Source: Government Portal Official Website (https://www.kmu.gov.ua/, as of June 2018)

(2) Local Government (Oblast and Municipality)

1) Administrative Structure

Ukraine is divided into several levels of territorial entities. On the first level, there are 27 regions: 24 oblasts, one Autonomous Republic of Crimea, and two "cities with special status" of Kyiv and Sevastopol. The 24 oblasts are divided into raions and cities.

Regarding the administrative structure under oblasts in Ukraine: An oblast is divided into raions which consist of cities, villages and rural settlements, and significant cities which consist of districts. However, the two cities with special status, Kyiv City and Sevastopol, are administratively independent from the oblasts where the two cities are geologically located in.

Since the 2014 Crimean crisis, Crimea and Sevastopol have been controlled by Russia and been incorporated as a federal subject of Russia. However, they are still recognized as part of Ukraine by most of the international community.

2) Selection of Mayors and Deputies of Local Government

The law of Ukraine “on local elections” defines major principles, organization, and the order of holding of election of deputies of councils of oblast, raion, city, district, village, rural settlement, and the election of mayors of city, village, rural settlement, and city.

The governor of oblast state administration is appointed by the President of Ukraine.

In a case of a city where the number of voters equals or exceeds 90,000, the election of the city mayor is conducted under a majority election system of absolute majority in the only single mandate constituency that respectively coincides with the territory of the city in compliance with existing administrative and territorial structure or the territory of unified city community.

The election of deputies of council of oblast, raion, city, and district is conducted under the proportional election system in a multi-mandate constituency under the election list of local organizations of political parties with the assignation of candidates to the territory election constituencies, a multi-mandate constituency is divided for, which coincides with the territory of oblast, raion, and city in compliance with the existing administrative and territorial structure or the territory of a unified city territorial community set in accordance with the law of Ukraine "on voluntary unification of territorial communities".

The election of deputies of councils of village and rural settlement is conducted under the majority election system of relative majority in single mandate constituencies within the territory of respective village (several villages whose residents voluntarily united into village community) or rural settlement.

Local elections may be regular, extraordinary, repeat, intermediate, or first as shown in Table 3.4.

Table 3.4 Types of Local Election

Types of Election	Descriptions
Regular	Local elections shall be held simultaneously throughout Ukraine on the last Sunday of October of the fifth year of the powers of the councils, heads, and elders elected in the previous ordinary local elections. The decision to hold regular elections is taken by the Verkhovna Rada of Ukraine.
Extraordinary	Local elections shall be appointed by the Verkhovna Rada of Ukraine in case of early termination of powers of the Verkhovna Rada of the Autonomous Republic of Crimea, oblast, district, city, district within city, village, settlement council, village, settlement, city mayor, as well as in other cases stipulated by the laws.
Repeat	Local elections shall be appointed by the respective territorial election commission if the relevant election in this election district is recognized as such which has not occurred or if the person elected as a deputy has refused the deputy mandate.
Intermediate	Elections of the deputy of the village and rural settlement council shall be appointed in the single-mandate constituency by the territorial election commission in case of early termination of the powers of the deputy of the village and rural settlement council elected in the respective single-mandate constituency.
First	Elections of deputies, village, rural settlement, and city mayors shall be appointed by the Verkhovna Rada of the Autonomous Republic of Crimea, the regional, Kyiv and Sevastopol City Council, unless otherwise provided by law, in the event of the formation of new local councils.

Source: Ukraine law "on local elections"

3.1.3 Concerned Ministries in the Field of Solid Waste Management

(1) Ministry of Ecology and Natural Resources

1) About MENR

The Ministry of Ecology and Natural Resources of Ukraine (MENR) is a central executive authority, activity of which is governed and coordinated by the Cabinet of Ministers of Ukraine.

MENR is responsible for in the field of environmental protection, ecological safety, treatment of waste, hazardous chemicals, pesticides, and agricultural chemicals, and has state ecological expertise.

The Ministry is entitled in the area of atmospheric air, preservation of ozone layer, protection and restoration of flora and fauna, restoration and protection of lands, restoration and protection of water resources (surface, ground, sea waters), and efficient usage of water resources.

Moreover, the Ministry ensures legal and regulatory governing of the water management and land reclamation, geological study, and efficient usage of mineral resources, as well as performs state supervision on the fulfilment of the requirements of the environment legislation.

2) Organizational Structure

According to Table 3.5 which is provided by MENR, the Ministry consists of 19 departments/units and 241 staff in MENR. "Division of waste management" and "Division of environmental impact assessment" under "Department of Environmental Safety and Licensing Activity" are involved in MSWM and environmental impact assessment (EIA), respectively.

Table 3.5 Organizations of Ministry of Ecology and Natural Resources

No.	Position/Department/Division	Staff
1.	Ministry's Top Management	7
1.1.	Minister	1
1.2.	First Deputy Minister	1
1.3.	Deputy Minister for European Integration	1
1.4.	Deputy Minister	3
1.5.	State Secretary	1
2.	Advisors to the Minister	7
3.	Managing Office of Expert Work and Organizational and Analytical Support (Secretariat)	21
4.	Department of Strategy and European Integration	25

No.	Position/Department/Division	Staff
5.	Managing office of work with state-owned objects/facilities	10
6.	Personnel Management Office	10
7.	Managing Office of Land and Water Resources Protection	11
8.	Managing Office of Biodiversity Protection and Biosafety	11
9.	Department of Ecological Network and Nature Reserve Fund	20
10.	Managing Office of Budgetary Policy and Financial Planning	17
11.	Legal Department	20
12.	Department of Environmental Safety and Licensing Activity	34
	- Managing office of waste management and eco-safety	9
	- Division of waste management	**4**
	- Division of ecological safety	4
	- Managing office of environmental impact assessment and licensing activity	23
	- Division of environmental impact assessment	**5**
	- Division of licensing and control	8
	- Division of atmospheric air and environmental audit	5
	- Division of handling pesticides and agrochemicals	4
13.	Department of Climate Change Issues and Preservation of the Ozone Layer	23
14.	Managing Office of Accounting and Reporting, Payment for Labor	11
15.	Division of Information Security and Protection of Electronic Services	6
16.	Internal Audit Sector	4
17.	Sector of Secret Work	2
18.	Chief Specialist on the Issues of Mobilization and Civil Defense	1
19.	Chief Specialist on the Issues of Prevention and Detection of Corruption	1
	Total	**241**

Note: There are differences between the total and detailed numbers of staffs at some groups in the original document.
Source: MENR (Translated by the JICA Survey Team)

3) Budgetary Information

The annual expenditure of MENR in the past three years is shown in Table 3.6. In the past three years, the total budget of MENR is increasing at approximately UAH 1.0 billion annually and in 2017, it was UAH 7.48 billion. According to MENR, MENR does not have any subsidy program for solid waste management of local government.

Table 3.6 Annual Expenditure of Ministry of Ecology and Natural Resources

Unit: UAH in thousands

Code*	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan*
2400000	**Ministry of Ecology and Natural Resources of Ukraine**	**5,558,965**	**6,455,622**	**7,488,088**	**N/A***
2401000	**The apparatus of the Ministry of Ecology and Natural Resources of Ukraine**	**1,159,734**	**1,688,194**	**956,279**	**-**
2401010	General governance and management in the field of ecology and natural resources	34,811	39,764	59,941	55,182
2401040	Applied scientific and scientific-technical developments, performance of works under state target programs and state orders in the field of environmental protection activities, financial support of scientific staff training	22,374	26,530	32,306	18,434

Code*	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan*
2401090	Advanced training and retraining in the field of ecology and natural resources, preparation of scientific and scientific-pedagogical staff	11,603	13,841	29,819	13,778
2401160	Preservation of the natural-reserved fund	-	156,117	279,488	205,870
2401270	Taking environmental measures	420,993	142,857	202,246	220,927
2401500	Taking measures to implement the priorities for developing the sphere of environmental protection	0	88,436	115,037	-
2401510	Contributions of Ukraine to the budgets of the United Nations Framework Convention on Climate Change, Kyoto Protocol and International Transaction Log	166	-	-	-
2401520	Ensuring the activities of the National Center for Greenhouse Gas Emissions Accounting	1,259	1,748	2,174	1,722
2401530	State support of measures aimed at the reduction (increase of absorption) of greenhouse gas emissions, including heat insulation of premises of social welfare institutions, and development of international cooperation on climate change issues	668,528	1,218,901	235,266	-
2402000	**State Agency of Environmental Investments of Ukraine**	**2,574**	**-**	**-**	**-**
2402010	Governance and management in the field of environmental investments	2,574	-	-	-
2404000	**State Service of Geology and Subsoil of Ukraine**	**129,033**	**89,808**	**130,241**	**-**
2404010	Governance and management in the field of geological study and use of subsoil	39,149	20,982	30,241	25,732
2404020	Development of the mineral raw material base	89,884	68,826	100,000	100,000
2405000	**State Ecological Inspection of Ukraine**	**125,757**	**148,979**	**242,635**	**-**
2405010	Governance and management in the field of environmental control	125,757	148,979	242,635	370,943
2406000	**National Commission on Radiation Protection of the Population of Ukraine**	**650**	**689**	**815**	**-**
2406010	Governance and management in the field of radiation protection of the population	650	689	815	907
2407000	**State Agency of Water Resources of Ukraine**	**2,295,597**	**2,406,183**	**3,529,290**	**-**
2408000	**State Agency of Ukraine on Exclusion Zone Management**	**1,845,620**	**2,121,769**	**2,628,831**	**-**

Note: Total calculation was not done because there was no table chart shaped data for the plan of 2018
Source: JICA Survey Team based on MENR's information

4) Development Strategy

According to the development strategy of MENR, the MENR has set the following seven main targets to be achieved by 2020:

- Target 1. Increasing the level of public ecological conscience;
- Target 2. Improvement of ecological situation and increase of level of ecological safety;
- Target 3. Achieving the condition of an environment safe for human health;
- Target 4. Integration of ecological policy and improvement of integrated ecological governance system;
- Target 5. Termination of losses of biological and landscape diversity and establishment of ecological network;
- Target 6. Assurance of ecologically balanced nature usage; and
- Target 7. Improvement of regional ecological policy.

Specific targets related to MSW are determined in a section for "waste and hazardous chemical substances" under Target 2, as follows:

- In cases of towns having a population of over 250,000 people, the rate of municipal waste disposed at the sanitary landfill sites have to be over 70% and 100% by 2015 and 2020 respectively;
- Decreasing the rate of bio-degradable waste at landfill sites by 15% by 2020;
- Increasing by 1.5 times the volume of recycled waste by 2020; and
- Introducing advanced technologies for recovery of municipal solid waste.

In order to evaluate the achievement of the targets, parameters to be monitored were set in the annex of the development strategy.

(2) Ministry of Regional Development, Construction, Housing, and Communal Services

1) About MRDCHCS

The Ministry of Regional Development, Construction, Housing, and Communal Services of Ukraine (called as "MRDCHCS") is the central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine.

The MRDCHCS is the main body in the system of central bodies of executive power, which ensures the formation and implementation of state regional policy, state housing policy, and policy in the field of construction, architecture, urban development, housing and communal services, and also ensures the formation of state policy in the field of architectural and construction control and supervision, control in the sphere of housing and communal services, in the sphere of efficient use of fuel and energy resources, energy saving, renewable energy sources, and alternative fuels.

Regarding MSWM, according to the law "On waste", a responsibility of MRDCHCS is as follows:

- Formation of the state policy on municipal waste management;
- Development and approval of state standards, norms and rules on municipal waste management;
- Support and supervision of municipal waste management implemented by local governments; and
- coordination of activities of local executive bodies for municipal waste management.

2) Organizational Structure

Organization structure of MRDCHCS is as shown in Table 3.7. MRDCHCS consists the minister who is vice prime minister of Ukraine, four deputy ministers and 31 departments/divisions/Sectors.

Table 3.7 Organization structure of MRDCHCS

No.	Department/Divisions	Seat
-	Senior Management - Minister - First Deputy Minister - Deputy Minister - Deputy Minister for European Integration - State Secretary	5 1 1 2 1 1
1	Directorate of Energy Efficiency	7
2	Directorate of Financial Mechanisms for Sustainable Local and Regional Development	17
3	Directorate for Development of Local Self-Government, Territorial Organization of Power and Administrative-Territorial Arrangement	21
4	Directorate for Strategic Planning and European Integration	7
5	Directorate of Regional Development	18
6	Department of Administrative and Organizational Support	24
7	Financial Department	21
8	Department of Life Support Systems and Housing Policy	53
9	Department of Local Self-Government and Territorial Organization of Power	23
10	Department for Regional Development - Division of Regional Development Monitoring - Division of Projects and Programs of Regional Development - Division of Institutional Support for Territorial Development - Division of Interregional and Cross-Border Cooperation - Unit of Rural Development	22 5 6 4 4 2
11	Department for Designing Construction Objects, Technical Regulation and Scientific and Technical Development	31
12	Department of Urban Development, Architecture and Territory Planning	25
13	Department for Implementing Priority Projects of Regional Development	34
14	Department of Economics of Life Support Systems	20
15	Legal Department	26
16	Management Office of International Cooperation and Interaction with International Financial Institutions	10
17	Management Office of Pricing, Economy and Contractual Relations in Construction	15
18	Management Office of Territory Improvement and Communal Services Division of Municipal Waste Management Division of Communal Services Unit of Territory Improvement	12 5 4 2
19	Management Office (Service) of Human Resources	14
20	Division of Information Technologies	9
21	Division of State Property Management	7
22	Division of Media Interaction	7
23	Operative Dispatching Division	6
24	Unit of Internal Audit	4
25	Unit of Civil Society Development	2
26	Unit of Tender Procedures	2
27	Unit of Civil Defense	2
28	Unit of Mobilization Work and Defense	2
29	Unit for Prevention and Detection of Corruption	2
30	Unit of Monitoring	3
31	Unit of Regime-Secret Work	2
-	Total	453

Source: MRDCHCS Website (http://www.minregion.gov.ua/, As of 01April 2018)

3) Budgetary Information

Table 3.8 below shows the annual expenditure of MRDCHCS in the past three years.

Total expenditure in 2017 is UAH 10.3 billion wherein 2.1 billion is used for "the Programs" which is directly controlled by MRDCHCS and 8.2 billion is used for "the Subventions" which is subsidy to regional/local governments for specific usage. Highlighted program related to solid waste management are detailed as below.

Table 3.8 Annual Expenditure of MRDCHCS in the Past Three Years

Unit: UAH

Code	Name of Program and Financing Budget	2015	2016	2017
2750000	MRDCHCS Total	6,567,566,482	5,919,411,000	10,358,804,700
2751000	Programs	1,532,811,105	2,182,816,000	2,110,831,300
2751010	Management in Regional Development, Construction, and Housing	46,501,312	50,574,200	87,633,100
2751030	R&D, Works, Studies for Programs, Regulation, and Standardization in the Field of Construction, Housing, and Regional Development	3,988,733	4,650,400	6,113,900
2751070	The functioning of the State Scientific and Technical Library	4,635,943	5,104,400	6,938,000
2751180	The development of e-government in the field of Regional Development, Construction, and Housing	-	-	7,161,800
2751190	Providing state support for the construction (purchase) of affordable housing	-	-	29,646,200
2751320	Construction of soccer fields with artificial turf in the regions of Ukraine	-	-	243,833,200
2751370	Financial support of the State Fund for Youth Housing	6,841,657	6,849,900	6,850,000
2751380	Partial compensation of interest rate commercial bank loans to young families and single young citizens for construction (reconstruction) and housing	59,816,779	53,377,000	41,537,200
2751420	The increase in the authorized capital of the state of specialized financial institution "State Fund for Youth Housing" and use for the implementation of the state program for youth housing	33,674,108	24,000,000	34,310,900
2751430	State concessional lending to individual rural builders for construction (reconstruction) and housing	-	39,520,400	39,138,500
2751470	Reduce the cost of mortgages for affordable housing people who need better housing	78,824,656	68,779,400	59,856,600
2751520	The project "Reconstruction of sewage facilities and sewage construction technological line for processing and disposal of sludge Bortnychi WWTP"	33,099,099	89,036,800	17,582,000
2751600	**Development of urban infrastructure and activities in the district heating sector of Ukraine, development of water supply and sanitation in the city of Nikolayev, reconstruction and development of municipal water management of Chernivtsi**	**169,914,146**	**229,527,700**	**522,000,100**

Code	Name of Program and Financing Budget	2015	2016	2017
2751610	**Financing arrangements for the implementation and coordination of the project development of urban infrastructure measures in the district heating sector in Ukraine, emergency lending program for Ukraine, municipal infrastructure development programs in Ukraine, and measures to restore east Ukraine**	**11,493,146**	**12,513,000**	**16,948,100**
2751700	Compensation costs related to temporary accommodation in sanatoriums disabled and other citizens who move out temporarily occupied territory and the area of the antiterrorist operation	1,547,372	-	-
2751710	Repayment of payables to recover costs related to the partial payment for the temporary residence of citizens who temporarily moved from the occupied territory and the area of the antiterrorist operation	213,915	-	-
2751830	Restoration and adaptation Mariinsky Palace in Kyiv	99,972,970	-	-
2751840	Purchase of new equipment and licensed software	4,919,635	-	-
2751860	Construction of urban sewage treatment plants Baryshivka	10,000,000	-	-
2752000	State Architectural and Construction Inspectorate of Ukraine	68,831,534	79,470,700	133,177,200
2753010	Control and management of e-government	2,874,992	2,931,400	-
2753030	E-government and the National Informatization Program	6,849,300	2,000,000	-
2754000	State Agency for Energy Efficiency and Energy Ukraine	325,359,641	881,740,900	858,104,600
2755010	Leadership and Management in Surveying, Mapping, and Cadastre	516,444,818	588,395,400	-
2755020	Land reform	44,922,007	44,144,600	-
2755030	General state surveying and mapping work, demarcation, and delimitation of state border	52,731	199,800	-
2756010	Leadership and management in the restoration of Donbass	2,032,613	-	-
2760000	Subventions	5,034,755,377	3,736,595,100	8,247,973,400
2761040	Subvention from the state budget to local budgets to implement measures aimed at developing the health care system in rural areas	-	-	0
2761070	**State Regional Development Fund**	**-**	**2,694,549,500**	**3,089,859,900**
2761130	**Subvention from the state budget to local budgets formation of joint infrastructure of local communities**	**-**	**944,708,200**	**1,434,114,800**
2761140	Subvention state budget regional budget of the Donetsk Region in arrears for electricity supply companies	-	-	1,799,079,200

Code	Name of Program and Financing Budget	2015	2016	2017
2761350	Subvention from the state budget to local budgets for financing of socio-economic compensation for the risk population living in the surveillance zone	102,602,993	97,337,300	117,353,900
2761520	**Subvention from the state budget to local budgets for repayment of the difference in tariffs for thermal energy, heating, and hot water services for centralized water supply system, which produced, transported, and supplied to the population and / or other businesses centralized water supply and drainage, providing public services for centralized water supply and sewage, which arose due to the mismatch of the actual cost of heat energy and services in centralized water, sanitation, heating, and hot water tariffs that were approved and/or agreed by the government or local government**	**4,685,122,822**	**-**	**1,797,978,900**
2761560	Subvention from the state budget to local budgets for restoration (construction, repair, reconstruction) infrastructure in Donetsk and Luhansk regions	247,029,562	-	-
2761600	Subvention from the state budget to local budgets for projects within the Emergency Recovery Credit Program for Ukraine	-	0	9,586,700

Source; JICA Survey Team based on the date from MRDCHCS Website (http://www.minregion.gov.uaabout/funding/, as of 15May2018)

A) 2751600: Program on "Development of urban infrastructure and activities in the district heating sector of Ukraine, development of water supply and sanitation in the city of Nikolayev, reconstruction and development of municipal water management of Chernivtsi"

This program consists of several projects related to urban infrastructure such as district heating, water supply, and wastewater treatment and sanitation including solid waste management in major cities. Budget expenditures of this program in the past three years were UAH 169.9 million (2015), UAH 229.5 million (2016), and UAH 522.0 million (2017); and for the plan in 2018, budget is UAH 676.5 million.

This program, among others, provides financing through credit funds named "Urban Infrastructure Project 2 (UIP2)" of the International Bank for Reconstruction and Development (IBRD) and the Clean Technology Fund (CTF) for ten projects in nine cities including a municipal solid waste management project in Kharkiv. This project provides:

- Construction of processing of municipal solid waste collection system and landfill gas power generation in Dergachi City, Kharkiv Oblast;
- Purchase of motor vehicles and containers for solid waste landfill;
- The pre-contractual services and technical supervision of the construction of a new complex for processing of solid waste collection system and landfill gas to power generation in Dergachi City, Kharkiv Oblast;

Financing for these activities, in addition to pre-contractual services, started in 2018 and will be completed in 2020. Approximate budget for this project from program code 2751600 in 2018 is UAH 144.8 million.

B) 2751610: Program on "Financing arrangements for the implementation and coordination of the project development of urban infrastructure measures for the district heating sector in Ukraine, emergency lending program for Ukraine, municipal infrastructure development programs in Ukraine and measures to restore east Ukraine"

Code 2751610 is to ensure the implementation and coordination of joint project with the International Bank for Reconstruction and Development (IBRD) and European Investment bank (EIB) projects for infrastructure rehabilitation and replacement and modernization of equipment in selected utilities (UIP2).

Expenditures for this program are allocated to the development and implementation of training programs, workshops, and seminars for the training of staff of regional Project Management Units (PMUs), Central Project Management Groups, specialists of enterprises (local governments), payment for consultants, and preparation and submission of consolidated reports to IBRD, EIB, and central executive authorities for the projects of water and wastewater, district heating, solid waste utilization, energy efficiency, street lighting of settlements as well as restoring the infrastructure of eastern regions of Ukraine.

C) 2761070: Subvention from the "State Regional Development Fund"

Code 2761070, Subvention from "State Regional Development Fund (SRDF)", provides subsidy for investment program and regional development projects which were approved by MRDHCS to local governments. Total SRDF budget is approx. UAH 3,000 million, in which, solid waste management sphere accounts for approx. UAH 10 million (0.3% of total SRDF)[9] for the projects of landfill construction, processing facility construction, purchase of collection vehicles, and organization of utility company and/or cooperative, etc. MRDCHCS Order No. 80 (24 April 2015) ""Preparation, evaluation, and selection of investment programs and projects of regional development, which can be implemented at the expense of the SRDF" regulates selection criteria and application procedure of this SRDF.

D) 2761130: "Subvention from the state budget to local budgets for the formation of joint infrastructure of local communities"

The budget program 2761130 "Subvention from the state budget to local budgets for the formation of joint infrastructure of local communities" stipulated a total of UAH 1,900 million in 2018; the amount has been increased in the past two years. In 2016, budget was UAH 944.7 million and in 2017, it was UAH 1,434.1 million. The conditions of this grant are regulated by the Order Cabinet of Ministers of Ukraine No. 200 (16 March 2016).

For the solid waste management sphere, two projects in 2016 and three projects in 2017 were implemented (Table 3.9).

Table 3.9 Joint Infrastructure Projects in Solid Waste Management Sphere in 2016 and 2017

Year/No	Oblast	Recipient of Subsidy	Project (Object) Name	Budget (UAH)
2016/01	Khmelnytsky	OTG Dunaivtsi	Creation of waste sorting plant	3,363,030
2016/02	Khmelnytsky	OTG Chornoostrivska	Purchasing of rear loading garbage truck and 100 containers for waste collection	2,688,180
2017/01	Donetsk	OTG Soledarsk	Purchasing of garbage truck for the removal of solid waste	1,192,738
2017/02	Lviv	OTG Shehynivska	Purchasing of containers for waste collection	172,600
2017/03	Khmelnytsky	OTG Dunaivtsi	Retrofit of waste sorting plant	1,215,890

**OTG means United Territorial Communities*
Source: JICA Survey Team

[9] *Solid Waste Management Sphere total: 11.5million UAH (2015), 10.5 million UAH (2016) and 9.0 million UAH(2017)*

E) 2761520: "Subvention from the state budget to local budgets for repayment of the difference in tariffs for thermal energy, heating, and hot water services for centralized water supply system, which are produced, transported, and supplied to the population's and/or other businesses' centralized water supply and drainage; providing public services for centralized water supply and sewage, which arose due to the mismatch of the actual cost of heat energy and services in centralized water, sanitation, heating, and hot water tariffs that were approved and/or agreed by the government or local government"

Budget program 2761520 provides subsidies from the state budget to local budgets to repay the difference between the actual cost and tariffs of heat energy services for central heating, hot water supply, water supply and drainage, cold water, and sewerage which were approved or agreed by the government. There is no financing for expenditures related to the municipal solid waste management system from the state budget under the above-mentioned budget programs.

(3) Ministry of Economic Development and Trade

1) About MEDT

The provision of the Ministry of Economic Development and Trade of Ukraine approved by the Cabinet of Ministers of Ukraine as of 20 August 2014 defines the scope of activities, for which the Ministry ensures the implementation of the state policy.

Thus, in accordance with the provision, MDET is the main body in the system of central executive authorities which ensures[10]:

- formation and implementation of state policy of economic and social development and trade, state industrial policy, state investment policy, state foreign economic policy, state policy in the field of technical regulation, standardization, metrology and metrology activity, state property management, entrepreneurship development, public-private partnership, intellectual property, tourism and resorts (except for state supervision (control) in the sphere of tourism and resorts), state and public procurement and state order for training experts, scientific, educational and working personnel, including advanced training and retraining;
- formation and implementation of state policy in the sphere of state statistics, state material reserve, export control; formation of state policy in the field of consumer protection, state policy on price control, state regulatory policy and policy on licensing, authorization system, supervision (control) in the field of economic activity.
- Implementation of state policy for arranging and monitoring the production of securities and strictly accountable documents.
- Ministry of Economic Development is the authorized body to coordinate activities for implementing state defense order.

From the view point of municipal solid waste management (MSWM), there is no specific department which is directly related to MSWM. However, since MEDT is involved in the formulation of Ukrainian laws and regulations, MEDT reviews the draft acts related to MSWM as well in order to check if they influence the industrial sector.

2) Organizational Structure

The organization structure of MEDT is shown in Table 3.10. MEDT consists of the minister, 4 deputy ministers, state secretary, and 25 departments/divisions.

According to the Head of the Department of Industrial Policy, the Ministry has 814 staff including the minister in MEDT and 26 staff in the Department of Industrial Policy. The numbers of staff in the other departments were not provided by MEDT.

[10] *Source Decision of the Cabinet of Ministers of Ukraine dated 20 August 2014 No. 459*

Table 3.10 Organization Structure of MEDT

No.	Position/Department	Seat
-	Minister/ First Vice Prime Minister of Ukraine First Deputy Minister Deputy Minister Deputy Minister/Trade Representative of Ukraine State Secretary	1 1 2 1 1
1	Department of managing state property	N/A
2	Department of public procurement regulation	N/A
3	Department of Regulatory Policy and Entrepreneurship Development	N/A
4	**Department of Industrial Policy**	**26**
5	**Department of public investment projects and development support**	**N/A**
6	Department of Strategic Development of defense and security sector	N/A
7	Department of Technical Regulation	N/A
8	Department of economic strategy and macroeconomic forecasting	N/A
9	Department of regulation of foreign economic activity	N/A
10	Department of Tourism and Resorts	N/A
11	**Department of Attracting Investment**	**N/A**
12	Department of Intellectual Property	N/A
13	Department of International Trade and Economic Cooperation and European Integration	N/A
14	Department of Trade Defense	N/A
15	Department of Market Access and Interaction with the World Trade Organization	N/A
16	Department of Export Development	N/A
17	Legal Department	N/A
18	Department of Staff	N/A
19	Department of Development of Information and Communication Technologies, Workflow and Electronic Services	N/A
20	Department of Financial Work and Economic Support	N/A
21	Department of Information Security	N/A
22	Office of Internal Audit	N/A
23	Division of Interaction with Public Authorities and Public Relations	N/A
24	Department of Mobilization and Civil Protection	N/A
25	Sector of corruption prevention and detection	N/A
-	**Total**	**814**

N/A: Not Available
Source: Ministry of Economic Development and Trade (As of March 2018)

The Department of Industrial Policy reviews the draft acts related to MSWM. In the case of the draft law on Waste Electrical and Electronic Equipment Directive (WEEE), the Department of Industrial Policy participates in a national working group to make a discussion.

In the case of international cooperation project including technical assistance projects, the Department of Public Investment Projects and Development Support is the contact to submit application of official development assistance (ODA) projects. Concerned ministries and local governments have to send applications for ODA projects and MEDT evaluates the project applications.

In case of public-private partnership (PPP) projects, the Department of Attracting Investment is the agency concerned. MEDT evaluates and approves the projects.

3) Budgetary Information

Table 3.11 below shows the annual expenditure of MEDT in the past three years and budget of 2018.

Total budgetary expenditure in 2017 of UAH 2.69 billion became twice from 2016. Furthermore, in the plan for 2018, total budgetary expenditure is estimated at UAH 6.16 billion, which increased 2.3 times from 2017.

Table 3.11 Annual Expenditure of MEDT in the Past Three Years

Unit: UAH in thousands

Code	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
1200000	Total expenditures by the main spending unit of the state budget	1,349,370.58	1,276,237.10	2,692,107.45	6,158,485.20
1201010	Governance and management in the field of economic development and trade	145,081.59	220,863.20	262,260.26	441,934.60
1201020	Contributions of Ukraine to the budget of the WTO and the Single Budget of the CIS bodies	18,501.18	21,039.40	37,141.68	55,452.40
1201030	Ensuring bilateral cooperation between Ukraine and foreign states and international organizations, informational and organizational support of Ukraine's participation in international forums, conferences, exhibitions	3,992.75	15,007.20	34,407.58	100,606.20
1201070	Research, applied scientific and scientific-technical developments, performance of works under state target programs and state orders, scientific developments in the field of standardization and certification of industrial products, training of scientific staff and financial support for the development of scientific infrastructure in the field of economic development and trade	4,197.18	-	-	-
1201090	Advanced training of civil servants in the field of economy and retraining of management staff for the sphere of entrepreneurship	1,590.58	1,594.30	-	-
1201120	Financial support for publications on economic issues and ensuring the operation of the web portal on public procurement	2,613.61	893.10	748.40	748.40
1201220	Preservation and operation of the national reference base, ensuring the operation of services, applied scientific and scientific-technical developments, performance of works under state target programs and state orders in the field of standardization, metrology and reference base, harmonization of national standards with international and European ones, training of scientific staff in the field of economic development	22,563.78	29,471.90	35,599.78	38,121.60
1201440	Implementation of the program "Promotion of mutual trade by eliminating technical barriers in trade between Ukraine and the European Union."	52,065.96	55,911.50	184,898.28	75,873.70
1201480	Ensuring the operation of the Kryvyi Rih Mining and Processing Plant of Oxidized Ores	23,850.00	23,850.00	23,850.00	23,850.00

Code	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
1201510	Functioning of trade missions abroad	-	2,778.00	0.00	-
1201520	Implementation of state target programs on reforming and developing the defense industrial complex, development and introduction of new technologies, expansion of existing production facilities for manufacturing defense products	-	124,903.70	370,238.26	3,043,700.00
1202010	Governance and management in the field of consumer rights protection	19,898.13	-	-	-
1203010	Governance and management of the state reserve	8,785.29	12,027.70	22,421.64	32,472.10
1203020	Maintenance of the state material reserve	148,059.63	145,321.10	191,303.30	213,959.80
1203040	Accumulation (increase) of material assets of the state material reserve	332,670.61	56,284.10	521,187.13	268,054.00
1204010	Governance and management in the field of investment activity and management of national projects	10,898.48	147.40	-	-
1205010	Governance in the field of intellectual property	6,555.43	6,505.80	3,980.31	-
1206010	Governance and management in the field of efficient use of energy resources	1,199.33	-	-	-
1207010	Governance and management in the field of statistics	490,726.86	537,916.50	944,019.68	1,388,045.00
1207020	Statistical surveys and censuses	8,675.49	8,671.30	8,682.21	119,743.80
1207030	Survey of living conditions of households	5,494.19	4,703.80	5,236.13	5,498.30
1207040	Applied developments, training of scientific staff in the field of state statistics	1,055.40	1,100.00	1,249.90	1,136.10
1207090	Training of staff in the field of statistics by a higher educational institution of the fourth level of accreditation and ensuring the activity of its practice bases	-	-	-	334.80
1208010	Governance and management in the field of export control	7,169.39	7,247.10	15,566.50	21,068.40
1201230	Financial support for tourism development, creation of tourist safety conditions, development of tourist infrastructure of international transport borders and highways in Ukraine	-	-	13,553.44	27,886.00
1209010	Governance and management in the field of price control	4,282.24	-	-	-
1201530	Development of e-government in the field of providing administrative services	-	-	1,998.00	-

Code	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
1201530	Formation of the authorized capital of the public joint stock company "Expertno-kredytne ahentstvo" (Expert-credit agency)	-	-	-	200,000.00
1201550	Replenishment of the authorized capital of the state innovative financial and credit institution for providing statutory activities	-	-	-	100,000.00
1201700	Allocation of funds to the Ministry of Economic Development and Trade of Ukraine	29,443.48	-	-	-
1201710	Implementation of measures to protect the national interests of Ukraine	0.00	-	-	-
1203700	Ensuring the replenishment of the stocks of tangible assets of the state reserve	0.00	-	-	-

Source: JICA Survey Team based on MEDT's information

3.1.4 National Waste Management Strategy

The Government of Ukraine approved its National Waste Management Strategy including the action plan in November 2017, which was supported under the European Union (EU) initiative. In the strategy, the future waste management process is proposed with the 1st (2017-2018), 2nd (2019-2023), and 3rd (2024-2030) implementation stages under the waste management hierarchy, which aims to reduce the waste volume that will be disposed of at the landfills.

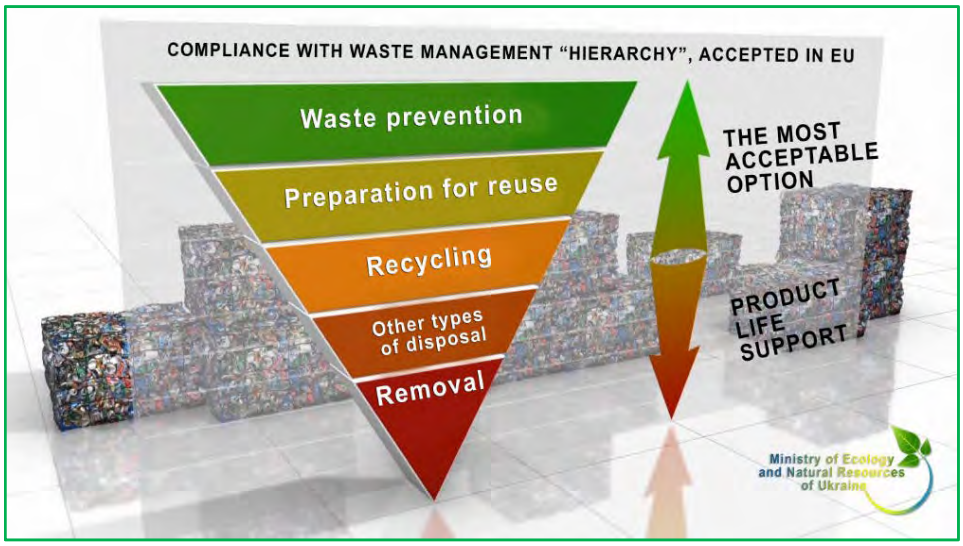
(1) European Directives taken into account

The strategy took into account the European approaches, which are based on the following EU directives:

- Framework Directive 2008/98/EC the European Parliament and the Council of 19 November 2008 on waste and repealing certain directives;
- Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste;
- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC;
- Directive 94/62/EC of the European Parliament and of the Council of 20 December 1994 on packaging and packaging waste;
- Directive 2012/19/EC of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE);
- Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators.

(2) Waste management hierarchy

The details of waste management hierarchy adopted under the strategy are shown in Figure 3.5.



Source: MENR

Figure 3.5 Waste Management Hierarchy

The first priority is put on waste "reduction (prevention)" and "reuse" of waste is regarded as the second priority. Material recycling of waste is regarded as the third priority and energy recovery from waste (thermal recycling), which is to use waste as secondary energy resource, is also recommended as fourth priority. Therefore, WTE plant, which generates power though incineration is categorized as the fourth priority.

(3) Special measure in the field of municipal solid waste (MSW)

Special measures for various types of waste, such as MSW, industrial waste, construction waste, hazardous waste, agricultural waste, packaging waste, WEEE, used batteries, and medical waste, have been determined. Remarkable measures for MSW are shown as follows:

- full reimbursement of expenses by including in the tariff for the municipal solid waste management of all losses related to the provision of such services;
- implementation of a mechanism for full financing of the waste management system, taking into account the principles of "polluter pays", "extended producer responsibility", and "pay as you throw";
- installation for segregated collection of the following types of solid waste:
  - hazardous waste in the composition of municipal solid waste;
  - large-sized waste (furniture, large household goods, etc.);
  - secondary raw materials;
  - electrical and electronic equipment waste, waste cells, batteries, and accumulators;
  - garden and park waste of biological origin (grass, leaves, branches, etc.); and
  - construction and repair waste.

(4) Target Indicators

Under the strategy, target indicators have been set for each implementation stage as shown in Table 3.12. According to the target indicators, construction of new incineration plants is highly expected.

Table 3.12 Target Indicators under National Waste Management Strategy

Area	Indicator	Unit	Baseline (2016)	Target Value by Stage		
				2017-2018	2019-2023	2024-2030
1. Prevention of waste generation	1-1 Organization of a network of centers for the introduction of cleaner production (technology) to minimize the volumes of waste generated	Unit	-	5	10	20
	1-2 Adoption of regulatory legal acts for the introduction of an eco-design of goods for long-life, easy reuse, and recycling	Unit	-	2	5	10
	1-3 Decrease in the volumes of primary raw materials	%	90	85	80	70
2. Preparation for reuse	2-1 Introduction of separate collection of waste, which are good for reuse and recycling, in settlements	Unit	575	800	2,500	5,000
	2-2 Establishment of collection centers for repair waste for reuse (primarily, WEEE)	Unit	-	25	100	250
	2-3 Increase in the volumes of municipal solid waste sent for reuse	%	5	7	8	10
3. Recycling	3-1 Foundation of new recycling facilities	Unit	65	100	250	800
	3-2 Foundation of organic waste composting facilities	Unit	20	70	150	500
	3-3 Increase in the volumes of waste sent for recycling	%	3.04	5	15	50
4. Other types of disposal including energy recovery	**4-1 Construction of incineration plants**	Unit	1	3	15	20
	4-2 Increase in amount of municipal solid waste treated at incineration plants	%	2.37	5	7	10
		mil.Ton	1	1.5	2	3
5. Final disposal	5-1 Decrease in a number of final disposal sites of municipal solid waste (according to the Directive 1999/31/EC)	Unit	6,000	5,000	1,000	300
	5-2 Decrease in amount of landfilled waste	%	50	45	40	35
	5-3 Decrease in amount of landfilled municipal solid waste	%	95	80	50	30
	5-4 Creation of a network of regional landfills for municipal solid waste (according to the Directive 1999/31/EC)	Unit	-	5	25	50

Source: National Waste Management Strategy

3.1.5 Current Legal System on Waste Management

The framework legislation in the field of waste management is the law “On Waste”. Laws on waste treatment and disposal such as incineration and landfilling and laws on recycling of major types of waste have not been established yet and they are under preparation as described in Section 3.1.7.

Current laws, regulation, technical guidelines, and a national plan related to MSWM are shown in Table 3.13.

From the viewpoint of public services of MSWM, the laws “On Local Government” and “On Housing Communal Services” are very important to understand.

Table 3.13 List of Laws Related to MSWM

No.	Date of Issue	No. of Document	Laws/Regulation
1	5 March 1998	Law of Ukraine from No.187/98-BP	On Waste Management
2	9 November 2017	Law of Ukraine No. 2189-VIII	On Housing and Communal Services
3	21 May 1997	Law of Ukraine No. 280/97-VR	On Local Government in Ukraine
4	9 April 1999	Law of Ukraine No. 586-XIV	On Local State Administrations
5	6 August 2014	Resolution of the Cabinet of Ministers of Ukraine No. 409	On the Establishment of State Social Standards in the Field of Housing and Communal Services
6	16 June 2005	Resolution of the Cabinet of Ministers of Ukraine No. 481	On the Approval of Procedure for Establishing Temporary Norms of Consumption, Quality Standards, and Provisions for Housing and Communal Services
7	8 November 2017	the Cabinet of Ministers of Ukraine No. 820-p	National Strategy for Waste Management in Ukraine until 2030
8	26 July 2006	Resolution of the Cabinet of Ministers of Ukraine No. 1010	On the Approval of Procedure for the Formation of Tariffs for Collection of Municipal Waste
9	10 December 2008	Resolution of the Cabinet of Ministers of Ukraine No. 1070	On the Approval of Rules for the Collection of Municipal Waste
10	2005	State Building Regulations of Ukraine. DBN V.2.4-2-2005	Design of Municipal Solid Waste Landfills. Main provisions of the design (as amended by the Order of the MRDCHCS from 06 June 2016 No. 138)
11	10 January 2006	Order of the Ministry of Construction No. 2	On the Approval of Recommendations for the Preparation of Local Solid Waste Management Programs
12	10 January 2006	Order of the Ministry of Construction No. 5	On the Approval of Recommendations for the Improvement of the Operation of Solid Waste Landfills
13	10 January 2006	Order of the Ministry of Transport No. 8	On the Approval of the Methodology for the Development of Environmental Impact Assessment for Solid Waste Management Facilities
14	1 February2007	Order of the Ministry of Construction No. 32	On the Approval of the Program of Retraining and Advanced Training of Specialists in the Sphere of Housing and Communal Services in the Field of Municipal Solid Waste Management
15	2 October 2008	Order of the Ministry of Housing and Communal Services No. 295	On the Approval of Methodical Recommendations for the Implementation of the Monitoring System in the Field of Solid Waste Management
16	10 August 2009	Order of the Ministry of Housing and Communal Services No. 243	On the Approval of Methodological Recommendations on the Application of the Procedure for the Formation of Tariffs for the Municipal Waste Collection
17	7 June 2010	Order of the Ministry of Housing and Communal Services No. 176	On the Approval of Methodological Recommendations on the Collection, Transportation, Processing, and Disposal of Municipal Waste
18	1 August 2011	Order of the Ministry of Regional Development No. 133	On the Approval of Separate Municipal Waste Collection Methodology
19	23 March 2017	Order of the Ministry of Regional Development No. 57	On the Approval of Procedure for the Development and Ratification of Schemes for Sanitary Cleaning of the Urban Areas

Source: MRDCHCS and Kyiv Oblast State Administration

(1) Law "On Waste"

The law "On Waste" was established by the Verkhovna Rada of Ukraine in 1998 and has been amended 14 times.

The law defines legal, organizational, and economic principles of activity related to waste management as well as prevention of negative impact of waste on the environment and human health.

1) Contents of law "On Waste"

The contents of the law are shown in Table 3.14.

Table 3.14 Contents of the Law "On Waste"

No. of Chapter/Article	Title of Section	Outline of Section
Chapter I (Article 1-7)	Terms	Basic terms, tasks, and scope of the law are defined. Environmental impact assessment.
Chapter II (Article 8-12)	Rights of waste ownership	Ownership and responsibility for waste.
Chapter III (Article 13-17)	Objectives in waste management sector, rights, and obligations	Right/obligation of the citizen, enterprises, institutions, organizations, and economic entities.
Chapter IV (Article 18-25)	Competence of executive authority and local authorities in waste management sector	Competence of the Cabinet of Ministers of Ukraine, oblast state administrations, local self-government, and concerned ministries (MENR and MRDCHCS).
Chapter V (Article 26-30)	Accounting, monitoring, and information on waste management	Register and monitoring of waste management facilities.
Chapter VI (Article 31-37)	Measures and requirements for prevention or decrease of waste management and environmental safety against waste	The law said the Cabinet of Ministers and other central and local executive bodies have to develop and implement an waste management system to reduce waste generation and negative impact from waste. The following are regulated: ▪ Requirements for landfill sites and stock yards; ▪ Procedure for implementation of collection of recyclable waste; and ▪ Requirement for municipal waste management.
Chapter VII (Article 38-41)	Economic providing measures on waste disposal and decreasing their development	Economic measures to ensure recycling of waste and reducing waste generation volume such as ecological tax for landfill sites and subsidies for investment are regulated.
Chapter VIII (Article 42-44)	Rights in waste management and responsibility for third countries	Guilty acts and compensation for damage caused by violation of the law related to the waste management are regulated.
Chapter IX (Article 45)	International cooperation	The law said that international laws are followed in international cooperation.
Chapter X	Final provisions	The schedule until enforcement.

Source: Law "On waste"

2) Responsibility of MSWM

Article 37 regulates that MSWM shall be conducted by MENR, MRDCHCS, oblast state administrations, executive bodies of councils of city, village, and rural settlement, and public inspectors on settlement improvement.

Competence of the above responsible organization except public inspectors is regulated in Chapter IV as summarized in Table 3.15. In addition to the competences in the table, Ministry of Healthcare has also responsibility for the MSWM on the matters related to sanitary and epidemiological well-being of the population.

Table 3.15 Competence of Responsible Organizations for MSWM

-	Cabinet of Ministers	MENR	MRDCHCS	Oblast state administration	Local self-government
Plan	-ensuring the development and implementation of national and interstate waste management programs	-	-formation of the state policy on municipal waste management, ensuring the development of state programs on municipal waste management, plans and measures on municipal waste management -Approval of oblast/ regional (cities of Kyiv and Sevastopol) MSWM programs	-participation in the development of national programs of MSWM -organization of the development and implementation of regional and local waste management programs -development and approval of schemes for sanitary cleaning of settlements	-Approval of local and regional waste management programs and control over their implementation -Development and approval of schemes for sanitary cleaning of settlements
Regulation	-approval of a list of hazardous wastes	-Participation in the development and approval of regulatory documents on waste management issues	-provision of human health requirements in regulatory documents on waste management -setting sanitary requirements for products made from waste -development and approval of state standards, norms and rules on municipal waste management -approval of the rules of operation and maintenance of municipal waste management facilities	-	-
System development	-	-Creation of information and analytical systems and data banks on volume of waste generation and management, reuse /recycling technologies -development and introduction of waste management systems -compiling and keeping the register of MSWM facilities -setting the procedure for conducting MSWM operations	-methodical provision and control when defining the hazardousness level of waste -normative and methodical support on municipal waste management -setting the procedure for the development, approval and confirmation of schemes for sanitary cleaning of settlements	-compilation and keeping of the register of objects of waste generation, treatment (processing) and utilization and the register of waste removal sites -organization of keeping records of waste generation, treatment (processing), neutralization /detoxification, utilization and removal, and waste certification	-taking measures to stimulate economic entities engaged in waste management
Budget	-	-	-	-involvement and unification on local budgets and funds for MSWM facilities as well as for studying the possibility of waste utilization and marketing	-
Operation	-approval of procedures for provision of permissions for MSWM operations -approval of requirements for waste management systems	-supervision and control on waste management -approval of sites of hazardous waste management facilities -elaboration of proposals for site of facilities and their transportation of hazardous wastes -transportation of hazardous waste through the territory of Ukraine	-	-Provision of permits for operations for waste management for three years -Control over on industrial and municipal waste management -organization of collection and disposal of household and commercial waste -Creation of landfill sites and segregated collection system of recyclables -Approving the locations of waste management facilities (except for hazardous waste) -ensuring the implementation of and providing a conclusion on the environmental impact assessment regarding activities in the field of waste management.	-Organization of collection and disposal of household and commercial waste, -Creation of landfill sites, organization of segregated collection system of recyclables -Resolving issues regarding the placement of waste management facilities -Control over the reuse/ recycling and safe handling of waste -Provision of permit for place of MSWM -Decide on site selection and construction of waste management facilities

-	Cabinet of Ministers	MENR	MRDCHCS	Oblast state administration	Local self-government
Organizational coordination	-coordinating the work of ministries, other central and local executive bodies for waste management	-ensuring the exchange of information with relevant authorities of other states and international organizations for waste management -coordination of work of other authorized bodies of executive power on waste management	-coordination of activities of local executive bodies for municipal waste management	-coordination and facilitation of the development of entrepreneurial activity for waste management -interaction with local self-government bodies	-coordination of activities of economic entities located on their territory, within the limits of their competence

Source: Law "On Waste"

(2) Law "On Local Government"

The law "On Local Government" defines the system and guarantees the local government in Ukraine grounds for the organization of activities, legal status, and responsibility of bodies and officials of local government.

The law establishes responsibility of bodies and officials of local government in the face of territorial community, the state, legal entities, and natural persons. In particular, authorities of a council, village, settlement and town/city head, head of a district, regional, and oblast council and self-organized civic bodies may be pre-terminated.

Exclusive competences related to MSWM are regulated in Chapter 1 of Section II as shown in Table 3.16.

Table 3.16 Competences of Local Government in MSWM defined in Law on Local Government

Organizations	Competences
Local self-government	▪ Approval on the placement for new facilities for MSWM ▪ Identification on a competitive basis of legal entities that conduct collection and transportation of municipal waste
Executive bodies of local self-government	▪ Solving the issues on collecting, transporting, recycling, and disposing of municipal waste ▪ Approval of schemes for sanitary cleaning of settlements and implementation of separate collection systems for municipal waste ▪ Approval of the rules for the provision of municipal waste management services ▪ Determination of the territory for waste treatment and disposal ▪ Control over activities of business entities in the field of waste management

Source: Law "On Local Government"

The budget of local self-government is regulated in Section III. The state government shall financially support local self-government to implement housing communal services. The local budget should be sufficient to ensure that local self-government bodies can provide the population with services not lower than the minimum social needs.

(3) Law "On Housing and Communal Services"

The law "On Housing and Communal Services" defines basic principles of organizational and economic relations that arise in the sphere of provision and consumption of housing and communal services including municipal waste management service between their producers, providers, and consumers, as well as rights and duties of the latter.

The control over observation of standards, norms, order, and rules in the sphere of housing and communal services shall be performed by the central and other executive bodies specially authorized thereto, as well as local self-governing bodies.

The minimum norms of housing and communal services define a minimum list and requirements as to the quantity and quality of housing and communal services and are approved by the Cabinet of Ministers of Ukraine.

The agreements on the provision of housing and communal services, according to the set list for the objects of state or communal property, shall be concluded according to the results of tender. The list of housing and communal services, which may be provided on competitive basis, is defined by the local self-governing body.

The agreement on tariffs for housing and communal services including municipal waste management is regulated in Article 10. Tariffs are established by the law, by state bodies or local self-government bodies. Unless otherwise tariffs are regulated, the tariffs shall be established by agreement of waste generators and service providers.

Regarding municipal waste management service, it is regulated in Article 25 of the law as follows:

- Consumers are obliged to conclude an agreement on municipal waste management with a person determined in accordance with the procedure established by law. Unless otherwise specified by law, entering into a collective agreement on the provision of utilities in accordance with the rules for the improvement of the territory of the settlement developed based on the scheme of sanitary clearing of the settlement and approved by the local self-government, the association of co-owners of an apartment building, the manager of an apartment building or another authorized person has the right to choose between providers of domestic waste management services specified in the legislation established by law.
- The criteria of the quality of municipal waste management services is compliance with i) the schedule of municipal waste disposal, ii) the rules for the provision of municipal waste management services approved by the Cabinet of Ministers of Ukraine, and iii) the requirements of legislation on the provision of municipal waste management services.
- In the case of separate collection of municipal waste, in setting tariffs for municipal waste management services, the operational cost for separately collected recyclable resources shall not be taken into account.

3.1.6 Current Legal System on Environmental and Social Considerations

The laws and regulations on environmental and social considerations excluding the waste management are shown in Table 3.17.

Table 3.17 List of Laws and Regulations in Environmental Field

No.	Category	Date of Issue	No. of Laws	Name of Laws
1	Framework legislation	25 June 1991	Law of Ukraine No. 1264-XII	On Environmental Protection
2	**EIA**	**23 May 2017**	**Law of Ukraine No. 2059-VIII**	**On Environmental Impact Assessment**
3	**SEA**	**20 March 2018**	**No. 2354-VIII**	**On Strategic Environmental Assessment**
4	Environmental monitoring	30 March 1991	Resolution of the Cabinet of the Ministers of Ukraine No. 391	On approval of the instruction on the state environmental monitoring system
5	Air (Framework)	30 March 1998	Law of Ukraine No. 2707-XII	On protection of atmospheric air
6	Air (Methodology)	4 August 1986	Order of the state committee of hydrometeorology and environmental control No. 192	OND-86. A method of calculating concentrations of industrial pollutants in atmospheric air.
7	Air (Monitoring)	30 July 2001	Order of the Ministry of Environment of Ukraine No. 286	On approval of the rules of detecting concentrations of pollutants in atmospheric air
8	Air (Standards)	1 March 2000	-	Maximum permissible concentrations (MPC) and approximate safe levels (ASL) of pollutants in atmospheric air of residential areas
9	Air (Standards)	9 February 1997	DSP-201-97	State rules for the protection of atmospheric air of residential areas from pollution by chemical and biological substances

No.	Category	Date of Issue	No. of Laws	Name of Laws
10	Water (Framework)	6 June 1995	Code of Ukraine No. 213-95BP	Code of Water
11	Water (Standards)	4 July 1988	SPN4630-88	Sanitary rules and norms for protection of surface waters from pollution
12	Water (Standards)	12 October 2011	Order of Kyiv City State Administration No. 1879	On approval of the rules of accepting influent wastewater
13	Water (Standards)	25 March 1999	Resolution of the Cabinet of the Ministers of Ukraine No. 465	On approval of the rules of protecting the surface water from contamination with effluent
14	Noise	1 December 1999	DSN 3.3.6.037-99	State sanitary regulations for industrial noise, infrasound, and ultrasound
15	Vibration	1 December 1999	DSN 3.3.6.039-99	State sanitary regulations for industrial and general vibration
16	Safety	22 December 2000	No. 10/4887	State Motor Vehicle Inspectorate of the Ministry of Internal Affairs of Ukraine
17	Safety	20 August 2002	DNAOP 0.00-1.03-02	Requirements of the construction rules and safe operation of cranes DNAOP 0.00-1.03-02
18	Safety	22 July 2009	DBN A.3.2-2-2009	Work safety and industrial safety in construction
19	Safety	24 January 2008	DSP 9.9.5-080-2002	Rules of design and safety of works in laboratories (departments, sections) of microbiological profile State sanitary rules
20	Land (Framework)	25 October 2001	Code of Ukraine No.2768-III	Code of Land
21	Land	17 February 2011	Law of Ukraine No.3038-VI	On Regulation of Urban Development Activities

Source: JICA Survey Team

In Ukraine, there is no regulation on air emission limit value for incineration plants. Thus, the following EU Directives shall be applied (Table 3.18):

Table 3.18 List of EU Directives Related to Air Emission Limit Value

No.	Category	Date of Issue	No. of Laws	Name of Laws
1	Air (Standards)	21 May 2008	EU Directive 2008/50/EC	On ambient air quality and cleaner air for Europe
2	Air (Standards)	4 December 2000	EU Directive 2000/76/EC	On the incineration of waste

Source: JICA Survey Team

The part of related waste management are highlighted in Table 3.17. Among the above listed laws, the law “On EIA” and the law “On SEA” are most important for construction projects of new MSWM facilities. The outlines of the laws are described below.

(1) Law “On Environmental Impact Assessment (EIA)”

The implementation of the EIA is mandatory in the decision-making process on the planned activity, as defined by parts two and three of Article 3 of the Law of Ukraine "On EIA". Such planned activities are subject to environmental impact assessment before making decisions on performing the planned activities.

The planned business activities include construction, reconstruction and provision of equipment, expansion, restructuring, liquidation (dismantling) of objects, and other interventions on the natural environment; planned activity does not include reconstruction, technical upgrading, overhaul, expansion, restructuring of objects, other interventions on the environment that do not have a significant environmental impact in accordance with the criteria approved by the Cabinet of Ministers of Ukraine. The criteria related to MSWM are as follows:

- All facility for hazardous waste management; and
- Facility for domestic and other waste management which handles 100 tons of waste or more daily.

The process of EIA is shown below:

i) Preparation, submission, and publication of notice of the planned activities;
ii) Obtaining conditions for the scope of research and the level of detail of the information to be included in the EIA report;
iii) Obtaining comments and suggestions from the public for the planned activities, scope of research and the level of detail of the information to be included in the EIA report;
iv) Preparing the report on environmental impact assessment;
v) Submitting the EIA report and announcing the public hearing;
vi) Conducting public discussion;
vii) Analysis by the notified body of the information provided in the environmental impact assessment report, any additional information provided by the entity as well as information received from the public during a public discussion while implementing the cross-border impact assessment procedure, other information;
viii) Provision by the notified body of the reasoned opinion on the environmental impact assessment, taking into account the results of the analysis;
ix) Taking into account the conclusion of the environmental impact assessment in the decision on the implementation of the planned activities.

(2) Strategic Environmental Assessment (SEA)

The Law "On SEA" is one of the key requirements of the European Union (EU)-Ukraine Association Agreement and a number of other international agreements.

The concept of sustainable development, which seeks to integrate economic, social, and environmental components of development, becomes of increasing importance in the international, national, and regional policies at the present stage of society development. The emergence of this concept is related to the need to solve environmental problems and to take into account environmental issues in the planning and decision-making processes on socio-economic development at the national, regional, and local levels.

The objective of SEA is to ensure a high level of environmental protection and to enhance incorporation of environmental factors into the preparation of plans and programs to ensure sustainable development.

The adoption of the bill is a progressive step, since the impact on the environment in Ukraine has not been taken into account sufficiently.

SEA precedes EIA in specific projects and influences the choice of future activities that will fall under EIA.

The process of SEA is as follows:

i) Determination of the scope of SEA;
ii) Preparation of SEA report;
iii) Conducting public consultations and consultations with MENR and MoH, and, if needed, cross-border consultations;
iv) Review on the SEA report and results of the public discussion and the consultations;
v) Informing the stakeholders about the approval of the state planning document prepared based on the review result; and
vi) Monitoring the consequences of the implementation of the state planning document for the environment, including for the health of the population.

3.1.7 Status of Revision of Current Legal System on Waste Management

Upon the approval of the National Waste Management Strategy in November 2017, the laws related to the waste management are now under the process of amendment or redevelopment. According to the National Waste Management Strategy Implementation Plan, the original schedule for development and amendment of laws is set as shown in Table 3.19. However, according to MENR, as of the middle of May 2018, they are running late from the schedule due to coordination among various organizations.

Table 3.19 Original Schedule of Development and Amendment of Laws and Related EU Directives

Title of Laws	Expected Deadline	EU Directives to be Followed
On waste	1 March 2018	On waste (2008/98/EC)
On electronic and electrical equipment waste	1 April 2018	On WEEE (2002/96/EC)
On cells and batteries	1 April 2018	On batteries and accumulators and waste batteries and accumulators (2006/66/EC)
On packaging waste	1 April 2018	On packaging and packaging waste (1994/62/EC)
On domestic waste	1 June 2018	On waste (2008/98/EC)
On waste landfill	1 August 2018	On the landfill of waste (1999/31/EC)
On waste incineration	1 August 2018	On industrial emissions (integrated pollution prevention and control) (2010/75/EC)
On spent petroleum products	1 September 2018	On waste (2008/98/EC)
On decommissioned motor vehicles	1 September 2018	On end-of-life vehicles (2000/53/EC)
On the management of extractive industry waste	31 December 2018	On the management of waste from extractive industries (2006/21/EC)

Source: Ministry of Environment and Natural Resources

According to MENR, the above laws are supposed to take into account the European approaches and the laws will follow the EU directives, respectively, as shown in Table 3.19. Some of the EU directives such as "On waste (2008/98/EC)" are described in the following section.

3.1.8 Related Legal System of EU

(1) Legal system of EU

The development or amendment of related laws under the National Waste Management Strategy is mostly implemented by following the legal system of EU. Thus, EU directives related to waste management were studied as follows:

Laws established by EU are categorized into "Regulations", "Directives", "Decisions" and "Recommendations". Most of environmental laws are established as directives. The directives cannot be applied to EU member countries and EU member countries have to establish own laws in compliance with the directives in each country in a certain period. The regulations and decisions force EU member countries and specific targets, respectively, to comply with themselves. The recommendations have no binding force.

(2) EU directives related to Waste Management

In 1975, the directive on waste (75/442/EEC) as the first directive related to waste management in European Economic Community (EEC) was established. Since then, a lot of directives on each waste type such as WEEE, packaging waste, and abandoned vehicles were established. The main active directives related to waste management and environmental standards for waste management facilities are shown, respectively, in Table 3.20 and Table 3.21.

Table 3.20 List of EU Directives on Waste Management

Data of Issue	No. of Directive	Name
04/03/2009	2008/98/EC	**On waste**
14/05/2009	2006/66/EC	On batteries and accumulators and waste batteries and accumulators
24/02/2010	1999/31/EC	**On the landfill of waste**
26/09/2011	2000/53/EC	On end-of life vehicles
27/10/2011	2000/76/EC	**On the incineration of waste**
26/09/2011	2002/96/EC	On WEEE
8/06/2011	2011/65/EU	On the restriction of the use of certain hazardous substances in electrical and electronic equipment text with EEA[1] relevance (RoHS)
08/09/2011	1994/62/EC	On packaging and packaging waste

Note: 1) EEA means "European Economic Area".
Source: JICA Survey Team

Table 3.21 List of EU Directives on Environmental Standards Related to Waste Management Facilities

Category	Data of Issue	No. of Directive	Name
Air	27/05/2008	2001/80/EC	On the limitation of emissions of certain pollutants into the air from large combustion plants
	27/10/2011	2000/76/EC	On the incineration of waste
	24/11/2010	2010/75/EC	On industrial emissions (integrated pollution prevention and control)
Water	07/09/2004	91/271/EEC	On urban wastewater treatment
	27/05/2009	2006/11/EC	Concerning pollution caused by certain dangerous substances discharged into the aquatic environment of the community
	04/05/1976	76/464/EEC	Concerning pollution caused by certain dangerous substances discharged into the aquatic environment of the community
Noise	26/10/2011	2002/49/EC	Relating to assessment and management of environmental noise

Source: JICA Survey Team

The part of related the waste management are highlighted in Table 3.20. Among the above directives, "On waste (2008/98/EC)" which is a legislative framework regulating basic concepts on waste management and, "On the landfill of waste (1999/31/EC)" and "On the incineration of waste (2000/76/EC)" which regulate waste treatment and disposal are outlined as follows:

1) Directive "on waste (2008/98/EC)"

The directive defines waste management hierarchy, goals for reuse/recycling, terms of reuse/recycling/recovery/bio-waste, and concepts of waste collection/treatment/disposal.

A) Waste management hierarchy

Waste management hierarchy to be applied to laws and policies is as follows:

i) Prevention
ii) Preparing for reuse
iii) Recycling
iv) Other recovery including energy recovery
v) Disposal

B) Promotion of reuse, recycling, and recovery

EU member countries should conduct separate collection of waste if it is practical technically, environmentally, and financially.

Regarding papers, metals, plastics, and glasses, separate collection has to be started by 2015. Reuse and recycling rates of these recyclable materials in household waste and waste discharged in the same way with household waste shall be 50% or more on a weight basis.

According to the Annex II of the directive, in case energy efficiency of MSW incineration plants is over 0.60 or 0.65, the incineration would be authorized as "recovery".

The energy efficiency can be calculated by using the following formula:

$$\text{Energy efficiency} = (E_p - (E_f + E_i))/(0{,}97 \times (E_w + E_f))$$

In which:

E_p	:	annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (GJ/year)
E_f	:	annual energy input to the system from fuels contributing to the production of steam (GJ/year)
E_w	:	annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)
E_i	:	annual energy imported excluding Ew and Ef (GJ/year)
0.97	:	a factor accounting for energy losses due to bottom ash and radiation.

C) Measures on bio-waste

The directive defines degradable waste from gardens and parks, organic waste from households, restaurants, kitchens, food delivery business, food process factories are categorized into bio-waste. It does not include sewer sludge, textiles, papers, lumbers, and degradable waste from forests, agriculture, and livestock.

EU member countries are required to take measures as follows:

- Separate collection which is suitable for composting or digesting;
- Treatment complying with environmental conservation at a high level; and
- Utilization of environmentally safe materials made of bio-waste.

2) Directive "On the incineration of waste (2000/76/EC)"

Regarding incineration of waste, the directive "on the incineration of waste", which targets solid waste incineration plants and waste co-incineration plants with energy and material recycling, was established in 2000.

The objective of the directive is to prevent or minimize negative impacts on environment (especially air, soil, and water) and human health caused by waste incineration plants and incineration plants treating waste and others together.

In order to achieve the objective, the directive regulates the following:

- requirements for operation license;
- conditions of waste treatment and facility operation;
- monitoring emission materials from the plants;
- emission limit value of toxic substances such as dioxins and mercury.

It is supposed to be applied to all incineration plants from December 2015.

3) Directive "On the landfill of waste (1999/31/EC)"

The directive set goals on the amount of degradable waste disposed at landfill sites as shown in Table 3.22. If an EU member country used to landfill over 80% of all the degradable waste, it has a 4-year grace period to achieve the above goals.

Table 3.22 Goals of Amount of Degradable Waste Disposed at Landfill Site

Target Years	Goals of Ratio of Annual Amount of Degradable Waste Disposed at Landfill Sites to that of 1995
2009	50%
2016	35%

Source: Directive on the landfill of waste

According to the directive, basically, waste can be landfilled only after intermediate treatment. Intermediate treatment residues will be disposed at landfill sites for non-hazardous waste or ones for hazardous waste depending on a result of hazardousness tests. Inert waste, which is technically difficult to be treated, can be disposed at landfill sites without intermediate treatment. Waste, whose volume or hazardousness cannot be reduced by intermediate treatment, is not allowed to be disposed at landfill sites.

Landfill sites are categorized into the following three levels:

i) landfill for hazardous waste
ii) landfill for non-hazardous waste
iii) landfill for inert waste

3.1.9 Current Legal System on Energy

(1) Major Laws and Regulations Related to Energy

The most important issue of energy and electricity-related laws and regulations in Ukraine is to realize the request from EU. However, some cases that directly apply EU requirements are sometimes established in the Ukrainian law and regulations with a slight time lag. Table 3.23 shows principal Ukrainian legislation and the EU request to the energy field such as thermal power generation, hydroelectric power generation, district heating and biomass, and waste energy generation for the purpose of compliance with the EU requirements in Ukraine.

Table 3.23 Principal Laws and Regulations Related to Energy

Ukrainian Laws and Regulations	EU Directive
▪ The Protocol of Joining the Energy Community Treaty by Ukraine ▪ Order No. 733-p of the Cabinet of the Ministries of Ukraine 'On approval of the action plan for implementation the obligations under the Energy Community Treaty establishment', dated 3.08.2011, amended on 7 October 2015 ▪ Order No. 1080-p of the Cabinet of the Ministries of Ukraine 'On signing an additional agreement No. 1 between Ukraine and the European Union, represented by the European Commission, on amending the agreement on financing the program "Continue to support the realization of the Energy Strategy of Ukraine", dated 20 December 2013', dated 13 October 2015 ▪ Order No. 671-p of the Cabinet of the Ministries of Ukraine 'On the launch of the pilot project "Energy Bridge "Ukraine - European Union", dated 15 June 2015 ▪ Law of Ukraine "On operating principles of the electricity market of Ukraine"	▪ Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants ▪ Directive 2006/32/EC of 5 April 2006 on energy end-use efficiency and energy services 407 ▪ Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources ▪ Directive 2009/73/EC of 12 July 2009 on common rules for the internal market in natural gas and repealing ▪ Regulation (EC) No 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks

Source: JICA Survey Team

(2) Energy Policy

As a result of the 2014 conflict with Russia, it became necessary to revise "Energy Strategy of Ukraine to 2030" (hereinafter referred to as the "Energy Strategy"), which was released in 2006 and was

updated and approved by the Cabinet of Ministers in 2013. In 2015, "Energy Strategy to 2035 (draft)" was announced by Ministry of Energy and Coal Industry but it has been reviewed and approved by the Cabinet of Ministers of Ukraine dated 18 August 2017.

(3) Energy Strategy

The Energy Strategy indicates the policy direction upon dividing the period up to 2035 into three stages as shown in Table 3.24.

Table 3.24 Direction of Energy Strategy until Year 2035

Period	Direction
2015-2020 : Reform	▪ Completion of privatization process ▪ Completion of the legal framework for energy market reform, strengthening the independence of national energy market regulators ▪ Decentralization of power and transfer of resources and responsibilities for the housing and utilities sector and electric public utility operations to the local level, substantiated decentralization of power supply systems using local fuels and renewable energy ▪ Introduction of energy management system ▪ Diversification of routes and sources of energy
2021-2025 : Modernization	▪ Integration, simultaneously with the submission of the application for Ukraine's accession to the EU, of Ukraine's unified energy system to the ENTSO-E, and of Ukraine's gas transport system to the European Network of ENTSO-G ▪ Full implementation of the EU Third Energy Package and other EU directives ▪ Tax reforms in the mining sector to ensure fair business environment and create an attractive investment climate ▪ Establishment of a comprehensive system of energy and environmental taxes and the concentration of investment resources for implementing large-scale projects to establish financing funds for energy development projects ▪ Stiffening of the requirements to energy consuming equipment and buildings ▪ Introduction of demand management system ▪ Establishment of energy security system
2026-2035: Integration and Innovation Stage	▪ Providing support for financial market infrastructure ▪ Implementation of targeted programs for the development of technological platforms, implementation of targeted programs for the development of technological platforms that would provide the long-term impact on the country's energy mix and economy structure ▪ Protection of consumer rights with regard to access to high-quality power supply ▪ Establishment of a system for support of R&D ▪ Development of the domestic market for GHG trading ▪ Use of Ukraine's financial resources and the opportunities for deeper international cooperation ▪ Development of a support system for pilot projects of advanced energy technologies ▪ Development of the tools to support national energy companies for expanding their participation in European and global markets ▪ Ukraine's full and active participation in international agreements system and international projects in the energy sector in order to develop a common energy security system

Source: Energy Strategy

In the Energy Strategy, comparing 2013 to 2035, the outlook is that coal and natural gas will decrease, and nuclear and renewable energy will increase. The following two points are able to be listed as the major factors that will bring about such changes:

- The consumption of coal will be suppressed by greatly increasing nuclear for the electricity supply.
- The consumption of natural gas will be suppressed by improving efficiency and utilizing renewable energy as heat production fuel.

Concerning fuel production, Energy Strategy includes policies for promotion of higher efficiency and technology development geared to self-sufficiency in coal and natural gas, mitigation of risk based on diversification of importing sources for petroleum.

(4) Renewable Energy from Waste

In the Law of Ukraine "On alternative energy sources", renewable energy sources are defined to be renewable non-fossil energy sources, namely solar, wind, aerothermal, geothermal, hydrothermal, wave and tidal, hydropower and biomass.

In this Law, biomass is defined a non-fossil biologically renewable substance of organic origin which is capable of biological decomposition, such as waste and residues of forestry, agriculture, livestock industries, fisheries or related industries, as well as an organic component of industrial or household waste. Biogas is the gas generated from biomass, as a result of biological decomposition, produced by forced gasification of biomass, derived from designated areas or facilities of storage and/or disposal of waste, or produced from biomass as a component of industrial or household waste.

The Energy Strategy designates the amount of such renewable energy extracted from biomass or wastes is targeted to be increased from 2.2% of overall energy consumed in 2015 to 11.5% in 2035.

Nowadays in Ukraine there are 14 landfills with the system for biogas extraction in settlements.

For reference, it is generally said that one 16 ha landfill, which receives 730 thousand m3 of household waste per year, sells 4 million kWh of electric energy to the grid per year.

The feed-in tariff (FIT) as known "Green Tariff" in Ukraine is already set for economic entities which generate electric energy from biomass or biogas. At this moment in the current related regulations, The FIT is not applied to energy obtained through incinerating the waste which is mixed the organic and inorganic substances in the waste to energy system. However, a possibility to adopt the FIT to such energy recovered from waste incinerating is still under discussions among concerned authorities.

3.1.10 Current and Revision Status of Legal System on PPP

(1) PPP in Ukraine

As previously mentioned in Section 3.1.3 (3), formation and implementation of state policy of "Public-Private Partnership (PPP)" are under the responsibility of the Ministry of Economic Development and Trade.

As shown in Table 3.25and Table 3.26, the basic and fundamental legal framework for PPP consists of the following five national laws and subordinated regulations:

Table 3.25 Basic Law for PPP

Issued Date	Law No.	Name of the Law in Ukraine
01 July 2010	No. 2404-VI	On public-private partnership
16 July 1999	No. 997-XIV	On concessions
14 December 1999	No. 1286-XIV	On concession for construction and operation of highways
21 October 2010	No. 2624-VI	On peculiarities of lease or concession of facilities in the field of heating, water supply and sewage disposal that are in communal property
08 July 2011	No. 3687-VI	On peculiarities of lease or concession of state-owned fuel and energy complex facilities

Source: JICA Survey Team based on MEDT Website (http://www.me.gov.ua/, as of 18 May 2018)

Table 3.26 Subordinate Regulations Governing the Implementation of PPP

Issued Date	Order No.[1]	Name of the Law of Ukraine
11 Dec 1999	CMU Reg. No. 2293	On approval of the list of state property that can be provided in the concession
18 Jan 2000	CMU Reg. No. 72	On the register of concession agreements
12 Apr 2000	CMU Reg. No. 639	On approval of the method of calculating concession fees
12 Apr 2000	CMU Reg. No. 642	On approval of the concession bidding and making concession agreements for the objects of state and municipal property which are provided in the concession
12 Apr 2000	CMU Reg. No. 643	On approval of the typical concession contract
06 Jul 2000	CMU Reg. No. 1064	On approval of the procedure of defining the concession objects to build and operate public roads
13 Jul 2000	CMU Reg. No. 1114	On approval of defining the concession objects, concessionaires of which may be granted exemptions in concession fees, grants, compensation, and conditions of provision
04 Oct 2000	CMU Reg. No. 1519	On approval of the typical concession contract to build and operate the highway
04 Oct 2000	CMU Reg. No. 1521	On approval of the concession bidding for construction and operation of highways
11 Apr 2011	CMU Reg. No. 384	Some questions about arranging the implementation of public-private partnership
16 Feb 2011	CMU Reg. No. 232	On approval of method of identifying risks of public-private partnership, their evaluation and determination of their management form
09 Feb 2011	CMU Reg. No. 81	On approval of providing (by private partner to public partner) the information on implementing the agreement concluded within public-private partnership
17 Mar 2011	CMU Reg. No. 279	On approval of state support for the implementation of public-private partnership
27 Feb 2012	MEDT Order No. 255	Some questions about analyzing the efficiency of public-private partnership
11 Jan 2012	CMU Reg. No. 71	On the list of the state-owned Fuel and Energy Complex facilities that can be provided in the concession
11 Jul2013	CMU Reg. No. 493	On approval of the billing of operational readiness of road built on concession
14 Aug 2013	CMU Reg. No. 739	On approval of the concept of public-private partnership in Ukraine for 2013 - 2018

Note: 1) CMU means "Cabinet of Ministers of Ukraine".
Source: JICA Survey Team based on MEDT website (http://www.me.gov.ua/, as of 18 May 2018)

(2) Law "On PPP"

1) Main Features of PPP Mechanism in Ukraine

The main features of PPP mechanism in Ukraine which attract private business are:

- Granting rights for administration (usage, operation) of the partnership or acquisition object, creation (construction, reconstruction, modernization) of the public-private partnership object with the subsequent administration (usage, operation), subject to the adoption and implementation by a private partner of investment commitments in accordance with the agreement concluded according to public-private partnership.
- Registering "public interest" in a contractual relationship.
- Long-term relationship (5 to 50 years).
- Transferring the part of risks to a private partner within the implementation of public-private partnership.
- Adding investments by a private partner to the partnership objects from sources which are not prohibited by law.

2) The Essence of Public-Private Partnership

A PPP is a cooperation between a public partner (state, territorial communities in the person of relevant state bodies and local self-governing bodies) and a private partner (legal entities, except for state and municipal enterprises, or individuals – entrepreneurs).

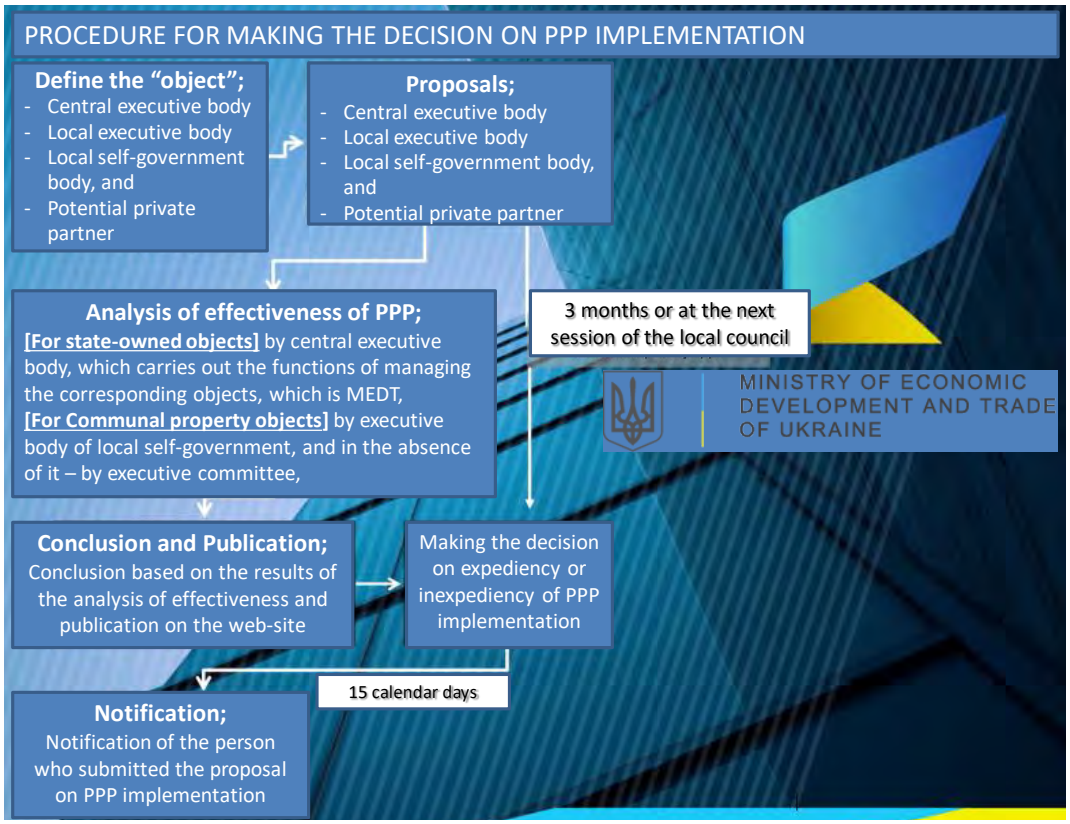
The project will be carried out on a contractual basis within the framework of realization of public-private partnership such as agreements on concession, joint activity, property management, mixed agreement, and other contracts.

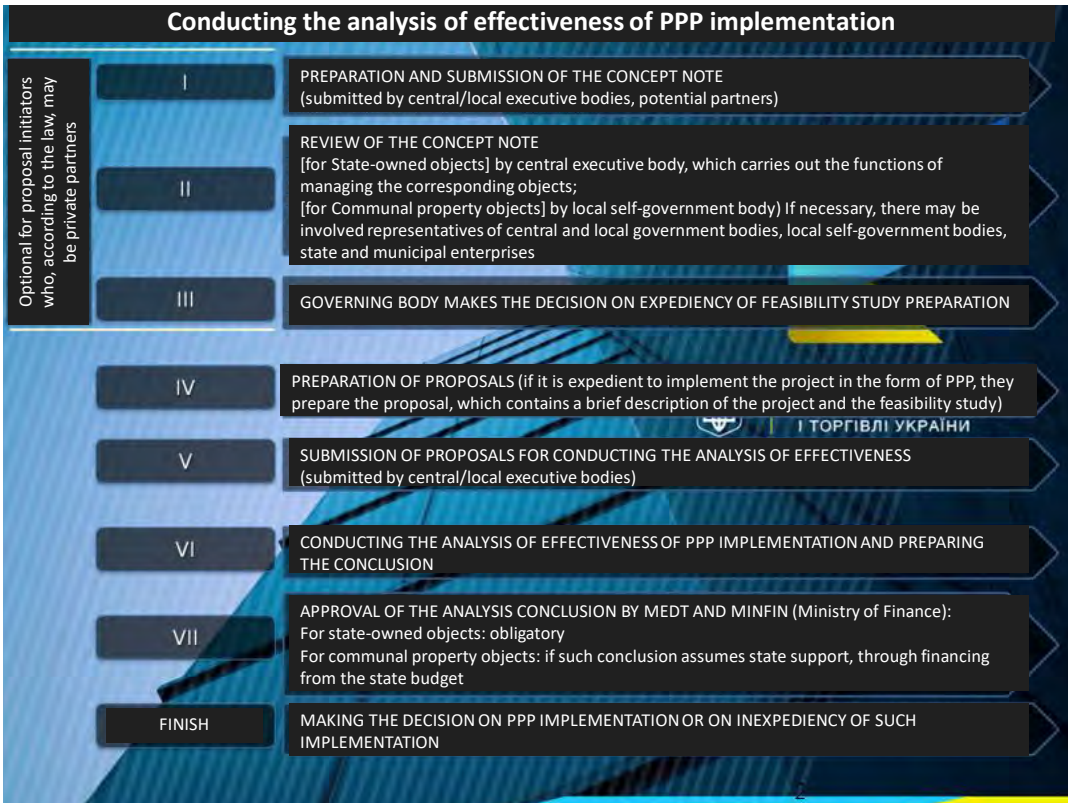
According to the Law on PPP, the objects of public-private partnership can be:

- Existing, in particular, reproduced (by reconstruction, modernization, technical re-equipment) objects that are in state or communal ownership, including subsoil areas;
- Created or purchased objects as a result of performance of the contract entered into within the framework of public-private partnership.

3) Procedure

According to Chapter III "Decision-Making on PPP implementation" of Law on PPP (2011), the following procedure shown in Figure 3.6 is required before the start of the PPP projects.





Source: JICA Survey Team based on MEDT Website (http://www.me.gov.ua/, as of 18May2018)

Figure 3.6 Procedure for making public-private partnership decisions

(3) Existing PPP Projects

Table 3.27 shows existing PPP project by region. According to the Ministry of Economic Development and Trade in Ukraine, as of 1 January 2018, the number of closed contracts on the basis of PPP is 191, of which 182 were implemented (157 – concession agreements, 24 - joint agreements, and 1 - public-private partnership agreement). This leaves 9 contracts that were not implemented due to expiration (4), cancellation (3), and suspension (2).

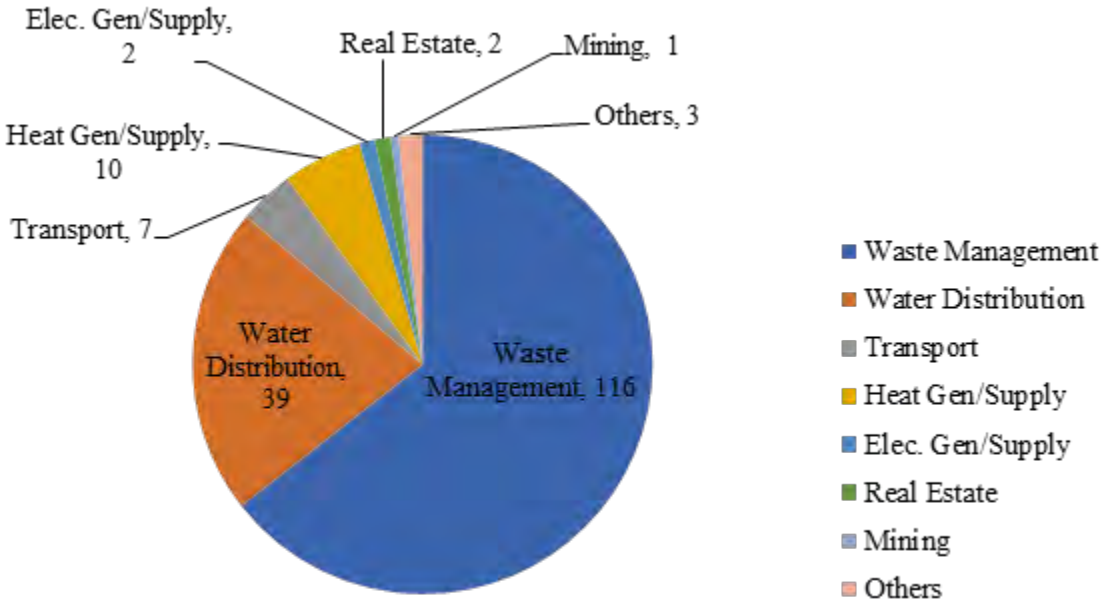
Table 3.27 Existing PPP Projects by Region

No.	Region	Valid as of 1 January 2018			
		Concession	Joint Activity	PPP Agreement	Total
1	Vinnitsa	0	0	0	0
2	Volyn’	0	0	0	0
3	Dnipropetrovsk	0	0	0	0
4	Donetsk	2	2	0	4
5	Zhytomyr	0	1	0	1
6	Transcarpathian	4	5	0	9
7	Zaporizhia	7	0	0	7
8	Ivano-Frankivsk	1	0	0	1
9	Kyiv	13	0	0	13
10	Kirovograd	0	1	0	1
11	Lugansk	1	0	0	1
12	Lviv	3	1	0	4
13	Mykolaiv	14	1	0	15
14	Odessa	0	6	0	6

No.	Region	Valid as of 1 January 2018			
		Concession	Joint Activity	PPP Agreement	Total
15	Poltava	109	5	0	114
16	Rivne	0	0	0	0
17	Sumy	0	0	0	0
18	Ternopil’	0	0	0	0
19	Kharkiv	1	0	0	1
20	Kherson	0	1	0	1
21	Khmelnitsky	2	0	1	3
22	Cherkassy	0	0	0	0
23	Chernivtsi	0	0	0	0
24	Chernihiv	0	1	0	1
25	KCSA	0	0	0	0
TOTAL		157	24	1	182

Source; MEDT website (http://me.gov.ua/, as of 1 April 2018)

These contracts are realized in Figure 3.7: waste management which is mostly waste collection (116 contracts, 64.7%), collection, purification, and distribution of water (39 contracts, 21.4%), construction and/or operation of motorways, roads, railways, runways at aerodromes, bridges, railways, tunnels and subways, sea and river ports and their infrastructure (7 contracts, 3.9%), production, transportation, and supply of heat (10 contracts, 5.5%), production, distribution, and supply of electric energy (2 contracts, 1.1%), real estate management (2 contracts, 1.1%), search, exploration of mineral deposits, and extraction (1 contract, 0.6%), others (3 contracts, 1.7%).



Source; JICA Survey Team based on MEDT (http://me.gov.ua/, as of 1 April 2018)

Figure 3.7 Number of Existing PPP Projects by Sector (Sphere)

The PPP Unit of the Department of Investment Attraction, MoEDT has shared the information about the list of PPP projects in the field of waste management (as of 1 January 2018) as shown in Table 3.28.

Among the 116 projects in solid waste management sphere, 109 projects are bundled and managed as one project under the initiative of Poltava Oblast State Administration. A private company in Kyiv, LLC “Technopark Complex T” closed the Memorandum of Understanding with Poltava Oblast to provide the service from collection, transportation, sorting of solid waste, and obtaining secondary raw

materials for 49 years from 2012[11][12]. The present status of this project is now being confirmed by the PPP Unit of MoEDT.

No. 110 is the decontamination project for MSW landfills in Mariupol City, Donetsk. The projects from no. 111 to 115 are service provision for the removal (collection and transportation) of solid waste in several areas in Transcarpathian (Zakarpattia) Oblast.

Table 3.28 List of PPP Projects in the Field of Waste Management (as of 1 January 2018)

No.	Project Activity	State Partner	The Private Partner	Type of Contract	Completion Date of the Contract	Contract Period	Current State
1 to 109	Collection, transportation, and utilization of solid waste	Poltava Oblast State Administration with 109 village councils	LLC "Technopark Complex T"	Concession	09/06/2061 (2012)	49 years	(Request to Poltava Oblast)
110	Decontamination of municipal landfills number 1 and 2	Mariupol City Council (Donetsk)	LLC "TIS Eco"	Joint activity	04/24/2023 (2011)	12 years	Performing
111	Collection of solid waste in Vynohradiv area	Vynohradiv City Council (Transcarpathian)	ABE "Vinohradiv "	Joint activity	-	-	Performing
112	Provision of municipal waste removal	Berehovo City Council (Transcarpathian)	LLC "Beach Vertikal"	Joint activity	-	-	Performing
113	Collection and removal of solid waste, bulky, and construction waste in Uzhgorod City	Uzhgorod City Council (Transcarpathian)	LLC ABE "Uzhgorod"	Joint activity	15/10/2037 (2012)	25 years	Performing
114	Collection and removal of solid waste, bulky, and construction waste in the territory Serednye settlement and village councils of Uzhgorod District	Uzhgorod District (ration) administration (Transcarpathian)	LLC ABE "Uzhgorod"	Joint activity	12/10/2029 (2014)	15 years	Performing
115	Provision of municipal waste removal	Mukachevo City Council (Transcarpathian)	LLC ABE "Umvelt Ukraine"	Joint activity	07/30/2054 (2009)	45 years	Performing
116	Waste CHP Olexandria	Olexandria City Council (Kirovograd)	LLC "Alliance Group Limited"	Joint activity	05/24/2032 (2017)	15 years	Registration permits

Source; JICA Survey Team based on the information provided by MoEDT

3.1.11 Project Implementation Procedures in Ukraine

In Ukraine, when public infrastructure development project is initiated, its procedures are clearly stipulated in the related regulations such as the governmental order No. 45 dated 16 May 2011, which is “on approval of the development of design documentation for construction objects” and DBN A.2.2-3-2014, which is for “structure and contents of project documentation for construction”.

According to these documents, construction project for infrastructures related to solid waste management will be categorized into the following stages:

[11] Poltava Oblast Website (http://oblrada.pl.ua/index.php/the-news/2105-pidpisano-memorandum-pro-vprovadzhennja-proektu-z-pererobki-tverdih-pobutovih-vidhodiv, as of 19 June 2018)
[12] Uriadovy Courier Website (https://ukurier.gov.ua/uk/articles/poltavshinu-ochistyat-vid-smittya/, as of 19June2018)

i) General Plan for Infrastructure Development of City or Oblast;
ii) Scheme of Sanitation and Cleaning as a part of individual infrastructure plan under the above General Plan;
iii) Technical Economical Basis Justification (TEO);
iv) Stage-Project (Stage-P);
v) Stage-Working Document (Stage-R);
vi) Construction Supervision.

(1) General Plan for Infrastructure Development of City or Oblast

This general plan shows the conceptual ideas for the development of all categories of infrastructures required at the oblast or city in a certain term. The description of the development plan is very general but usually covers almost all possible technologies to be applied.

(2) Scheme of Sanitation and Cleaning

"Structure and content of the scheme of sanitation settlements (DBN B.2.2-6 2013)" defines that the scheme of sanitation and cleaning is the document that contains graphics and text materials on priority implementation activities and scope of work of sanitation systems and methods for collection, storage, transportation, processing, recycling, removal, and disposal of waste.

According to this DBN B.2.2-6 2013, the contents of the scheme shall consist of the following text component as explanatory notes, together with the basic drawing in scale of 1:10,000 or 1:5,000:

- Section 1. Characteristics of the settlement for the aspects of sanitation and cleaning;
- Section 2. Measures of collection, transportation, recycling, treatment and disposal of waste (solid, bulky, repair, liquid), including hazardous waste in their composition;
- Section 3. Measures of collection, transportation, recycling, treatment and disposal of industrial waste III - IV hazard classes;
- Section 4. Measures of cleaning facility improvement;
- Section 5. Other measures of sanitation;
- Section 6. Environmental impacts;
- Section 7. Technical and economic parameters and calculation of funding;

The scheme shall be expertized by the external authorized bodies for the approval.

(3) Technical Economical Basis Justification (TEO)

It is a bit difficult for the foreign engineer to understand what "the Technical Economical Basis Justification (TEO)" is because this term is usually translated in English as "the Feasibility Study" but the contents seems to be different than the level of feasibility study usually used in other countries. According to DBN A.2.2-3-2014, TEO is the document developed based on the approved scheme and the input data for facilities and related objects of infrastructure, requiring detailed study of relevant decisions and determining the options and feasibility of construction. TEO justifies the main design solutions, production capacity, range, and quality of products, if they are not given directive, cooperation of production, provision of raw materials, intermediate products, fuel, electricity and heat, water and labor resources, including the choice of a particular land for building, construction costs, and the main technical and economic indicators.

TEO shall be also expertized by the external authorized bodies for the approval. In any cases, when the new facility development plan, which is not included in TEO is proposed, TEO shall be revised to include such new plan and has to be expertized again.

(4) Stage-Project (Stage-P)

The implementation of the project after the approval of TEO shall be divided into two stages: the first one is the project stage, so called as "Stage-Project" or "Stage-P", and the second one is the working document stage, so called as "Stage-Working Documentation" or "Stage-R".

Stage-P requires the documents developed for certain facilities on the basis of data and approved at the previous design stage, which means TEO, and determines urban, architectural, artistic, environmental, technical and engineering solutions for the facility, and the estimated cost of construction.

In Stage-P, evaluating the effectiveness of the decisions and comparison of technical and economic parameters of the project under the approved TEO shall be conducted.

Document for the Stage-P shall also be expertized by the external authorized bodies for the approval.

(5) Stage-Working Documentation (Stage-R)

When the investment for the project will be realized after approval of Stage-P, the project stage moves to the next stage, which is "Stage-Working Documentation (Stage-R)". Sometimes, it is also called "Stage-D".

The purpose of Stage-R is to provide the document for the detailed instruction of the construction and not require further external expertise.

The contents of Stage-R documents are usually set for the following:

- Working drawings;
- Painting and decorating;
- Cost estimates;
- Specifications of equipment, products, and materials;
- Specification and dimensional drawings for appropriate types of equipment and products;
- Working documents for construction products; and
- Sketchy drawing of non-standard products.

(6) Construction Supervision

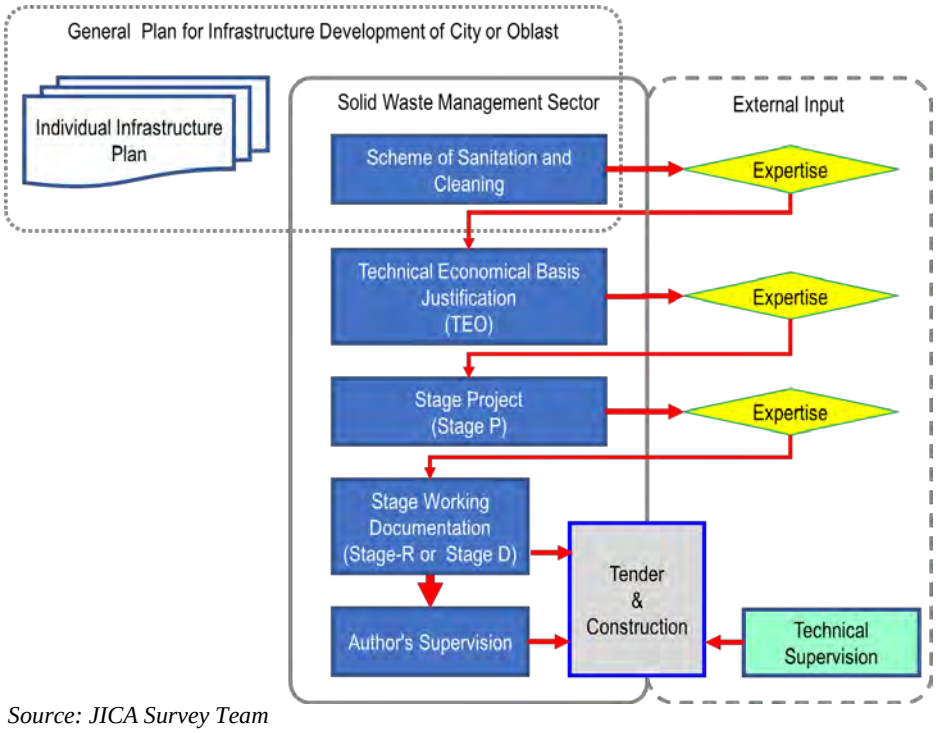
There are two types of construction supervision during the construction stage, one is the "Author's Supervision" and the other is the "Technical Supervision".

In principle, the engineering and design firm who implemented Stage-P and Stage-R shall continue to conduct the Author's Supervision as the owner's engineer under the new contract with the client without tendering.

Author's Supervision is to check if the construction works surely follow the Stage-P documents. In case that the contractor proposes an alternative work or equipment, the engineer shall verify its technical and financial validity and approve its change if determined acceptable. Safety management of the construction field is under the responsibility of the Author's Supervision.

Technical supervision shall be conducted by different engineers who belong to the client or other authorized organizations to check the quality of construction materials, equipment or others used for the construction.

Figure 3.8 shows the image of implementation flow of the project in Ukraine.



Source: JICA Survey Team

Figure 3.8 Project Implementation Flow in Ukraine

3.2 Current Status of Kyiv City

3.2.1 General Information

(1) Natural Conditions

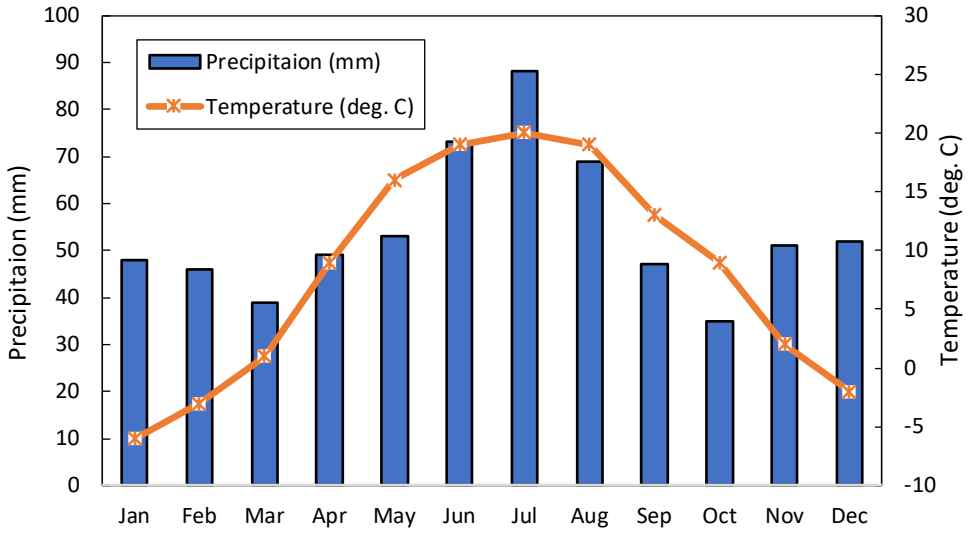
1) Geographical Features

Kyiv Oblast is located in the geographical center of Europe, the southwest of the East European Plain, and its total area is around 28,131 km2. Kyiv Oblast is divided into three sections. The north part of the oblast is characterized by low-lying swampy plains of Polissia lowland. The southwest and central parts lie on Dnipro upland which is 273 m high. The eastern part of the region is located on the floodplain and terraces of Dnipro River in Dnipro lowland. Kyiv has many rivers and Dnipro River is 246 km long within the region's boundaries; all the other rivers belong to the Dnipro basin.

Kyiv City is located at latitude 50°12" - 50°35" N and longitude 30°14" - 30°49"E, and has an area of 840 km2. The Dnipro River divides the city into the right bank and the left bank, and 62% and 38% of the territories are occupied by city buildings, respectively. Most of the city buildings are located in the high ground of the right bank area. Quaternary sediments in the city of Kyiv consist of loess plateau, which are easily eroded, so a wide network of ravines and gullies was formed in the city.

2) Meteorological Phenomenon

Kyiv is characterized by warm summer continental climate with moderate humidity. The annual average temperature in Kyiv reaches 7.2°C. The warmest month is July with an average temperature of 19.5°C, and the coldest month is January with an average temperature of - 6°C. The annual average precipitation is 500 - 600 mm; the months with the most precipitation are June and July. The snowfall period is around five months from November to March. Autumn is usually warm and dry. Summer is characterized by many sunny days and long vegetation period. The summarized monthly climate information is shown in Figure 3.9.



Source: Kyiv City Council for the Questionnaire of JICA Survey Team

Figure 3.9 Monthly Temperature and Precipitation in Kyiv City

(2) Population

As of 1 February 2018, the total resident population in Kyiv Oblast, excluding that in Kyiv City, is estimated to be 1,749,133 people, while the total present population is 1,754,912 people. As for the city of Kyiv, the total resident population is estimated to be 2,893,094 people, while the total present population is 2,934,401 people. Total resident population of Kyiv Region, Kyiv Oblast, and Kyiv City

is 4,689,313, and it is the largest region occupying about 11.1% of the total resident population in Ukraine[13].

Of the resident population in Kyiv Oblast, 46.1% are male and 53.9% are female. Population under 15 is 17.4%, while 61.2% is from 16 to 59, and 21.4% is over 60.

Kyiv City's resident population consists of 46.3% male and 53.7% female, which is almost the same as that of Kyiv Oblast. Population under 15 is 16.7%, while 62.8% is from 16 to 59, and 20.4% is over 60.

Detailed demographics of Kyiv Oblast is given by the Kyiv Oblast State Administration as shown in Table 3.29. Total area of the oblast is 28,131 km^2 and the average population density is 57.3 people per 1 square kilometer. Area around Kyiv is the most populated. The largest cities of Kyiv Raion are: Bila Tserkva, Brovary, Fastiv, and Boryspil.

Table 3.29 Detailed Demographics of Kyiv Oblast

City/Raion	Population, In Thousands			Territory in km^2	Population Density, In Thousands per/ km^2
	Total	Urban	Rural		
Cities					
Bila Tserkva	207.7	207.7	-	34	6.11
Berezan'	16.5	16.5	-	33	0.50
Boryspil	60.7	60.7	-	37	1.64
Brovary	100.9	100.9	-	34	2.97
Vasyl'kiv	37.3	37.3	-	21	1.78
Bucha	31.9	31.9	-	10	3.20
Irpin (City Council)	86.8	86.8	-	27	3.21
Obukhiv (City Council)	33.7	33.2	0.5	13	2.59
Pereyaslav-Khmelnytsky	27.5	27.5	-	31	0.89
Fastiv	46.9	46.9	-	43	1.09
Rzhyshchiv	7.4	7.4	-	36	0.21
Slavutych	25.1	25.1	-	21	1.20
Total	682.4	681.9	0.5	340	2.11
Raions					
Baryshivsky	35.6	10.8	24.8	958	0.04
Bilotserkivsky	49.9	14.0	35.9	1277	0.04
Bohuslavsky	34.4	16.4	18.0	772	0.04
Boryspilsky	52.4	-	52.4	1468	0.04
Borodiansky	57.5	35.7	21.8	934	0.06
Brovarsky	67.4	18.1	49.3	1188	0.06
Vasylkivsky	57.6	21.6	36.0	1184	0.05
Volodarsky	17.5	6.2	11.3	646	0.03
Vyshhorodsky	73.2	33.6	39.6	2031	0.04
Zhurivsky	16.3	5.1	11.2	763	0.02
Ivankivsky	29.8	10.5	19.3	3616	0.01
Kaharlytsky	33.1	13.6	19.5	926	0.04
Kyevo-Sviatoshynsky	177.6	81.9	95.7	726	0.24
Makarivsky	36.4	11.4	25.0	1364	0.03
Myronivsky	34.2	11.7	22.5	904	0.04
Obukhivsky	35.5	19.3	16.2	760	0.05

[13] Source: https://ukrstat.org/en/operativ/operativ2018/ds/kn/kn_e/kn0118_e.html (as of 07 April 2018)

City/Raion	Population, In Thousands			Territory in km^2	Population Density, In Thousands per/ km^2
	Total	Urban	Rural		
Pereyaslav-Khmelnytsky	28.1	-	28.1	1456	0.02
Polisky	5.7	0.7	5.0	1288	0.004
Rokytniansky	27.0	11.1	15.9	661	0.04
Skvyrsky	37.4	16.3	21.1	980	0.04
Stavyshchensky	22.1	6.6	15.5	674	0.03
Tarashchansky	28.0	10.8	17.2	758	0.04
Tetiyivsky	32.0	13.3	18.7	757	0.04
Fastivsky	30.8	9.3	21.5	897	0.03
Yahotynsky	32.7	19.9	12.8	793	0.04
Total	1052.1	397.9	654.3	27781	0.04

Source: Kyiv Oblast State Administration for the Questionnaire of JICA Survey Team

The total area of the city is 839 square kilometers and the average population density is 3,448 people per 1 km^2.

Table 3.30 shows the population of each district of Kyiv City.

Table 3.30 Population of Each District of Kyiv City

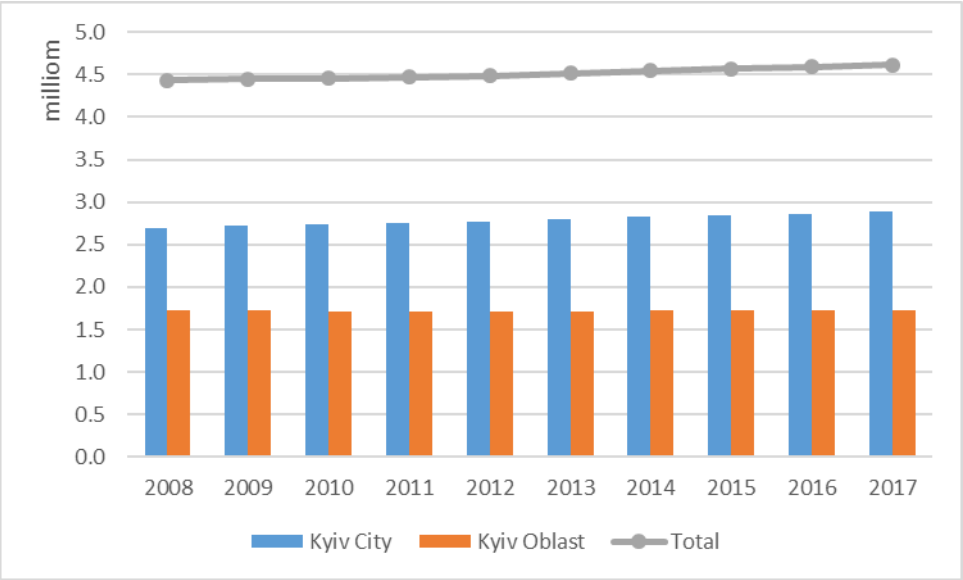
District	Available Population		Permanent Population	
	On 1 February 2018	Average Size in January 2018	On 1 February 2018	Average Size in January 2018
Goloseevsky	251,621	251,758	249,523	249,660
Darnytsky	340,092	339,993	333,593	333,494
Desnyansky	369,227	369,258	366,337	366,368
Dniprovsky	356,101	356,116	354,372	354,387
Obolonsky	320,587	320,644	317,713	317,770
Pechersky	158,477	158,402	153,754	153,679
Podilsky	201,761	201,636	198,351	198,226
Svyatoshinsky	341,675	341,657	335,755	335,737
Solomensky	370,833	370,835	368,787	368,789
Shevchenko	224,027	224,163	214,909	215,045
Total	2,934,401	2,934,462	2,893,094	2,893,155

Source: http://www.Kyiv.ukrstat.gov.ua/p.php3?c=1123&lang=1 (as of 7 April 2018)

Figure 3.10 shows the population curve in the past ten years of both Kyiv City and Kyiv Oblast, which indicates that the population has been almost stable.

According to the city of Kyiv, it is projected that its total present population will increase from 2,906,600 in 2017 to 2,987,700 in 2020, and 3,297,000 in 2030.

However, both sides of Kyiv Oblast and Kyiv City mention that many unregistered residents, about one million people, at the respective boundaries are not counted in the above-mentioned statistics. Some are living in the city boundary but not registered as citizens of Kyiv City and vice-versa.



Source: JICA Survey Team referring the following data sources.
Kyiv Oblast State Administration for the Questionnaire of JICA Survey Team
http://kyivobl.ukrstat.gov.ua/content/p.php3?c=114&lang=1 (as of 7 April 2018)

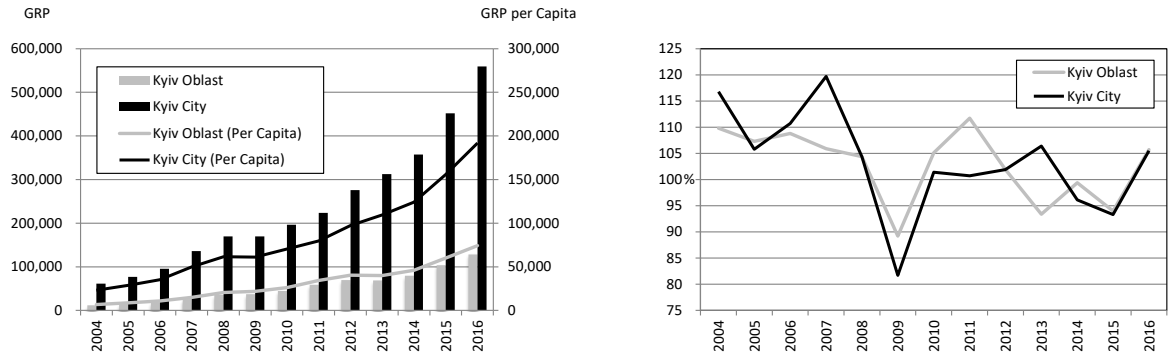
Figure 3.10 Population Curve of Kyiv City and Oblast (2008 – 2017)

(3) Economic and Industrial Conditions

1) Gross Regional Products

Figure 3.11 shows the gross regional products (GRP) and its growth rate of Kyiv City State Administration and Kyiv Oblast Administration. The GRP of Kyiv City State Administration and Kyiv Oblast Administration in 2016 were UAH 599,140 million and UAH 128,638 million, respectively. The capital city of Kyiv produces 23.4 % of the total national GDP.

Growth rates of GRP of Kyiv City and Kyiv Oblast went negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty. In 2016, it became positive and is expected to remain positive.



Source; JICA Survey Team based on State Statistic Service of Ukraine website (http://www.ukrstat.gov.ua/, as of 01Apr2018)

Figure 3.11 GRP in Kyiv City and Kyiv Oblast (Total, Per Capita, Growth Rate)

2) Industrial Situation of Kyiv City and Kyiv Oblast

Industrial production index in Kyiv City was reduced to 4.9% in 2017 from the previous year of 2016, where the largest reduction is wood production, paper, and printing business (32.0%) followed by mechanical engineering and machinery (19.4%). Meanwhile, textile, clothing, and leather industry grew to 27.0%, which is the highest growth in 2017. Chemical production industry also increased by 9.5%.

In Kyiv Oblast, industrial and agricultural sectors are very active in the oblast. Industry adds up 62% to the total aggregate production. Business in oblast relies on a strong power industry (Kyiv Hydroelectric Power Plant, Trypilska TTP, Chernobyl Nuclear Power Plant). Kyiv Oblast has well developed machinery, oil and gas, food, textile and wood industries. Agriculture is a core part of the oblast's agricultural sector. Plant growing makes 42% of the region's gross output and farming - 58%. The most widely planted agricultural crops are winter wheat, sugar beets, flax, potatoes, and vegetables. Farming produces mostly dairy products and meat. Rabbit breeding, beekeeping, and fishing industry are developing as well. Significant numbers of agricultural areas and reservoirs are not in use anymore due to their radioactive contamination during the Chernobyl disaster in 1986.

3) Employment and Unemployment

In 2016, the average numbers of economically active population aged 15-70 in Kyiv City and Kyiv Oblast were 1,461.6 and 789.8 thousand people, respectively, in which, 1,364.3 and 736.3 thousand were employed, and the rest (97.3 and 53.5 thousand) were unemployed, i.e., employment rates were 62.3% and 57.8%, respectively.

The unemployment rate (ILO standard) of the economically active population aged 15-70 in Kyiv City and Kyiv Oblast were 6.7% and 6.8% (Table 3.31).

Table 3.31 Employment and Unemployment Ratio in Kyiv City and Kyiv Oblast

	Economically Active Population Aged 15-70 (Thousand Persons)			Economically Inactive Population Aged 15-70, (Thousand Persons)	Employment Rate (%)	Unemployment Rate (%)
	Total	Including				
		Employed	Unemployed			
Ukraine	17,955.1	16,276.9	1,678.2	10,934.1	56.3%	9.3%
Kyiv Oblast	789.8	736.3	53.5	485.0	57.8%	6.8%
Kyiv City	1,461.6	1,364.3	97.3	729.2	62.3%	6.7%

Source: Economic Activity of Population in Ukraine 2016 (State Statistics Service of Ukraine, 2017)

4) Household Income and Expenditure

The State Service of Statistics of Ukraine conducted household income and expenditure survey every year. The below Table 3.32 shows a part of the result.

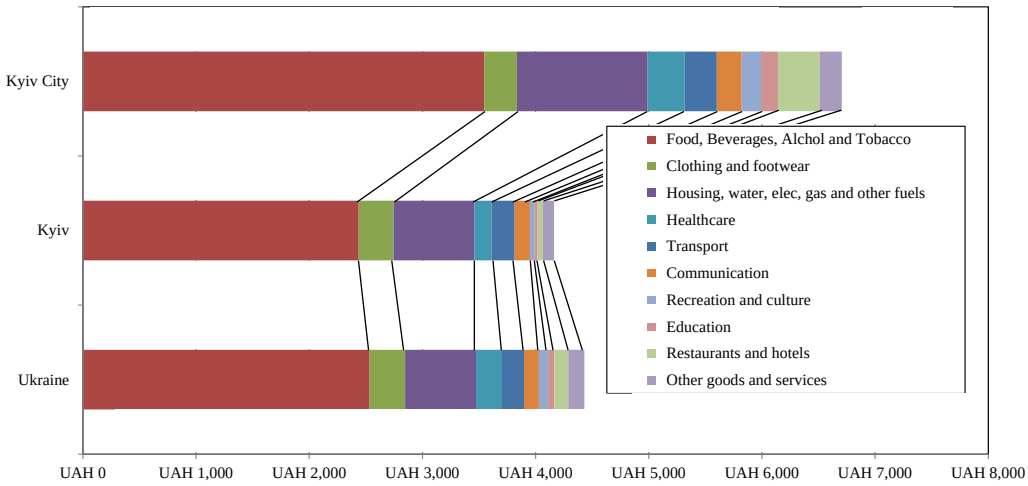
Average household incomes in a month of Kyiv Oblast and Kyiv City surveyed in 2016 amounted respectively to UAH 5,380.53 and UAH 7,466.85/household-month and average monthly expense amounted to UAH 4,419.87 and UAH 7,333.64/household-month, respectively.

Figure 3.12 shows the monthly expenditure of household on average. Kyiv City is remarkably high compared with all Ukrainian average even Kyiv Oblast. As a part of it, the expense on housing communal products and services, which contains waste removal in some area, is approx. 15% in Kyiv.

Table 3.32 Average Monthly Income and Expenditure in Surveyed Households in Kyiv City and Kyiv Oblast

	Unit	All Ukraine	Kyiv Oblast	Kyiv City
Number of surveyed households	households	8,168	304	363
Average persons in a household	person/household	2.11	2.14	2.13
Total number of households	Thousand households	15,033.40	654.70	1,099.00
Total cash income of household (average)	**UAH/household-month**	**5,367.51**	**5,380.53**	**7,466.85**
Salary of household (average*)	UAH/household-month	2,914.70	3,239.89	4,669.69
Pension of household (average*)	UAH/household-month	1,211.26	1,269.65	1,232.82
Total cash expense in a household	**UAH/household-month**	**4,948.62**	**4,419.87**	**7,333.64**
Balance (as a reference)	UAH/household-month	418.89	960.66	133.21

Source: JICA Survey Team based on Expenditure and Resources of Households of Ukraine in 2016 (State Service of Statistics of Ukraine, 2017)



Source: JICA Survey Team

Figure 3.12 Composition of Monthly Expenditure of Household (Average) in Kyiv

5) Utility and sanitary infrastructure

A) Power supply

Kyivenergo supplies power in Kyiv with a single process of generation, transmission, distribution and sale of electric and thermal power. Kyivenergo generates electricity at two combined heat and power plants with total installed capacity of 1,200 MW.

As shown in Table 3.33, in recent years there have been a significant increase in power consumption due to intensive construction of housing, public and office buildings and increase of household electricity consumption.

Table 3.33 Power Supply in Kyiv City

Items		1996	2014
Power Consumption (MW)	Summer	875	1,449
	Winter	1,193	2,077

Source: Kyiv City State Administration

B) Water supply and sewerage system

The status of water supply and sewerage system in Kyiv City is as shown in Table 3.34. In the both case of drinking water supply and sewer treatment, the design capacities are more than demands.

Table 3.34 Status of water supply and sewerage system in Kyiv City

Item	Status
Water supply	- Design capacity of drinking water supply of Kyiv: 2,100,000 m^3 / day - Average daily supply of drinking water: 2017: 750,000 m^3/ day 2015: 1,200,000 m^3 /day
Sewerage system	- Design capacity of the sewage treatment plant: 1.8 million m^3/day - Average daily volume of treated sewer: 750,000 to 800,000 m^3/day

Source: Kyiv City State Administration

3.2.2 Administrative Structure

(1) Kyiv Oblast State Administration

1) Organizational Structure

The organizational structure of Kyiv Oblast State Administration is shown in Table 3.35. The apparatus of oblast state administration is a group of main structural units, which ensures the exercise of powers of oblast state administration which are defined by legislative acts. Structural units are departments, management offices, divisions, and groups which constitute the state administration.

Table 3.35 Organizational Structure of Kyiv Oblast State Administration

Apparatus	
▪ Division of Economic Support ▪ Division of Work of the Management of the Apparatus ▪ Division of Information and Computer Security ▪ Control Department ▪ Division of Patronage Service ▪ Division of Work with Appeals of Citizens ▪ Division of Financial Support ▪ General Division ▪ Division of Human Resources	▪ Sector for the Prevention and Detection of Corruption ▪ The Mobilization Work Sector of Secret-Secret Work ▪ Management Office of Organizational Work and Interaction with Executive Authorities and Local Self-Government ▪ Office of Legal Support ▪ Division of Administration of the State Register of Voters
Structural Units	
▪ Internal Audit Department ▪ Department of Agricultural Development ▪ **Department of Ecology and Natural Resources (41)** - Division of Financial Accounting and Logistics (6) - Sector of Legal Support (2) - Sector of Human Resources and Documentation (2) - Division of Ecological Network and Ecosystem (5) - Division of Water Ecosystems and Natural Resources (5) - IT and Public Relations Sector (3) - Division of Environmental Permitting Activities (5) - **Division of Waste Management (5)** - Division of Nature Management (5) ▪ Department of Economic Development and Trade ▪ Department of Civil Protection and Liquidation of Consequences of the Chernobyl Disaster ▪ Department of Urban Development and Architecture ▪ Department of Education and Science ▪ Healthcare Department ▪ Department of Regional Development and Housing and Communal Services	▪ Department of Social Protection of the Population ▪ Department of Finance ▪ Child and Family Service ▪ Property Management ▪ Department of Internal Policy ▪ Office for Defense and Law Enforcement ▪ Office of Information and Public Relations ▪ Infrastructure Management ▪ Department of Culture, Nationalities, and Religions ▪ Department of Youth Policy and National Patriotic Education ▪ Office of Physical Culture and Sports

Source: Prepared by the JICA Survey Team based on the website of Kyiv Regional State Administration
Note: The numbers in "( )" show numbers of staffs of the organizations.

The main task of the Department of Ecology and Natural Resources of Kyiv Oblast State Administration is the implementation of state policy in the field of environmental protection, rational use, reproduction, and protection of natural resources, and waste management (excluding radioactive waste management); conservation, protection, and practical use of environmental network; management and regulation in the sphere of environmental protection, use of territories, objects, and natural reserve fund objects in Kyiv Oblast; providing environmental and radiation safety.

2) Budgetary Information

The annual expenditure of Kyiv Oblast State Administration in the past three years is shown in Table 3.36. Total budgetary plan of 2018 is UAH 5.4 billion, which is 37.1% increase from the result in 2017. In general, although solid waste management cost is categorized in housing and communal service or waste disposal, it is difficult to compare the tendency of these years due to the budget code alternation in 2017.

Table 3.36 Annual Expenditure of Kyiv Oblast State Administration

Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
Governance	7,776.6	11,891.3	19,886.3	38,678.9
Education	455,531.9	422,006.0	715,324.1	938,633.2
Healthcare	1,025,666.5	1,137,288.5	1,401,716.5	1,621,072.9
Social protection and social security	222,631.7	242,145.7	315,325.4	328,620.2
Housing and communal services	-	-	11,374.4	2,184,487.1
Culture and art	54,405.3	63,367.1	61,919.9	97,140.9
Mass-media	4,566.5	8,792.2	19,092.0	18,164.2
Physical culture and sport	41,328.2	63,983.8	89,313.1	130,092.0
Construction	103,244.0	151,910.6	128,624.9	10,500.0
Agriculture and forestry, fisheries, and hunting	73,840.6	81,548.1	98,514.2	12,500.0
Transport and public road system	125,322.6	94,233.9	948,322.9	11,700.0
Other services related to economic activity	78,381.5	67,323.0	66,223.7	5,800.0
Environmental protection and nuclear safety	16,649.5	2,158.0	0.0	50,085.0
Prevention and elimination of emergencies and consequences of natural disasters	4,369.6	18,144.3	7,062.4	12,982.7
Debt service	-	-	-	-
Trust funds	34,507.6	15,733.4	79,310.2	-
Waste disposal	9,595.8	5,883.9	17,705.8	-
Expenditures not attributed to major groups	40,015.7	47,606.7	0.0	-
Total	2,297,833.6	2,434,016.5	3,979,715.8	5,460,457.1

Source: Prepared by the JICA Survey Team based on the website of Kyiv Oblast State Administration

3) Development Strategy

Kyiv Oblast Development Strategy for the period until 2020 has been developed by the steering committee and working group of the Kyiv Oblast Development Strategy with the assistance of the EU project called “Support to Regional Development Policy in Ukraine” and approved under Decree No. 370 as of 6 Nov. 2014 of the Head of Kyiv Oblast State Administration and decision of No. 856-44-VI as of 4 Dec. 2014 of the Kyiv Oblast Council.

Strategic goals and operational goals have been set based on analysis of current conditions as shown in Table 3.37. In order to achieve each operational goal, tasks and priority project areas have been determined.

Regarding MSWM, there is a task named “Development of Modern MSWM System” which is one of the tasks for the operational goal “Protection of Environment” and priority projects for the task are shown in Table 3.38.

Table 3.37 Strategic and Operational Goals under the Development Strategy

Strategic Goals	Operational Goals
1. Sustainable economic growth based on innovative development of diversified economy	1.1. Creation of new industry and modernization of existing industries 1.2. Growing competitive economic environment 1.3. Creating conditions for the priority development of small and medium enterprises 1.4. Development of tourism potential
2. High quality of life	**2.1. Protection of Environment** 2.2. Training people to live and work in changing economic environment 2.3. Providing healthy life 2.4. Providing the population with quality housing services 2.5. Development of cultural and spiritual environment, ensuring patriotic education of the population
3. Preservation and development of territories	3.1. Increasing rural employment 3.2. Integrated development areas for the benefit of local communities 3.3. Recovery of northern territories of Kyiv Oblast affected by the Chernobyl disaster

Source: Kyiv Oblast Development Strategy for the period until 2020

Table 3.38 Task and Priority Project Areas Related to MSWM under the Strategy Development

Task	Priority Project Areas
Development of modern MSWM system	▪ Elimination of unauthorized landfill site which can be pollution sources of groundwater and land ▪ Construction and reconstruction of landfill sites and provision of equipment for operation of the landfill sites ▪ Construction of sorting plants near the landfill sites ▪ Introduction of new modern technologies in the field of collection, sorting, transportation and processing of solid waste

Source: Kyiv Oblast Development Strategy for the period until 2020

(2) Kyiv City State Administration

1) Organizational Structure

The apparatus, departments, management, and others in the Kyiv City State Administration are shown in Table 3.39. The Division of Sanitary Cleaning and Engineering Protection within the Department of Housing and Communal Infrastructure, which is highlighted in the table, is responsible for MSWM in Kyiv City State Administration.

Table 3.39 Organization Structure of Kyiv City

Apparatus ▪ Division of Organizational Support of the Activities of the Kyiv Mayor (patronage service) ▪ Office of Analytical Support of Kyiv Mayor ▪ Office of Control and Analytical Support of the First Deputy Head of the Kyiv City State Administration ▪ Office of Control and Analytical Support of Deputy Heads of the Kyiv City State Administration ▪ Office of Control and Analytical Support of the Executive Office of the Kyiv City Council (Kyiv City State Administration) ▪ Control and Analytical Management Office ▪ Office of Document Flow and Analysis of Service Correspondence ▪ Office of Legal Cooperation with Law Enforcement and Municipal Security ▪ Office for the Prevention and Detection of Corruption	▪ Office of Citizens' Appeal ▪ Office of Information Security and Access to Public Information ▪ International Relations (International Relations Department) ▪ Office of Organizational Work and Regional Relations ▪ Office of Personnel Management ▪ Management Office of Financial and Economic Provision ▪ Legal Management Office ▪ Division for Ensuring the Work of the Administrative Commission ▪ Division of Mobilization Work ▪ Division of Organizational and Methodological Support of the Register of the Territorial Community of the City of Kyiv ▪ Regional Division of Administration of the State Register of Voters ▪ Sector of Secret Work
Departments ▪ Department of Construction and Housing ▪ Department of Internal Financial Control and Audit ▪ Department of Economics and Investments ▪ **Department of Housing and Communal Infrastructure** ▪ Department of Organizational Support ▪ Department of Budget Planning, Investment and Project Implementation ▪ Department of Housing and Communal Services ▪ Department Funeral Services ▪ Department for Energy Saving, Fuel, and Energy Complex and Drinking Water ▪ Department Housing and Communal Policy ▪ Department Financial Management, Accounting and Reporting ▪ Department of State Architectural and Construction Control of the City of Kyiv ▪ Department of Registration ▪ Department of Land Resources ▪ Department of Information and Communication Technologies ▪ Department of Communal Property of Kyiv ▪ Department of Culture ▪ Department of Urban Development and Architecture	▪ Department of Urban Improvement ▪ Department for the Control over Improvements ▪ Office of Emergency Situations ▪ Department of Education and Science, Youth and Sports ▪ Healthcare Department ▪ Department of Industry and Enterprise Development ▪ Department of Industry and Innovation Policy ▪ Department of Regulatory Policy and Entrepreneurship ▪ Department of Trade and Life ▪ Department of Social Policy ▪ Department of Public Communications ▪ Department of Internal Policies and Public Relations ▪ Department of Information Policy and Communications ▪ Department of Transport Infrastructure ▪ Department of Finance ▪ Department (Center) providing Administrative Services ▪ Office of Advertising ▪ Management (inspection) of self-regulatory control ▪ Department of Tourism and Promotions

Source: Prepared by the JICA Survey Team based on the website of Kyiv City

The main tasks of the Division of Sanitary Cleaning and Engineering Protection are:

- Ensures implementation of the state policy on housing regarding the complex development of housing services of the city, engineering protection of territories, development of municipal waste management, and defining the priority directions for development.
- Develops and implements targeted municipal programs, takes part in the development and implementation of state programs in this sphere.
- Interacts with local authorities in providing housing and utility services within their powers.
- Ensures implementation of powers of the city state administration to determine the frequency and timing of providing services for maintenance of houses and buildings and adjacent territories. Takes measures to provide the population with services for maintenance of houses

and buildings and adjacent territories.

- Ensures ***concluding contracts with enterprises*** of different ownerships on production and/or implementation (provision) of services for maintaining houses and buildings and adjacent areas, ***including the removal of waste.***
- Generates measures to overhaul housing stock within the allocated amounts of money for each work.
- Ensures implementation of powers of the executive body of Kyiv City Council (Kyiv City State Administration) regarding the management of objects in the field of maintenance of houses and buildings and adjacent territories, which are owned by the local community of Kyiv and ensures their proper maintenance and effective operation.
- Provides coordination and organizational and methodological support of relevant structural divisions of Kyiv District State Administrations and work of enterprises, institutions, and organizations in the field of services for maintenance of houses and buildings and adjacent territories.
- Implements the state policy on formation and maintenance of housing stock of dormitories. Participates in changing the status of dormitories, apartment buildings, residential properties, and apartments.
- Takes measures to transfer residential buildings, dormitories to communal property of local community of Kyiv, and privatize rooms in dormitories.
- Handles issues related to the operation and maintenance of residential buildings of housing cooperatives.
- Promotes the creation of the association of co-owners of multi-apartment buildings.
- Arranges monitoring of measures directed to ensure the stable operation of housing and communal services of the city in autumn and winter and of industry facilities in case of natural disasters and accidents as well as eliminating their impact and monitors the preparation of housing and communal services for autumn-winter period.
- ***Takes measures to provide the residents with services for waste removal.***
- ***Provides suggestions for waste collection and transportation, creation of landfills for their disposal, and implementation of separate collection of useful components of this waste.***
- Ensures implementation of powers of the city state administration ***to approve rules of provision of municipal waste transportation services.***
- ***Provides suggestions on approving the scheme of sanitary cleaning of Kyiv.***
- ***Coordinates the activities of WM enterprises of Kyiv regardless of ownership and subordination.***
- ***Studies and analyzes the status of waste management in Kyiv and predicts the data of its further development.***

2) Budgetary Information

The total expenditure of KCSA in 2017 was UAH 49.2 billion, a UAH 15.0 billion increase from the previous year. As a part of this, the Department of Housing and Communal Policy, who is in-charge of waste management, spent approximately UAH 3.2 billion. According to KCSA, approx. UAH 120 million was used for MSW management in 2017.

A more detailed financial information of MSWM sphere in Kyiv City is provided in Table 3.40.

Table 3.40 Annual Expenditure of Kyiv City State Administration

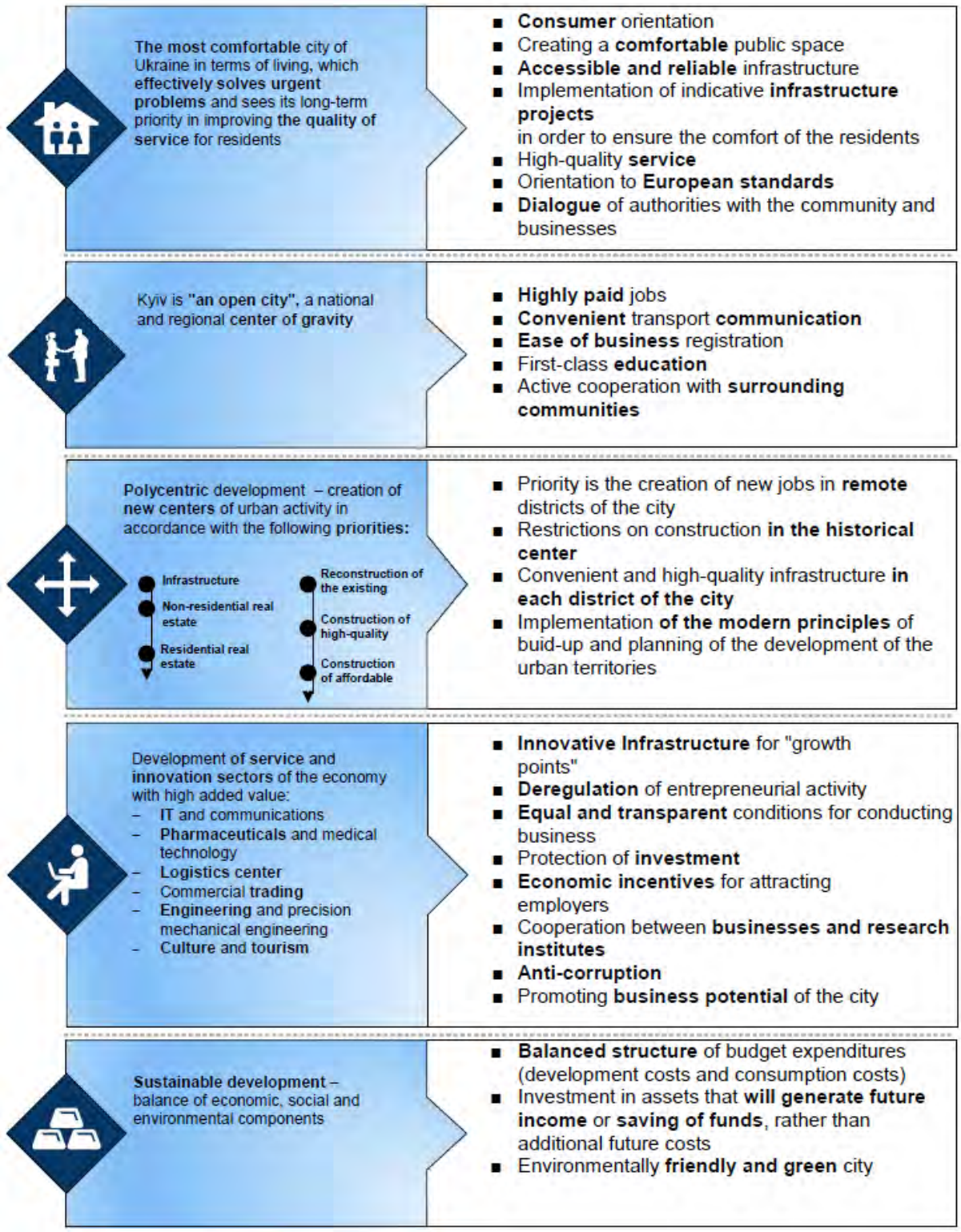
Unit: UAH in thousands

Code*	Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
010000	Governance	704,538.7	1,192,416.4	1,592,323.9	1,502,247.1
070000	Education	6,313,212.6	8,052,449.0	11,538,619.8	13,765,756.4
080000	Healthcare	8,231,105.5	7,639,957.9	9,329,577.1	9,232,324.9
090000	Social protection and social security	4,187,825.1	4,648,114.0	7,857,564.3	8,715,438.1
100000	Housing and communal services	2,145,931.8	2,597,612.2	3,258,851.0	2,381,024.3
110000	Culture and art	761,703.0	1,265,613.3	1,458,718.5	947,084.5
120000	Mass-media	33,723.6	36,699.5	60,545.8	104,277.0
130000	Physical culture and sport	241,694.4	300,797.0	433,358.8	533,468.7
150000	Construction	1,542,904.7	3,641,852.7	4,364,117.8	3,425,152.6
160000	Agriculture and forestry, fisheries and hunting	32,965.4	28,669.1	27,027.9	34,012.5
170000	Transport and public road system	1,533,482.9	2,552,720.5	7,276,192.3	6,036,661.3
180000	Other services related to economic activity	170,390.2	710,477.9	1,362,178.6	1,272,325.6
200000	Environmental protection and nuclear safety	-	-	-	82,277.8
210000	Prevention and elimination of emergencies and consequences of natural disasters	8,342.9	9,979.1	22,346.1	57,125.0
230000	Debt service	1,576,847.0	281,438.6	15,059.7	493,950.8
240000	Trust funds	298,395.8	312,963.7	351,273.4	-
240602	Waste disposal	2,949.7	0.0	-	-
250000	Expenditures not attributed to major groups	176,146.5	179,405.2	309,383.9	-
	Total	27,962,160.0	33,451,166.1	49,257,138.9	48,583,126.6

Source: Prepared by the JICA Survey Team based on the information of Kyiv City State Administration

3) Development Strategy

The Kyiv Development Strategy until 2025 has been approved under Decision No. 824/7060 of the Kyiv City Council as of 15 December 2011. According to the strategy, the priorities for development of Kyiv are shown in Figure 3.13.



Source: Kyiv Development Strategy until 2025

Figure 3.13 Priorities for Development of Kyiv

MSWM is part of the priority “Sustainable development - balance of economic, social, and environmental components”. The task and measures of the MSWM sector in the strategy are shown in Table 3.41.

Table 3.41 Task and Measures of MSWM Sector in the Development Strategy of Kyiv

Task	▪ Implementation of the modern methods of processing solid waste and limiting their burial at landfills (the goal – zero waste)
Measures	▪ Prevention of the formation of spontaneous accumulation of waste ▪ Reclamation of individual landfill maps of solid domestic waste No. 5 with the construction of a waste recycling complex ▪ Creation of facilities for the processing and disposal of solid domestic waste and vegetable waste

Source: Kyiv Development Strategy until 2025

3.2.3 Legal System on Waste Management

(1) Kyiv Oblast State Administration

The regulations of Kyiv Oblast State Administration related to MSWM are shown in Table 3.42.

Table 3.42 Regulations Related to MSWM Issued by Kyiv Oblast State Administration

Date of Issue	Type and Number of Document	Name of Document
19 May 2017	Decree of Kyiv Regional State Administration, No. 301-14-VII	On approval of the municipal solid waste management program in Kyiv Region for 2017-2010
19 May 2017	Decree of Kyiv Regional State Administration, No. 247	On approval of the modern solid waste management system implementation in Kyiv Region for 2017-2022
09 February 2018	Decree of the Head of Kyiv Regional State Administration, No. 54	To form a working group in order to develop proposals to the national plan of waste management
12 October 2016	Decree of the Head of Kyiv Regional State Administration, No. 418	On organizational measures for the elimination of unauthorized and uncontrolled waste landfills

Source: Kyiv Oblast State Administration

(2) Kyiv City State Administration

The regulations of Kyiv City State Administration related to MSWM are shown in Table 3.43.

Table 3.43 Regulations Related to MSWM Issued by Kyiv City State Administration

Date of Issue	Type and Number of Document	Name of Document
10 February 2014	Order of City State Administration, No. 1234	On approval of the scheme of sanitary cleaning of Kyiv City
17 March 2016	Decision of Kyiv City Council, No. 232/232	On approval of the complex target program of energy efficiency and development of housing and communal infrastructure of Kyiv in 2016 - 2020 and measures for its implementation
26 June 2007	Decision of Kyiv City Council, No. 1012/1673	On providing the Main Department of Municipal Economy of the executive body of the Kyiv City Council (Kyiv City State Administration) with a land plot for the construction, operation and maintenance of a waste recycling plant with thermal neutralization of the remaining solid waste at the CHPP-6 in the Desniansky District of Kyiv
15 December 2011	Decision of Kyiv City Council	On approval of Kyiv Development Strategy up to 2025

Source: Kyiv City State Administration

3.2.4 Related Legal System (Energy and PPP)

(1) Kyiv Oblast State Administration

According to the questionnaire survey and related interview, the oblast government follows legislations at the national level and there are no specific legislations at the oblast level.

(2) Kyiv City State Administration

According to the questionnaire survey and relative interview, Kyiv City State Government Administration follows legislations at the national level and there are no specific legislations at the city level.

3.2.5 Current Municipal Waste Management Situations in Kyiv City

(1) Waste Generation Quantity and Quality

1) Existing Data on Waste Quantity and Quality

A) Amount of MSW

According to the Sanitary Cleaning Scheme of Kyiv City (2011), the amount of municipal waste generated in the city was estimated based on population, waste generation rate of residents, and estimated amount of administrative and commercial waste, as shown in Table 3.44. For the year 2018, the population in Kyiv City and household waste generation rate were estimated at 3.016 million people and 1.11 kg/person/day, respectively. Therefore, the amount of household waste generation was estimated at 1.2 million t/year. Besides, municipal solid wastes generated by administrative and commercial sectors were estimated at 110,000 t/year and 122,000 t/year, respectively. Hence, the total amount of municipal solid waste generation in Kyiv City was estimated at 1.456 million t/year, that is about 4,000 t/day.

Table 3.44 Estimation of Municipal Waste Generation in Kyiv City

Indicator			Year					
			2010	2012	2014	2016	2018	2020
1	Population (permanent and temporary)	1,000 people	2,785.00	2,840.98	2,898.08	2,956.33	3,015.76	3,076.37
2	Average waste generation rate in residential areas	m^3/capita/year	2.00	2.00	2.04	2.08	2.12	2.17
3		kg/capita/year	390.00	393.90	397.84	401.82	405.84	409.89
4	Household waste in residential areas	1,000 m^3/year	5,570.00	5,681.96	5,912.67	6,152.75	6,402.57	6,662.54
5		1,000 tons/year	1,086.15	1,119.06	1,152.97	1,187.91	1,223.90	1,260.99
6	Administrative waste	1,000 m^3/year	698.24	719.40	741.20	763.65	786.79	810.63
7		1,000 tons/year	97.75	100.72	103.77	106.91	110.15	113.49
8	Commercial waste	1,000 m^3/year	678.84	699.41	720.61	742.44	764.94	788.12
9		1,000 tons/year	108.62	111.91	115.30	118.79	122.39	126.10
10	Total municipal waste generation	1,000 m^3/year	6,947.08	7,100.77	7,374.47	7,658.84	7,954.30	8,261.29
11		1, 000 tons/year	1,292.52	1,331.68	1,372.03	1,413.61	1,456.44	1,500.57

Source: State Enterprise Scientific Research Design Technology Institute of Urban Management (2011) "Sanitary Cleaning Scheme of Kyiv City"

B) Physical Composition of MSW

The physical composition of municipal solid waste in Kyiv City was surveyed and the results are shown in Table 3.45. Food and garden wastes account for 39%, paper/cardboard (No. 1~2) and glass account for 13%, respectively. Plastic (No. 3~6) accounts for 10%, metal (No. 7~8), leather/rubber, textile, and wood account for 1~2%, respectively, and unsorted residue accounts for 19%.

Table 3.45 Physical Composition of MSW in Kyiv City

Unit: %

No.	Component	Residential Waste from Apartment Houses	Residential Waste from Individual Houses	Weighted Average of Residential Waste	Administrative Waste	Commercial Waste	Weighted Average of MSW
1	Cardboard	4.04	3.15	3.97	17.36	8.39	**5.46**
2	Paper	6.21	2.51	6.51	19.11	9.18	**7.78**
3	PET bottles	2.07	2.16	2.07	1.82	2.61	**2.09**
4	Polymer film	3.97	5.27	4.05	3.10	5.69	**4.11**
5	Plastic	2.63	4.61	2.56	8.06	3.12	**3.07**
6	Tetra pack	0.86	1.50	0.91	1.25	1.13	**0.96**
7	Ferrous metal	1.03	1.92	0.99	0.68	0.70	**0.94**
8	Non-ferrous metal	0.15	0.16	0.16	0.13	0.25	**0.17**
9	Glass	12.09	14.95	12.19	18.45	15.83	**13.01**
10	Leather, rubber	1.12	2.14	1.09	1.55	0.43	**1.07**
11	Textile	2.39	3.27	1.79	2.18	0.65	**1.72**
12	Tree	0.89	1.07	0.93	2.35	4.53	**1.35**
13	Food and garden waste (compostable)	42.32	27.78	42.30	16.55	31.61	**39.26**
14	Hazardous waste	0.0066	0.00	0.0064	0.00	0.02	**0.0067**
15	Unsorted combustible residue	15.21	14.61	15.27	11.65	11.86	**14.68**
16	Unsorted incombustible residue	4.42	8.12	4.55	2.20	4.01	**4.31**

Source: State Enterprise; Scientific Research Design Technology Institute of Urban Management (2011) "Sanitary Cleaning Scheme of Kyiv City"

C) Chemical Composition of MSW

The chemical composition of municipal solid waste in Kyiv City was surveyed and the results are shown in Table 3.46. Moisture content, ash content, and elemental properties of carbon, hydrogen, oxygen, nitrogen, and sulfur for each component of waste were analyzed and calorific value of municipal waste was calculated at 1,498 kcal/kg.

Table 3.46 Chemical Composition of MSW in Kyiv City

Unit: %

No.	Component	Physical Composition	Moisture	C	H	O	N	S	Ash	Total
1	Paper, cardboard	13.2	11	38.95	5.23	39.04	0.22	0.18	5.38	100
2	Polymer (plastic)	9.49	10	30.71	4.82	34.2	0.11	0.16	20	100
3	Metal (black, colored)	1.07	3	0.77	0.04	0.19	0	0	96	100
4	Glass	13.2	2	0.66	0.03	0.11	0	0	97.2	100
5	Textile	2.13	10	49.28	5.94	28.3	4.16	0.12	2.2	100
6	Leather, rubber	1.08	5	72.89	10.25	0	0	1.98	9.88	100
7	Tree	1.55	30	35.46	4.78	28.8	0.12	0.04	0.8	100
8	Food waste	38.42	72	12.59	1.8	8.03	0.95	0.15	4.48	100
9	Unsorted residue	19.86	40	15.93	2.35	17.62	0.05	0.05	24	100
	Total	100	39.04	18.54	2.62	16.05	0.5	0.13	23.12	100

Source: State Enterprise; Scientific Research Design Technology Institute of Urban Management (2011) "Sanitary Cleaning Scheme of Kyiv City"

2) Result of Waste Composition Survey and Chemical Analysis of JICA Survey

The waste composition survey and chemical analysis of municipal solid waste in the three target cities were planned in this JICA survey so as to grasp the current characteristics of municipal solid waste in the target cities and to compare with the existing data. The waste composition survey in Kyiv City was

conducted on 15 May 2018 and chemical analysis was conducted successively. The physical composition of the municipal solid waste in Kyiv City measured by the JICA Survey Team is summarized in Table 3.47. Kitchen waste accounted for 44.0%, followed by plastics (21.5%), papers (13.5%), and glass (9.5%). The bulk density of the sample was 0.19 kg/L.

Table 3.47 Physical Composition of MSW in Kyiv City (2018)

No.	Component	Composition (%)
1	Papers	13.5
2	Kitchen wastes	44.0
3	Woods	2.3
4	Cloths	3.3
5	Plastics	21.5
6	Rubbers and leathers	1.5
7	Metals	1.4
8	Glasses	9.5
9	Crockery and stones	1.2
10	Others	1.8
	Total	100.0

Source: JICA Survey Team

The result of chemical analysis is presented in Table 3.48. Gross calorific value is 2,844 kcal/kg, moisture content is 43.9%, ash content is 7.8%, and loss on ignition is 48.4% in raw waste (wet basis).

Table 3.48 Chemical Composition of MSW in Kyiv City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	2,844	5,067
2	Moisture content	%	43.9	-
3	Ash content	%	7.8	14
4	Loss on ignition	%	48.4	86.2
5	Carbon	%	27	48
6	Hydrogen	%	3.8	6.7
7	Oxygen	%	17	30
8	Nitrogen	%	0.37	0.65
9	Chlorine	%	0.374	0.666
10	Sulphur	%	0.12	0.21

Source: JICA Survey Team

The detailed methodology and records of waste composition survey are attached as Appendix 5.

The gross calorific value of 2,844 kcal/kg in the JICA survey (2018), which was analyzed in the certified laboratory by a bomb calorimeter, is much higher than the previous report (2011), which was calculated based on analyzed chemical composition. The difference may be caused by change of waste characteristic over time, difference of analysis/calculation method of calorific value or other reasons.

As it is difficult to evaluate waste characteristic by a small number of samples and surveys, it is desirable that Kyiv City periodically implements waste characteristic survey to accumulate reliable data.

(2) Waste Collection and Transportation

1) Implementation Structure of Waste Collection and Transportation

Kyiv City State Administration entrusts the management of municipal waste collection and transportation service to a communal enterprise named 'Kyivkomunservis (KKS).' KKS is mainly in-

charge of management of municipal waste generated from multi-residential apartment managed by the Housing Maintenance and Management Companies of the municipal districts in the city. The other municipal solid wastes generated from individual houses, commercial, and administrative sectors are mostly not managed by KKS but through private service providers. KKS owns a small number of collection vehicles; therefore, actual implementation of municipal waste collection and transportation service is provided by the seven entrusted service providers as listed in Table 3.49.

Table 3.49 Municipal Solid Waste Collection Service Providers in Kyiv City

No.	Name of Service Provider	Type of Company
1	Kyivspetstrans	Public private joint stock company
2	Firm Altfater Kyiv	State enterprise
3	Celtic	Private company
4	Firm Volodar-Roz	Private company
5	Spetskomuntehnika	Private company
6	Kramar Recycling	Private company
7	ATP Shevchenkivskoho Rayonu	Communal enterprise

Source: Kyiv City State Administration

Municipal waste collection service is performed six days a week excluding Sunday and collective segregated waste collection system is not yet fully introduced in the city. The amount of municipal waste collected by KKS is about 1.2 million t/year and the collection rate of municipal waste is 100% according to Kyiv City State Administration.

The scenery of waste collection in the city is presented in Figure 3.14.

Typical waste containers in the city

Waste collection work by service provider

Source: JICA Survey Team (April 2018)

Figure 3.14 Scenery of Municipal Waste Collection in Kyiv City

2) Kyivkomunservis

KKS is a communal enterprise belonging to the Department of Housing and Communal Infrastructure of Kyiv City State Administration. KKS was established in 2004 and started waste collection and transportation service from 2008~2009, and then it was selected as municipal solid waste collection and transportation operator of Kyiv City from 2010. At the end of 2013, KKS became responsible for waste collection service for the Housing Maintenance and Management Companies of all the ten districts in Kyiv City. Currently, KKS has contract with Kyiv City State Administration for provision of municipal waste collection service in the city for seven years starting from December 2017.

KKS concluded 23 contracts with the above listed seven service providers for implementation of municipal solid waste collection service. KKS designates the service area, waste collection schedule, waste disposal site, and so on for each service provider. Therefore, it can be understood that KKS is the responsible body for the management of municipal solid waste collection and transportation in the

city, i.e., selection, monitoring, and supervision of the service providers, and the service providers are the implementers of actual waste collection and transportation service.

KKS owns 13 vehicles and they are mobilized in emergency situation and also utilized to provide waste collection service for some private waste generators. KKS collects 20,000~25,000 m^3 of municipal waste annually. Besides, KKS is currently promoting segregated waste collection of recyclables and hazardous waste such as cell batteries and fluorescent tubes as shown in Figure 3.15. KKS has set up segregated waste containers in the city and provides collection service for these containers. Although the number of the segregated waste containers is still limited, KKS intends to increase them to promote segregated waste collection and recycling.

Segregated waste containers in front of KKS office

Segregated waste containers in the city

Hazardous waste container in front of KKS office

Underground waste container in front of KKS office

Source: JICA Survey Team (April 2018)

Figure 3.15 Segregated Waste Containers Promoted by KKS

3) Waste Collection Service Providers

'Kyivspetstrans' is one of the major service providers performing municipal waste collection service in Kyiv City and it provides waste collection service in the four districts out of the ten districts in the city. Kyivspetstrans used to be a public enterprise in the former Soviet era but it is currently a public private joint stock company whose capital is shared by the Kyiv City State Administration (51%) and private funds (49%). Kyivspetstrans is also in-charge of operation of Landfill No. 5 which receives a large part of municipal waste generated in the city and Landfill No. 6 which receives construction waste and bulky waste generated in the city.

(3) Intermediate Treatment and Recycling

The only intermediate treatment facility of municipal solid waste in operation in Kyiv City is Energia Incineration Plant whose detailed information is described in the following section.

As for recycling, there are some waste sorting facilities operated by private companies which sort and recover recyclable materials from municipal solid waste. The companies involved in waste sorting and material recovery activity in Kyiv City are listed in Table 3.50.

Table 3.50 Companies Performing Waste Sorting and Material Recovery Activity in Kyiv City

No.	Name of Company	Type of Company	Outline of Recycling Activity
1	Kyivmiskvtorresursy	Private company	Operating two waste sorting facilities in the city.
2	Eco Stok	Private company	Operating two waste sorting facilities in the city.
3	Firm Altfater Kyiv	State enterprise	Operating mobile waste sorting facility in the city.
4	Celtic	Private company	Operating mobile waste sorting facility in the city.
5	Waste Management Systems	Private company	Operating waste sorting facility in Prolisky Village, Boryspil District of Kyiv Oblast.
6	Volodar-Roz	Private company	Operating waste sorting facility in Hlyboke Village, Boryspil District of Kyiv Oblast.

Source: Kyiv City State Administration

Among the above listed companies, 'Kyivmiskvtorresursy' has a wide network of recyclable materials collection points including 141 collection points in Kyiv City as shown in Figure 3.16. The company has 617 workers performing the largest scale of waste sorting and recovery activity in the city. It deals with municipal and industrial solid waste and segregates glass, wood, plastic, cardboard, rubber, and metal and sells them to recycling market. The amount of sorted and recovered materials by Kyivmiskvtorresursy is approximately 70,000 t/year.

Source: JICA Survey Team (April 2018)

Figure 3.16 Recyclable Material Collection Point Introduced by Kyivmiskvtorresursy

'Eco Stok' is a private company which operates recyclable waste sorting plant in Kyiv City from 2016. The sorting facility is operated by about 25 workers and it sorts out about 100 t/day of plastic, metal, glass, and cardboards. The waste collection service providers in the city, which have contracts with Eco Stok, bring municipal solid waste (which contains relatively high proportion of recyclable waste) to the Eco Stok's sorting facility and pay tipping fee to Eco Stok as agreed in the contracts. Then, the waste brought in Eco Stok is processed by trammel so as to separate into recyclables and non-recyclables (residue). The sorted recyclables are manually segregated into each category by the workers and the residue is disposed at Landfill No. 5. The recyclables segregated by categories are compressed with a pressing machine and sold to recycling factories in Kyiv Oblast when a certain amount is accumulated. Currently, there is only one sorting line in the facility but Eco Stok plans to install another sorting line within 2018. The photos of the sorting facility operation are presented in Figure 3.17.

Municipal solid waste received in the facility

PET bottles

Metal cans

Cardboards

Source: JICA Survey Team (April 2018)

Figure 3.17 Scenery of Sorting Facility Operation by Eco Stok

(4) Energia Incineration Plant

Energia Incineration Plant, herewith described as "the plant", is the only waste incineration plant in Ukraine and it incinerates more than 20% of waste which Kyiv City collects. The type of waste processed is municipal waste, herewith described as "the waste", and large-sized waste and construction waste are directly transported to Landfill No. 6.

1) Outline of the Plant

The plant is located at the corner of the industrial area along the Bylytsya Lake, surrounded by many industrial facilities and neighboring the Bortnychi Sewage Treatment Plant. The overview, the summary of the plant and facility layout are shown in Figure 3.18, Table 3.51 and Figure 3.19.

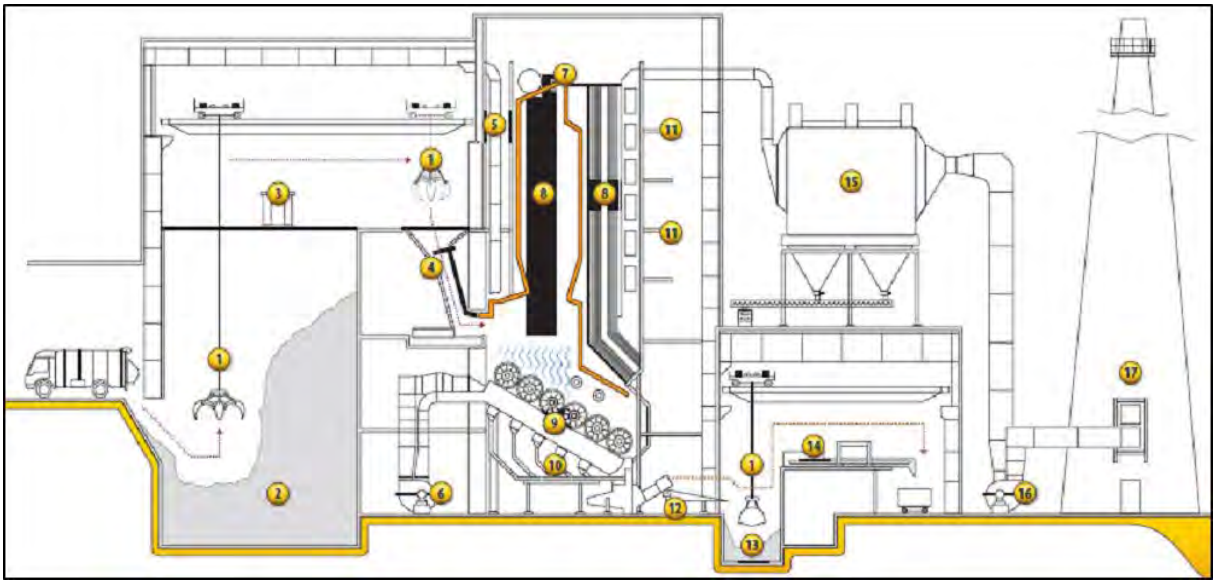
Source: JICA Survey Team (April 2018)

Figure 3.18 Overview of Energia Incineration Plant

Table 3.51 Outline of Energia Incineration Plant

Item	Outline
Name	Energia Incineration Plant
Address	02121,44, Kolektorna St., Kyiv, Ukraine
Site area	8.2 ha including 1.2 ha of the building for heat providing
Nominal capacity	1,440 tons/day (360 tons/day・furnace×4 furnaces)
Type of furnace	Stoker grate furnace（Rotary stoker furnace Plant maker：CKD Dukla
Operation start	December, 1987
Constructor	Government of the Soviet Union
Construction cost	RUB 6.6 billion
Energy utilization	Heat providing to Kyivenergo's heat grid

Source: JICA Survey Team



1	Waste Crane	6	Air Supply Fan	11	Service Areas	16	Gas Duct
2	Waste Pit (18,000 m^3)	7	Boiler	12	Sloping Conveyor	17	Stack
3	Operation of Waste Crane	8	Exhaust Gas Cooling Equipment	13	Ash Bunker		
4	Waste Charging	9	Furnace (rotary stoker type)	14	Ferrous Metal Separator		
5	Air Supply Pipe	10	Dust Removal Device	15	Electric dust collector		

Source: Energia Incineration Plant

Figure 3.19 Facility Layout of Energia Incineration Plant

Although the area of the site is enough, large buffer green zone is not established. Space for facilities such as weighing bridge, building for staff, approach road, unloading yard, management building, factory building, building for heat providing devices, and material storing yard are distributed with margin.

Type of the furnace is rotary stoker furnace and the plant was constructed by CKD Dukla, a Czech company with a licensing agreement with a company in Dusseldorf in Germany. When the plant was constructed, Ukraine was a part of the Soviet Union, and the construction project was implemented by the Government of the Soviet Union. The Government of the Soviet Union, in the 1980s, constructed ten waste incineration plants, but nine of them stopped operation because of lack of maintenance and/or financing. The plant is the only facility which is still being in operation in Ukraine.

2) Equipment Installed and Operative Situation

A) Waste Accepting and Feeding Facility

The waste accepting and feeding facility includes weighing bridges, unloading platform, waste pit gates, waste pit, waste cranes, and the outline of equipment and operative situation are as follows. The photos of waste accepting and feeding facility are shown in Figure 3.20.

a) Weighing bridge

There are two sets of weighing bridges being installed. The waste collection trucks coming into the site are weighed twice, that is when a truck comes in and goes out, so that the weight of the content can be known. The weighing brides are equipped with a roof and a building is installed between weighing bridges. A card reader is not equipped therefore a truck driver needs to get out of the truck and submit the worksheet to the staff in the building. The waste collection trucks are generally large in size and the overall weight of a truck mostly exceeds 25 tons.

b) Unloading platform and pit gate

The unloading platform is not covered with a roof but has adequate space. Devices to guide trucks are not installed either. However, only the place where trucks unload contents into waste pit is equipped with a pent-roof. The front side of the factory building is a wall and likewise, waste pit gates are not equipped. Instead, there are openings at the bottom part of the wall for which waste trucks dump the content into the opening.

Although there are ten waste pit gates, only three to five gates were functional because of the waste heaped up in the waste pit when the JICA Survey Team visited the plant.

c) Waste pit

The volume of the waste pit is 18,000 m^3.

d) Waste crane

There are two sets of waste cranes being installed. The lifting capacity of a crane is 10 tons or less and type of bucket is a prop type grab bucket of which the volume is 5 m^3. The grab bucket is driven by wires and the wires wear out only in a short period, therefore the wires need maintenance every two weeks. Necessary maintenance works are done by the workers of the plant. The crane buckets are also easily worn out and replaced after 5 to 7 years.

In Japan, when a crane is used in work, it is necessary to undergo a legal examination based on the Occupational Safety and Health Act, Article 41-2. Similarly, in Ukraine, it was explained that the plant undergoes legal examination once in four years. Besides, the cranes are self-checked every year in addition to the abovementioned legal examination.

Weighing bridges

Unloading platform

Waste Pit

Operation of Waste Crane

Source: JICA Survey Team (April 2018)

Figure 3.20 Waste Accepting and Feeding Facility

B) Combustion Equipment

Combustion equipment includes waste charging hopper, waste feeder, furnace, and auxiliary burner as Figure 3.21. The outline of the equipment and operative situation are as follows:

a) Waste charging hopper and waste feeder

The waste charging hopper is inclined slightly downward to the furnace, and no auxiliary devices such as waste level detector and blockage releasing device are installed. Waste feeder is an equipment to provide waste into furnace and has function to adjust quantity of waste to be incinerated. Waste feeder is indispensable because of structure of the furnace and waste feeder which has independent hydraulic device. Because of long term operation, it has become necessary to replace the whole unit and replacement works for second furnace was being proceeded when the JICA Survey Team visited.

b) Furnace

There were four furnaces all of which have a nominal capacity of 360 t/day, 15 t/hour × 24 hours. The furnaces are installed but its actual operational capacity was at approximately 10 to 11 t/hour. Type of furnace is a rotary stoker type with the number of stoker is 6, and the angle of fire grate is set to 30 degrees. Aluminum contained in wastes is melted on the fire grate, and then cooled off in the ash duct below causing blockage of the ash duct. It was reported that this kind of problem happened before but it was not observed in recent operation. Because of this the plastic contained in waste causes a similar problem.

Waste feeder

Furnace

Source: JICA Survey Team (April 2018)

Figure 3.21 Combustion Equipment

C) Exhaust gas cooling equipment

The exhaust gas cooling equipment includes a boiler, dust removal device, steam condenser and water purifier for boiler water. The outline of equipment and operative situation are as follows:

a) Boiler

The combustion gases generated by waste incineration are cooled by the boiler. Integral type boilers are installed and whole combustion gases pass through the boiler. The pressure of steam generated is 1.27 MPa, and the temperature is 250 °C, quantity of generated steam is 40 t/hour in normal conditions and 45 t/hour in maximum conditions. As the boiler heat transfer tubes become thinner through long time operation, continuous replacement is required. About 80% of the boiler heat transfer tubes have been replaced since the operation started.

b) Dust removal device

The dust attached to the boiler heat transfer tube needs to be periodically removed to keep effective heat exchange in the waste incineration plant. The dust removal devices using steam and soot blowers are installed in the plant. There are 14 units of dust removal devices being installed for each furnace and they are used twice a day.

c) Water purifier

A water softener is installed and salt is used for the reduction of the cation exchange resin.

d) Exhaust gas processing equipment

An electrostatic precipitator is installed to process exhaust gases. Equipment to control acid gases such as HCl, Sox, and NOx have not been installed.

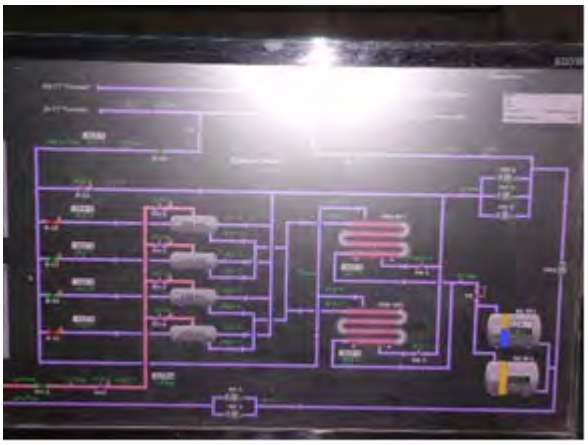
e) Heat utilization equipment

Energy recovered is not used for electricity generation but totally used for providing heat. The steam produced in the plant is forwarded to four units of hot water generators, which are installed in a detached building. The energy is returned in a form of condensed water having a temperature of approximately 100 °C, after this, the condensed water is forwarded to the reservoir in the plant again and then, it is returned to the boiler through the deaerator.

The hot water generated flows into the return pipe connecting the heat consumers in Kyiv City and the Poznyaky heat supply station. The water in the return pipe whose temperature is approximately 50 °C is warmed up to 65 °C by hot water provided from the plant. Thus, fuel, which is natural gas, is saved in the Poznyaky heat supply station.

The heat supply equipment in the plant was installed in 2014, at a cost of UAH 28 million.

Soot blower



Flow of heat providing equipment

Heat providing pipe

Heat Exchanger Units

Source: JICA Survey Team (April and May 2018)

Figure 3.22 Exhaust Gas Cooling Equipment

D) Draft Equipment

a) Draft system

A balanced draft system, a combination of a forced draft fan and an induced draft fan is applied in the plant. Combustion air to incinerate waste is absorbed by the waste pit room, subsequently heated to 120 °C and sent into the furnace from the bottom of the fire grate.

b) Stack

The stack is made from concrete and its height is 120 m. As an aviation obstruction marker, the stack body is painted in gray and brown color and red blinking lights are also installed. The color of the stack body was originally red and white but subsequently it was repainted.

E) Ash discharging equipment

a) Ash removal device

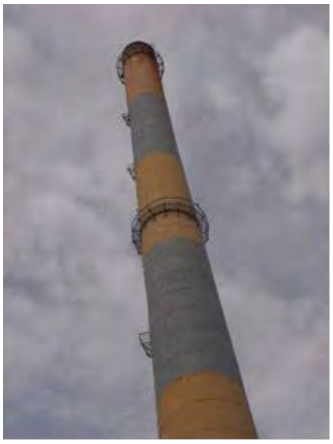
The ash pusher is installed to the discharge bottom ash. The bottom ash expressed as "slag" by the plant staff is transferred by a subsequent conveyer to the ash pit and stored. The ash discharged from the electrostatic precipitator, i.e., fly ash, expressed as simply "ash" by the plant staff is transferred by a conveyer placed at the bottom of the electrostatic precipitator and falls down into the ash pit and mixed with the bottom ash. The mixture of bottom ash and fly ash is transported to Landfill No.5.

b) Ash crane

There are 2 units of ash cranes installed in the plant and clamshell type buckets are applied.

c) Ferrous metal separator

The ash stored in the ash pit is discharged into the hopper of the ferrous metal separator. The ash is separated to large fractions and small and powder state matters by the trommel placed under the hopper. Large fractions are transferred by a conveyer to a magnetic separator in order to recover ferrous metal and residues that are returned to the ash pit. Small and powder state matters fall down through holes of the trommel and are manually replaced into another ash pit which will then be returned to the ash pit after dewatering.



Stack

Ash discharging equipment

Source: JICA Survey Team (April 2018)

Figure 3.23 Ash Discharging Equipment

F) Water supply facility

The city water is supplied to the plant by the two pipelines. In addition, two wells with depths of 65 m and 115 m are equipped in the plant site. City water is scarcely used for the reason of operational cost and thus well water from the 115 m well is mostly used.

G) Waste water facility

The waste water generated in the plant including rain water and melting snow water is not processed in the site but directly discharged into the sewer pipe.

H) Electric facility

Electricity is accepted through the 2 lines of 10 kV of the commercial power supply system. High tension electricity is delivered to the plant and is used for the equipment. Emergency dynamo equipment is not installed because of reliable commercial power.

I) Instrumentation Facility

Instrumentation facilities including exhaust gas monitoring devices have been replaced by devices manufactured in Ukraine.

3) Management of the Facility

While the facility belongs to Kyiv City, the management of the plant is entrusted to the Kyivenergo. The plant is placed as one of the branches of Kyivenergo. The contract term for the plant operation had lasted until 31 July 2018, and its operation was completely transferred from Kyivenergo to Kyivteploenergo on 1 August 2018. The situation of the management of the plant is summarized as follows.

A) Plant Administration System

a) Staff placement

The number of staff of the plant is approximately 180. The breakdown is as follows:

- Operation section: 21 to 22 staff x 4 groups
- Maintenance section: Electrical charge 5, Mechanical charge 13, Control and monitoring charge 6

In addition, the staff are placed in general management charge including personnel affairs and accounting, waste acceptance charge and ecological charge.

b) Safety and sanitation management

Management of safety and sanitation is performed thoroughly and matters such as wearing safety caps as well as matters at times of movement in the site are explained even for temporal visitors. The plant staff wears work clothes which have the company's logo. They also wear protection tools such as safety caps, gloves and mask.

c) Securing necessary technique and skill

In spite of the changes in administrative and financing system, the long term operation and the lack of maintenance company after construction, the necessary maintenance works has been continued. The Kyivenergo accepted parts of the staff who lost their jobs after the accident in the Chornobyl Nuclear Power Plant. The staff working in the plant have enough technical background experience.

B) Operational Situation

a) Planed annual operation days

The plant is basically in operation everyday but all the furnace operations are stopped for two weeks at a time every year for a periodical overhaul.

b) Amount of waste annually incinerated

The amounts of waste annually incinerated in the plant were approximately 253,000 tons in 2016 and 248,000 tons in 2017. These are equivalent to more than 20% of the municipal waste generated in Kyiv City.

Before 2014, the amount of waste annually incinerated was only 140,000 tons, so the processing tariff was revised and lowered to UAH 87 per ton considering financial situation of private waste collection service providers. With this revision, the amount of waste carried into the plant was recovered.

C) Acceptance of Waste

a) Type of waste

The waste accepted is non-hazardous municipal waste generated in Kyiv City excluding bulky waste and construction waste, and the waste that private waste collection service providers transport. These wastes are taken into the plant by making contracts with Kyivenergo. Acceptance days are all the days in a year and more than 70% of waste collection trucks come into the plant after 8:00 PM.

b) Means to weigh waste

Every waste collection trucks are weighed twice when a truck comes in and goes out by the weighing bridge installed at the entrance of the plant so that the content is calculated. The result is processed using a data processor.

c) Check system for unsuitable waste for incineration

The radioactive ray is checked by the dosimeter for every waste collection trucks when they arrive in the plant since the accident in the Chernobyl Nuclear Power Plant broke out. This check is still being continued up to now but mainly for the purpose of identifying radioactivity in hospital waste.

D) Combustion Control

a) Combustion temperature

The combustion temperature was previously controlled at 800 °C or more, but it is currently changed to 850°C or more.

b) Waste gas control

Although the device installed for waste gas control is only the electrostatic precipitator, the electrostatic precipitator is being improved from two cells to three cells to upgrade dust removal performance. As for the emission standards of contaminants, the Ukrainian emission standard is applied at present, but it is required to comply with stricter emission standard of the EU emission standard 2010 after the year of 2021. The Ukrainian emission standard and the EU emission standard 2010 are shown in Table 3.52.

Table 3.52 Ukrainian Emission Standard and EU Emission Standard 2010

Item	Ukrainian Emission Standard	EU Emission Standard 2010
Dust (mg/Nm^3)	112	10
HCl (mg/Nm^3)	720	10
SO_2 (mg/Nm^3)	120	50
NO_2 (mg/Nm^3)	543	200
Dioxins (ng/Nm^3)	Nil	0.1

Source: JICA Survey Team at Energia Incineration Plant and Official Journal of European Union, Annex XI

E) Energy Utilization

Before 2015, the heat supply was confined only by the big heat consumers around the plant, and only a part of recovered energy was utilized. Approximately 200,000 Gcal of heat supply became possible by installing more heat exchangers and connecting heat pipe to the heat supply network of Kyiv City in 2014 and heat utilization rate was significantly improved. Heat is sold to Kyivenergo at the price of UAH 480/Gcal, the revenue by sale of heat accounts for 67% of the whole revenue and it is used for the maintenance and repair of equipment. A selling price of UAH 480/Gcal is the price for industrial facilities, and revenue can be further increased if a selling price for the consumption of houses would be applied. The recovered heat can be fully utilized during the winter season, but it becomes redundant during the summer season.

F) Ash Discharge

a) Generation of ash

The amount of ash generated is around 30% of the original weight of waste. This value is much higher when compared with the general ash generation rate in Japan, which is around 10% of the original waste weight. It is considered that the waste is not sorted and contains more incombustible matters.

b) Recovery of ferrous matters

A ferrous matter classifier is equipped in the plant and approximately 2,000 tons of ferrous matters are recovered annually. The recovered ferrous matters are taken over by a contractor, but it contributes to only a little to the income generation.

c) Discharge and utilization of ash

Ash is basically transported to Landfill No.5, but approximately 10% of the ash is utilized. Typical usage of ash can be as an alternative material for clay spread under sealing works at the landfill site as well as aggregate spread with the pavement.

G) Maintenance of the Plant

It is becoming difficult to continue plant operations by means of only exchanging parts because of the long-time operation. The works to replace the cranes, the waste feeder, the boiler heat exchange tube, and the modification of dust collectors are on-going at the present moment. As periodical overhauls are not sufficient to properly maintain the equipment, large-scale rehabilitation is being implemented by stopping furnace operation in sequence from furnace No. 4 and then No. 3. The operation of furnace No. 2 was stopped and put under large-scale maintenance works; the works will be completed by the end of 2018. And then, the works for furnace No. 1 started in 2017.

Kyivenergo has developed the strategic improvement program until 2030 so that the plant is possible to continue its operation. This plan was also approved by the Kyiv City Council as part of the strategic program of Kyiv City. Renovation of waste gas treatment system, replacement to chemical treatment system, installation of super heater for steam, and electricity generator whose capacity is 3,000 kW are included in the program. Around or after 2030, the demolition of the existing plant and reconstruction of a new plant with processing capacity of over 260,000 tons per year are now considered.

H) Public Relations

a) Public information

A distribution material such as a booklet is not prepared, but efforts to understand the plant well were found in many pictures posted on the wall. In addition, visitors are positively invited and the plant normally receives about 20 groups of visitors annually but it was reported that the number of visitors already exceeded ten groups by March of this year.

b) Inhabitants relations

In Ukraine, a "sanitary area" is prescribed by law. It is specified that a waste disposal facility including an incineration plant shall be constructed away from any residential area 500 meters or more. Housing estates advanced on the opposite side of the Bylytsya Lake, and therefore, the plant receives some complaints especially regarding foul odor. The staff of the plant usually explains to the residents that the foul odor is caused by a different facility in clear up misunderstandings.

(5) Final Disposal

1) Waste Balance for Disposal

According to statistics during 2016 in Kyiv City, 1.176 million tons of municipal solid waste was generated and removed to transport to the following destinations:

- 256,200 tons (22%) to the incineration plant "Energia";
- 129,400 tons (11%) to stockpiling points for recyclables and solid waste sorting lines; and
- 790,400 tons to landfills and dumping sites: Landfill No.5 and Landfill No.6 received 519,800 tons (44%), the remaining 270,600 tons (23%) were taken to the landfills of Kyiv Oblast (LLC "Desna-2", PP "Eco-Start", ZVPP "Region-2001" and for processing (LLC "Ukrvtorenerhoresurs").

2) Landfill No.5

Landfill No.5, now operated by the PJSC Kyivspetstrans, is located near the village of Pidhirtsi, Obukhiv District, Kyiv Oblast, 15 km to the south of the Kyiv City limits. Designed to accommodate municipal solid waste (MSW) and industrial waste of 3 and 4 classes of danger. Landfill No.5 was constructed in 1986. The total area of the landfill is 63.7 ha and includes two stages with the area for waste disposal, 18.15 ha and 17.6 ha, respectively.

Construction of the first stage of the landfill, with an area of 18.15 ha, was completed in 1986. According to the project, the term of operation of the first stage is 9.1 years. Then, the second stage, with an area of 17.6 ha, was constructed in 1997.

From 1986 to 1997, the first stage received 22 million m3 of waste. To the second stage of the landfill from 1997 to 2006, there were brought 7.5 million m3 of waste.

The landfill was located on a territory with complicated natural, geological and hydrogeological conditions such as: dismemberment of territory by ravines and beams; the development of landslides, the flooding of the bottom of the beam, the phenomenon of erosion and the proximity of settlements.

Considering all the difficulties of the relief, for the first time in Ukraine, the MSW landfill was designed as an engineering facility that included a system of special environmental facilities.

The construction project envisaged the following decisions:

- Use of anti-leachate screen;
- Use of the drainage system;

- Intercepting of surface runoff water; and
- Construction of retaining dams.

Lack of practice at the time of design and construction of similar facilities in Ukraine, applicable rules and regulations and lastly, anti-filtration materials all contributed to the cease of implementation of the full range of all prescribed measures to protect the environment.

The first stage of the project envisaged the leachate collection system, but the question of its purification has not been resolved. The leachate was supposed to be sprayed over the filled part of the landfill but because of the low reliability of the leachate supply system, the system has failed a year after starting the operation.

During the engineering phase of the structures in the second stage of the landfill, the fill was supposed to have a system for collecting leachate as there was a foreseen network for pumping it into a storage device for further purification. During the construction process, it turned out that the construction of concrete rings was a threat and it may break through the polymer-based waterproof screen, and thus the project proposal was not implemented.

Neither on the first nor on the second stage of the landfill were the systems for leachate collection; and purification was implemented in the process of design and construction.

In the operation of the second stage of the landfill, it turned out that the construction of the layered drainage as well as the lack of sufficient control during the construction led to the rupture of the bottom of the waterproofing film. Because of this the underground water, which had to pass under the body of the landfill and then through the dam to the relief, was contaminated with the landfill leachate.

To prevent environmental pollution, the management of the PJSC Kyivspetstrans and JSC Kyiv Project made a joint decision to direct contaminated underground runoff to a pumping station and then pump it to the artificial storage facilities on the first and second stages of the landfill.

Having said this, from the two leachate formation components - precipitation and natural humidity – a third component was added - groundwater.

To increase the capacity of the first stage of the landfill, the Kyivspetstrans ordered the Design Institute JSC Kyiv Project in 1995 to draft the project. After this the JSC RBP Sanita in 1996 performed the construction works on increasing the dam and road construction, making it possible to increase the capacity for receiving waste of the first stage up to 1.5 million m3.

In 1995-1996, there was development in the construction project for the leachate pumping station, which was tasked to pump the leachate into artificial storage facilities within the landfill, but it did not solve the problem of the leachate collection and purification.

From February 1999, the clearing plant company Pall Rochem started to work at the landfill. The capacity is 200 m3 of leachate per day, which form 15% of the concentrate, and is subject to utilization.

For the concentrate, formed after processing, special temporary storage facilities were built. These were made with a screen of HDPE protective film (made in Germany), which is 2.5 mm thick, without sheltering with soil. The film does not lose its properties under the influence of sun and low temperatures. After undergoing the process purified water permeate meets the standards and is ready for discharge into the open body of water, and as for the concentrate, the problem of its disposal has yet to be solved.

Operation of the leachate treatment plant showed that its design capacity from 1999 to 2005 was used on average at only at 39.4%. Thus, the cost of purification of 1 m3 of leachate was UAH 40. After 2005 the plant did not work for several years and now its work is restored.

In 2002, it became clear that the purifying plant Pall Rochem is not productive enough: it could not purify 400,000 m3 of leachate, which the plant generated at that time.

Later Kyiv City State Administration approved its regulation as of 14 July 2005, No. 1262 "On measures to improve environmental, sanitary, and technical condition of the Landfill No. 5 of OJSC Kyivspetstrans."

According to Clause 4 of this regulation, The Head Office of the Communal Services, Main Directorate of Emergency Situations, Office of Environmental Protection, OJSC Kyivspetstrans, OJSC AK Kyivvodokanal, JSC Kyiv Project should jointly work on the known technologies of leachate

purification and suggested the purchase of the equipment from the Italian firm Vomm with a capacity of 400 m^3 per day.

However, the favorable option of technology and equipment is very energy-consuming, which requires the consumption of large amounts of gas and electricity to evaporate the leachate (150 kWh-160 kWh per 1 m^3 of leachate).

The imported Italian equipment were brought in and assembled at Landfill No.5, and at the same time the issue of disposal or recycling of residual sludge remains to be unsolved. They are conducting works on analyzing the composition of condensed liquid as well as the possibility to discharge it to the relief (open body of water).

The works on laying the waste at the landfill are carried out by the following technology:

The disposal platform is divided into working cells for everyday operation. Garbage carried by the trucks are unloaded at the edge of the disposal platform. Then bulldozers and roller-compactors move portions of solid waste to the working cell and is divided into layers of 0.5 to 0.7 m thick by the method of pushing with simultaneous compacting. In this way, working layers that are 2.0 m thick are formed. These layers are then interspersed with several layers of insulating cover soils (clay) with thickness of 0.25 m to 0.30 m. The working cell receives 3,000 m3 to 4,000 m3 of solid waste per day.

Since Landfill No.5 is dangerous to the environment, in 1993 they started a monitoring system for the quality of the groundwater.

Figure 3.24 shows several photos of Landfill No.5, taken by the JICA Survey Team on 8 March 2018.

Entrance of Landfill No.5

Truck scale building and waste collection truck

Distant view of landfill area

Municipal solid waste disposed of at the landfill

Leachate purifying facility by Pall Rochem operated since 1999

Leachate purifying facility by Vomm [never operated]

Source: JICA Survey Team (March 2018)

Figure 3.24 Scenery of Landfill No.5

Currently, PJSC Ukrvodproekt is developing the project reconstruction and technical re-equipment of the Landfill No.5 in the village Pidhirtsi, Obukhiv District, Kyiv Region, which also envisages the increase of dams of the first and second stages of the landfill as well as increasing their landfill capacity.

Upon such plan, there is necessary preparatory work according to which the term of operations of the Landfill No.5 will be extended until the introduction of the new waste processing facilities.

Then, it should be drafted and put into operation of the third stage of the landfill. At the landfill, there must be built a modern sorting-processing complex for deep processing of municipal waste (50%-70%), so that the third stage of the landfill would accommodate only non-recyclable remains which are inert to the surrounding environment.

On the other hand, however, according to the Department of Communal Services, it was approved by the City Council that Landfill No.5 shall be closed by October 2018 due to the resistance from the surrounding people, this might be realistically impossible.

3) Landfill of Construction Waste

Landfill No.6 operated by PJSC Kyivspetstrans is accepting the construction waste and bulk waste which is non-hazardous and non-organic. This landfill started its operation in 1999 with the area of 11 ha. At present, approximately 100,000 tons to 150,000 tons of such wastes are disposed of at this landfill. As this landfill is not equipped with a track scale, the waste amount is measured only by volume. It also does not equip any crushing machines, therefore, large waste is crushed by the heavy equipment such as the bulldozer or excavator.

This landfill is almost full or overflowed beyond its capacity and will stop accepting wastes in the near future. Figure 3.25 shows the photos of Landfill No.6, taken by the JICA Survey Team on 8 March 2018.

Distant views of Landfill No6.

Waste acceptance and control administration building

Source: JICA Survey Team (March 2018)

Figure 3.25 Scenery of Landfill No.6

Another landfill for construction waste is LLC Rekultyvatsia, located in the village of Horenka, Kyiv-Sviatoshynsky District, at a distance of up to 10 km from Kyiv and 7 km from Hostomel checkpoint. The landfill is located on the territory of the exhaust quarry of Irpin Clay Brick Plant.

The landfill is operated according to the approved working project for accepting certain waste in specified quantities. The main task of the landfill is the reclamation of lands disrupted by the quarry.

The landfill was commissioned in 2005. The total area of the landfill is 8 ha while the area for waste disposal is 7.8 ha. The design capacity of the landfill is 4 million m3. Since the start of operation, the landfill has accepted 2.9 million m3 of bulk waste and construction waste.

At the landfill there is a checkpoint, equipped with a modern system of monitoring and accounting of vehicles arriving at the landfill. Work at the landfill is controlled by a dispatcher from their workplace in the office of the company.

The landfill is equipped with the necessary machineries, namely: bulldozer T-130 - 2 units; front-loader TO-30 - 1 pc; watering machine PM-130 - 1 pc, and truck ZIL – 1 pc.

According to the scheme of sanitation of Kyiv, the landfill should continue its operation for the entire billing period of Scheme (2026). It should be noted that they should put into operation a second stage of the landfill and there also should be a facility for processing construction and bulk waste.

4) Other Landfills for Waste Transported from Kyiv

LLC Desna-2 (Brovary District, Rozhivka Village) - area is 5.15 ha, year of establishment is 1967, annually they accommodate 60,000 tons, and the degree of filling is 98%.

PP Eco-Start (Brovary District, Rozhivka Village) - area is 6.03 ha., annually they accommodate 47,920 tons, and the degree of filling is 34%.

ZVPP Region-2001 (Brovary District, V.Dymerka Town Settlement) - area is 11.35 ha. The amount of accumulated waste is more than 300,000 tons.

(6) Financial Matters

1) Waste Collection and Disposal Fee

Tariffs for municipal solid waste collection and disposal in Kyiv City are stipulated by Kyiv City State Administration Resolutions No. 665 and No. 666 as of 6 February 2017 as shown in Table 3.53 and Table 3.54.

The tariff includes the fee for waste collection and treatment service as well as the fee for waste treatment at Energia Incineration Plant and disposal fee at Landfills No. 5 and No. 6. The waste generators, whose municipal and bulky wastes are being collected by Kyivkomunservis, are being charged by the tariff shown in Table 3.53 and the other waste generators, whose municipal and bulky wastes are collected, are being charged by the tariff shown in Table 3.54 depending on their service provider.

The waste generation rate of households is set at 2.1 m^3/person/year; therefore, it is calculated that residents in Kyiv City pay UAH 156/year (= 2.1 * 74.45) for waste collection and disposal service. Besides, as it is stipulated that the bulk density of municipal solid waste is 5 m^3/t, it is also calculated that the municipal waste collection and disposal cost per unit ton for residents is UAH 372/t (= 74.45 * 5).

Table 3.53 Tariff for Municipal Solid Waste Collection and Disposal by Kyivkomunservis

Unit: UAH/m^3

Category of Waste Generator	Tariff for Municipal Waste and Bulky Waste
Residents	74.45
Public institutions	79.84
Other waste generators	92.78

Source: Kyiv City State Administration (2017) "Resolution No. 666 to change tariff for the services of municipal solid waste removal including activities of municipal waste management provided by public utility company `Kyivkomunservis` as a service provider

Table 3.54 Tariff for Municipal Solid Waste Collection and Disposal by Service Providers

Unit: UAH/m^3

Waste Collection Service Provider	Residents	Public Institutions	Other Waste Generators
Firm Altfater Kyiv	70.63	76.37	90.64
Motor transport enterprise of Shevchenkivskyi district	68.80	72.23	85.40
Kramar Recycling	69.72	73.98	91.60
Celtic	70.08	77.03	92.56
Spetskomuntekhnika	69.54	76.85	91.27
Kyivspetstrans	73.62	77.94	95.22
Firm Volodar-Roz	71.34	73.08	87.00
Kramar Eco	69.79	75.13	92.50
Celtic LLC	67.54	70.27	96.84

Source: Kyiv City State Administration (2017) "Resolution No. 665 to set tariff for the services of municipal waste removal including activities of municipal waste management

Multi-residential apartments in Kyiv City are managed by the 'Housing Management Sections (ZHEK)' belonging to the communal enterprise named 'Housing Maintenance and Management Company.' ZHEK provides housing utility service such as cleaning of apartments, maintenance and repair of building, heating system, and water supply system. ZHEK monthly collects utility service fee from residents which includes municipal waste management fee and the collected fee is transferred to the communal enterprise named 'Main Information Calculation Center (GIOC)'. Then, based on reports from Kyivkomunservis on amount of collected waste by each waste collection service provider, GIOC transfers the waste management fee to Kyivkomunservis and the waste collection service providers in accordance with their contracts. The waste collection service providers need to pay waste disposal fee at Landfill No. 5 or Energia Incineration Plant directly.

The treatment and disposal fee charged by the waste treatment and disposal facilities to the waste collection service providers in Kyiv City is summarized as shown in Table 3.55.

Table 3.55 Fee for Solid Waste Treatment and Disposal in Kyiv City

Waste Treatment and Disposal Facility	Type of Waste	Treatment and Disposal Fee
Landfill No. 5	Municipal waste	UAH 66.6/t
	Industrial waste	UAH 106.32/t
Landfill No. 6	Bulky waste	UAH 12/m^3
	Construction waste	UAH 78/m^3
Energia Incineration Plant	Non-hazardous municipal waste	UAH 87/t

Source: JICA Survey Team based on interviews with the concerned organizations

2) Budget and expenditure of the organizations related to MSWM

According to KCSA, the governmental budget for MSW management (approx. UAH 120 million in 2017) is not used for any transportation and disposal cost, which is basically used for capital expenditure and/or investment such as upgrading of exhaust gas control system in the Energia Incineration Plant, and on the purchase of new heavy machines, etc.

Removal tariffs collected from the citizens are solely used for transportation and disposal activities of transportation companies as well as for the disposal site operating company under the control of KCSA through the Communal Enterprise "Kyivkomunservis".

The details of the annual expenditures in the past three years were not obtained from KCSA during the survey period; however, the JICA Survey Team tried to analyze the following three related organizations' financial information which could be obtained from open data sources.

A) CE "Kyivkomunservis"

The general information of the company is sorted in Table 3.56. CE "Kyivkomunservis" was established according to the resolution of the Kyiv City Council in 15 July 2004. The company's objective is to develop the system of waste management in Kyiv – including preventing and reducing wastes, collection, transportation, storage, processing, recycling and removal, neutralization and conservation, and other services such as providing sanitary containers and agricultural services. In 2010, Kyiv City Council assigned CE "Kyivkomunservis" to be responsible for the removal of consumer wastes in Kyiv, with its obligations to:

- Provide timely and sufficient wastes removal to the established recycling sites,
- Conduct tenders to assign contractors for waste transportation,
- Coordination and control of activity of waste transportation companies,
- Implementation of the separate consumer waste collection.

Table 3.56 General Information of CE "Kyivkomunservis"

Name	**CE "Kyivkomunservis"** **Full name**: Municipal enterprise of the executive body of the Kyiv City Council (Kyiv City State Administration) "Kyivkomunservis"
Reg. No.	33745659
Authorized Capital	UAH 14,199,497.93
Paid-in Capital	UAH 6,930,000.00
Type of Company	Municipal entity
Shareholder(s) with %	Kyiv City State Administration (100%)
Year Started	2005 (legally registered on 13 September 2005)
Address	Kudryavska Str., 23, Kyiv, Ukraine
No. of Director(s)	1 Director
Employees	57 (as of 1 January 2018)
Website	http://kks.kiev.ua

Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 10 May 2018)

The income statement in the past three years and plan for this year of the company are shown in Table 3.57 and balance sheet as of 1 January 2018 is shown in Table 3.58. The following are found based on these:

- Principally, sales revenue accounts for UAH 221.6 million in 2017. This figure is assumed approx. 41.0% of total removal tariff of MSW for residents calculated as below:
  Estimated MSW generation in Kyiv City: 1,456 thousand t/year,
  Removal MSW tariff for residents: UAH 372/t (UAH 74.45/m3 * 5 m3/t),
  then, UAH 541.6 million/year is considered as the tariff from residents, annual sales of Kyivkomunservis, UAH 221.6 million/year is 41.0%.
- As for the cost side, the account of "other operating expenses" within the cost of sales is disproportionally high (over 95%), this is deemed as outsourcing to the subcontractors but no further details are currently available. As a rule, "other expenses" is applied for

unclassified residual costs, but in this case, "other expenses" comprise major item of cost of sales,

- Considering the balance of revenue and cost (gross profit), two years of the past three years made deficits and the 2018 plan also expects deficit of approx. UAH -12.3 million. In these years, to make up for this deficit, governmental subsidies were paid which are UAH 60.1 million in 2016 and UAH 25.9 million for the 2018 plan.
- As a tentative conclusion, removal tariff revenue is not enough for the subcontracted expenses and the generated loss is covered by the subsidy from the city government.

Table 3.57 Profit and Loss Statement of CE "Kyivkomunservis"

Unit: UAH

Financial Items	FY2015	FY2016	FY2017	FY2018 (Plan)
Sales revenue	136,985,000	161,285,000	221,561,000	244,690,000
Cost of sales	-178,153,000	-205,271,000	-218,144,000	-256,978,400
Material costs	-220,000	-487,700	-1,042,600	-3,218,000
Payroll	-1,518,900	-2,016,300	-3,145,700	-4,088,000
Deductions for social events	-555,300	-438,800	-670,800	-899,400
Depreciation	-479,700	-679,300	-1,620,900	-10,051,100
Other operating expenses	-175,379,100	-201,648,900	-211,664,000	-238,721,900
Gross profit	-41,168,000	-43,986,000	3,417,000	-12,288,400
Other income	48,417,000	60,183,000	5,583,000	25,900,200
Including grants and subsidies	46,523,700	58,559,200	-	17,365,800
Complementary assets	1,722,500	731,300	174,900	8,534,400
Other expenses	-6,677,000	-15,437,000	-7,586,000	-12,786,200
Profit (loss) before tax	572,000	760,000	1,414,000	825,600
Income tax	-102,000	-140,000	-440,000	-148,600
Net profit	470,000	620,000	974,000	677,000

Source: JICA Survey Team based on Statement on Completion of the Annual Financial Plan 2017, 2016, 2015 and Financial Plan for 2018

Table 3.58 Balance Sheet of CE "Kyivkomunservis" (as of 1 January 2018)

Assets			Liabilities		
Current Assets	**UAH**	**USD***	**Current Liabilities**	**UAH**	**USD**
Cash	1,411,000	50,272	Accounts Payable - suppliers	56,928,000	2,028,273
Accounts Receivable	53,346,000	1,900,651	Accounts Payable - fiscal payments	273,000	9,727
Accounts Receivable - Profit Tax	7,889,000	281,075	Advances Received	5,212,000	185,697
Inventory	415,000	14,786	Accrued Income	24,299,000	865,743
Other Current Assets	20,400,000	726,826	Other Current Liabilities	6,298,000	224,390
Total Current Assets	83,461,000	2,973,611	Total Current Liabilities	93,010,000	3,313,830
Fixed Assets	**UAH**	**USD**	**Long-term Liabilities**	**UAH**	**USD**
Fixture and Equipment	22,785,000	811,801	Long-term Debt	-	-
Construction in Progress	90,641,000	3,229,425	Targeted Financing	99,796,000	3,555,606
Other Non-Current Assets	160,000	5,701	Total Long-term Liabilities	99,796,000	3,555,606
			Shareholders' Equity	**UAH**	**USD**
			Common Stock, Additional Paid-in Capital	6,930,000	246,907
Total Fixed Assets	113,586,000	4,046,927	Retained Earnings	-2,689,000	-95,806
Total Assets	197,047,000	7,020,538	Total Liabilities and Equity	197,047,000	7,020,538

Note: Translation to USD is made for reference based on the year-end exchange rate of USD/UAH = 28.0
Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 10 May 2018)

B) PJSC "Kyivspetstrans"

The general information of the company is sorted in Table 3.59. PJSC "Kyivspetstrans" is the successor of the Open Joint-Stock Company "Kyivspetstrans", and before that, the Communal Enterprise for sanitary clean-up of Kyiv "Kyivspetstrans" (the same entity, but the legal type changed a couple of times).

The company's activity is providing services for the removal of solid waste and domestic waste management (collection, transportation, disposal). The company is managing the main landfill of Kyiv – Landfill No. 5 in Pidhirtsi. In its area of 63.7 hectares, there is more than 10 million tons of municipal waste and the height of the garbage layer has already reached 90 m.

The supreme body of the company is the General Meeting of Shareholders, which elects the governing bodies, the Supervisory Board (five persons), and the Revision Committee (three persons). The Supervisory Board elects an executive body - the Board of Directors (five persons).

Table 3.59 General Information of CE "Kyivspetstrans"

Name	**PJSC "Kyivspetstrans"** **Full name**: Private Joint Stock Company "Kyivspetstrans"
Reg. No.	02772037
Authorized Capital	UAH 28,422,960
Paid-in Capital	UAH 31,585,000
Type of Company	Private Joint Stock Company
Shareholder(s) with %	Kyiv City Council (Department of the municipal property) – **51.00%** LLC "Target Trade" (reg. no. 36592818) - **46.83%** Other (individuals) – **2.17%**
Year Started	1997 (registered on 21 May 1997)
Address	Pravdy Ave., 85, Kyiv, Ukraine
No. of Director(s)	1 Chair of the Board 4 Board members
Employees	271
Website	http://www.kst.in.ua/ https://smida.gov.ua/db/participant/02772037

Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 10 May 2018), and Portal of the Agency for the development of stock market infrastructure of Ukraine – (smida.gov.ua/, as of 30 May 2018)

Income statements in the past three years of the company are shown in Table 3.60 and balance sheet as of 31 December 2017 is shown in Table 3.61. Findings are as follows:

- According to the income statements in the past three years, percentages of gross profit on sales are 2 to 6% in black; however, after deduction of administrative cost and other expenses, FY2015 and FY2016 fell into deficit even if other income (most probably some kind of subsidy amounting to approx. UAH 10 million.) is provided. Only in FY2017 did the net profit turn into black.
- According to the independent auditor's opinion for financial statement of the company in 2017, the uncovered loss amounted to UAH 99.5 million, and current liabilities of the company exceed current assets by UAH 27.6 million. These circumstances indicate the existence of significant uncertainty, which may cast serious doubt on the ability of the company to continue its activities on a going concern basis,
- These facts are not considered as reasonable in general for the private company; however, considering that 51% of equity is held by KCSA, the company is deemed as semi-public company.

Table 3.60 Profit and Loss Statement of CE "Kyivspetstrans"

Unit: UAH

Financial Items	FY2015	FY2016	FY2017
Sales revenue	72,839,000	82,199,000	95,180,000
Cost of sales	-71,177,000	-76,678,000	-89,546,000
Gross profit	1,662,000	5,521,000	5,634,000
Administrative expenses	-7,920,000	-8,806,000	-8,771,000
Other income	13,547,000	10,753,000	14,123,000
Other expenses	-9,632,000	-15,671,000	-9,910,000
Profit (loss) before tax	-2,343,000	-8,203,000	1,076,000
Income tax	-	-	-
Net profit	-2,343,000	-8,203,000	1,076,000

Note: Translation to USD is made for reference based on the year-end exchange rate of USD/UAH = 28.0
Source: JICA Survey Team based on Statement on Completion of the Annual Financial Plan 2017, 2016, 2015 and Financial Plan for 2018

Table 3.61 Balance Sheet of CE "Kyivspetstrans" (as of 31 December 2017)

Assets			Liabilities		
Current Assets	**UAH**	**USD***	**Current Liabilities**	**UAH**	**USD**
Cash	1,816,000	64,702	Accounts Payable - suppliers	12,566,000	447,711
Accounts Receivable	25,130,000	895,350	Accounts Payable - fiscal payments	24,636,000	877,750
Inventory	4,749,000	169,201	Liability (- 1 year)	0	0
Other Current Assets	4,769,000	169,913	Other Current Liabilities	26,859,000	956,953
Total Current Assets	**36,464,000**	**1,299,167**	**Total Current Liabilities**	**64,061,000**	**2,282,413**
Fixed Assets	**UAH**	**USD**	**Long-term Liabilities**	**UAH**	**USD**
Fixture and Equipment	174,460,000	6,215,791	Long-term Debt	0	0
Intangible Assets	3,238,000	115,366	Long-term Target Financing	107,840,000	3,842,204
Other Non-Current Assets	26,000	926	**Total Long-term Liabilities**	**107,840,000**	**3,842,204**
			Shareholders' Equity	UAH	USD
			Common Stock, Additional Paid-in Capital	31,585,000	1,125,334
			Revaluation reserve	110,250,000	3,928,069
Total Fixed Assets	177,724,000	6,332,084	Retained Earnings	-99,548,000	-3,546,771
Total Assets	**214,188,000**	**7,631,250**	**Total Liabilities and Equity**	**214,188,000**	**7,631,250**

Note: Translation to USD is made for reference based on the year-end exchange rate USD/UAH = 28.0
Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 30 May 2018)

C) PJSC "Kyivenergo" and "Energia Incineration Plant"

PJSC Kyivenergo is one of the subsidiaries of the energy giant company in Ukraine "DTEK." In the past, the National Joint Stock Company "Energy Company of Ukraine" held 25% of Kyivenergo share but recently, all have been transferred to DTEK. Kyivenergo had owned and operated two Combined Heat and Power Plants (CHP5 and 6), distribution network of heat and electricity, a waste incinerator "Energia", which is the only one existing in Ukraine. The number of employees of the Kyivenergo is more than 12 thousand people. The company was selling electricity and heat to end users, corporate, and individuals by end of July 2018.

The decision 517/4581 of Kyiv City Council dated 24 April 2018 terminated the management contract of Kyiv City complex (comprising of the abovementioned heat and electrical generators and networks) between Kyiv City and Kyivenergo. All of the assets related to heat supply were transferred to the Communal Enterprise "Kyivteploenergo" including heat distribution network in Kyiv City, which are CHP5, CHP6, and Energia Incineration Plant. Asset related to the electricity supply, which is mostly

energy grid, was transferred to another DTEK subsidiary PJSC “Kyiv Electrical Network” and finally PJSC “Kyivenergo” will be liquidated in the near future.

As of May 2018, Energia Incineration Plant is still under the said restructuring. Therefore, it was difficult to obtain any formal financial data of the “stand-alone” Energia Incineration Plant. However, the JICA Survey Team has tried to sort out “assumed profit and loss statement” of Energia Incineration Plant as shown in Table 3.62 based on information gathered in this study for revenue side and Japanese similar example with adjustment for cost side.

Revenue consists of processing tariff in Energia incineration and sales of heat, whose total amount is calculated at UAH 138.0 million. On the other hand, total cost is estimated at UAH 103.2 million; then, gross profit will be approximately UAH 34.8 million. Based on this assumption, the Energia Incineration Plant can be self-supporting without any governmental subsidy and increase of processing tariff at this moment.

Table 3.62 Profit and Loss Statement of “Energia” Assumed by the JICA Survey Team

Revenue		UAH	In JPY	Remarks
	Tariff for "Processing"	22,620,000	90,480,000	Tariff UAH 87/t x 250,000 t/year
	Sales of Heat	115,320,000	461,280,000	UAH 576.6/Gcal x 200,000 Gcal/year
	Total	137,940,000	551,760,000	
Cost		**UAH**	**In JPY**	**Remarks**
	Labor Cost	16,513,200	66,052,800	180 employees x UAH 92,000/head/year
	Utilities (Water, Elec., etc.)	23,443,140	93,772,560	Adjusted from Japanese case (70%)
	Consumables	21,638,505	86,554,020	Adjusted from Japanese case (70%)
	Maintenance	19,416,106	77,664,423	Adjusted based on Ukrainian labor cost
	Ash Disposal	970,500	3,882,000	UAH 12.94 x 75,000 t/year
	Others (Monitoring, etc.)	21,175,945	84,703,780	Adjusted from Japanese case (70%)
	Total	103,157,396	412,629,583	
Gross Profit (Loss)		**34,782,604**	**139,130,418**	

Note: Tariffs specified in this table are VAT included (20%)
Note: UAH 1 is equivalent to JPY 4 in this table.
Source: JICA Survey Team based on interview survey and information gathered from open data sources.

D) CE “Kyivteploenergo”

The company CE “Kyivteploenergo” started its operations in June 2016. The company was established by the Kyiv City State Administration to replace PJSC “Kyivenergo” and became the major supplier of heat and hot water in Kyiv. It is planned that transfer of all assets, including Energia Incineration Plant from PJSC “Kyivenergo” to CE “Kyivteploenergo” will be completed by 31 July 2018.

On 22 March 2018, Kyiv City State Administration approved the increase of statutory capital of CE “Kyivteploenergo” by UAH 1.2 billion. This was done to enable successful transfer of assets from PJSC “Kyivenergo” and start preparation for the next heating season.

As of end of April 2018, PJSC “Kyivenergo” completed the first stage of communal property transfer and transfer of personnel to CE "Kyivteploenergo". As a result of the transfer, CE "Kyivteploenergo" will inherit all debts and uncollected receivables of PJSC “Kyivenergo.”

Table 3.63 shows the general information of CE “Kyivteploenergo”. Financial statements including income statement in 2017, plan for 2018, and balance sheet as of 01 January 2018 are available at the open resource website but are not mentioned here because they are now at the transition phase.

Table 3.63 General Information of CE "Kyivteploenergo"

Name	**CE "Kyivteploenergo"** ***Full name**: Municipal enterprise of the executive body of the Kyiv City Council (Kyiv City State Administration) "Kyivteploenergo"*
Reg. No.	**40538421**
Authorized Capital	UAH 5,000
Paid-in Capital	UAH 132,865,000
Type of Company	Municipal commercial entity
Shareholder(s) with %	Kyiv City Council – 100%
Year Started	2016 (legally registered on 06 June 2016)
Address	Velyka Zhytomyrska Str., 15A, Kyiv, Ukraine
No. of Director(s)	Temporarily Acting Director Director till 24 April 2018
Employees	247 (*as of 1 January 2018)*
Website	http://www.kte.kiev.ua/

Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 10 May 2018), and Portal of the Agency for the development of stock market infrastructure of Ukraine – (smida.gov.ua/, as of 30 May 2018)

(7) Private Sector and Informal Sector

As described in the previous sections, involvement of the private sector in municipal solid waste management in Kyiv City is observed in the fields of collection and transportation, intermediate treatment and recycling and final disposal.

As for the collection and transportation field, actual implementation of municipal waste collection and transportation services is entrusted to KKS and performed by the seven service providers including Kyivspetstrans, which is a public private joint stock company, and four private companies.

As for intermediate treatment, Energia Incineration Plant is operated by a public private joint stock company Kyivenergo but a communal enterprise named Kyivteploenergo will take over the operation of the Energia Waste Treatment Plant in near future.

As for the recycling field, some private companies are operating waste sorting and material recovery facilities as well as recyclable material collection points set-up by private company.

As for the final disposal field, the public private joint stock company Kyivspetstrans operates Landfill No.5 which receives the city's municipal solid waste as well as Landfill No.6, which in turn receives the construction and bulk waste generated in the city.

There is little information on the informal sector's activity on solid waste management in Kyiv City. Waste pickers are not observed in Landfill No.5 and No.6 when the JICA Survey Team firstly visited these facilities in the winter but it might be because of snowing. However, some recyclables collecting activity by waste pickers at the landfill was observed when the JICA Study Team visited to Landfill No. 5 for conducting the waste composition survey in May 2018. It is assumed that there may be informal recyclable collectors and traders in the city as there are several recyclable sorting facilities and recyclable material collection points in operation.

(8) Environmental Education and Public Awareness

The Public Relation Department of KKS is implementing environmental education and awareness raising activities focused on solid waste management issues. KKS initiated an environmental education and awareness raising project named "Choose Clean Future" from 2012 up to the present. The project conducted awareness raising projects on the importance of waste segregation and recycling, adequate management of hazardous wastes and so on by preparing education tools such as pamphlets and coloring books. KKS also provides lectures on waste management in universities. One of the popular activities is the Waste Art Competition and around 1,000 students participate annually. Some examples of the tools for awareness raising activities developed by KKS are shown in Figure 3.26.

Pamphlet on waste handling manner and recycling

Coloring book for pupils

Poster on Waste Art Competition

Awarded works of Waste Art Competition

Source: Kyivkomunservis

Figure 3.26 Tools for Awareness Raising Activities Developed by KKS

KKS has a limited budget on environmental education and awareness raising activities, which is about UAH 20,000 per year. Therefore, KKS is organizing awareness raising activities by coordinating and collaborating with public institutions in the education sector, waste collection service providers and environmental NGOs. So far, KKS has collaborated with environmental NGOs such as 'Ukraine Without Waste', 'Chysto Vyshgorod (Clean Vyshgorod City)', 'Zelenyi Ptakh (Green Bird)' and 'Druhe Zhyttja (Second Life)'. These NGOs are periodically holding promotions highlighting in the media about the prevention of environmental pollution with municipal wastes as well as the need for recycling and its utilization.

(9) Public Opinions on Waste Management including Incineration

Municipal waste management is indispensable, imminent administrative service for inhabitants. Wastes, however are mainly abandoned, and are deemed unnecessary, but the inhabitants don't want them to be located nearby. In light of this, inhabitants recognize the necessity of the removal and disposal of wastes; however, they do not want the waste disposal facilities to be located nearby. Inhabitants often complaint and/or protest against construction and operation of waste disposal facilities in their neighborhood.

1) Situations on landfill site

This happens in many cities in the world and Kyiv City is no exception. There is one incineration plant in Kyiv City, which is actually the only incineration plant in Ukraine, and its capacity is approximately 250,000 tons of municipal waste per year. Two thirds of the municipal waste generated in Kyiv City is buried in Landfill No.5.

Landfill No.5 receives various complaints on the concentration of waste to the site, odor, possibility of public water and ground water contamination, health uneasiness, etc. In 2016, an incident occurred where residents did not let waste trucks transport waste from Kyiv City to the landfill site. Some parts

of the environmental tax is rewarded to the area where the landfill site is located to minimize environmental damage and relax the situation. But this does not bring a fundamental solution and is not a countermeasure in cancelling the dissatisfaction of inhabitants. Occasionally some wastes were transported to unauthorized places for dumping in Kyiv Oblast Region. Since this is making the local inhabitants nervous, it is recognized that time has come to find an alternative solution to Landfill No.5 urgently.

2) Situations on creating waste incineration plants

The Kyiv City State Administration approved the program of economic and social development of Kyiv in 2017. They decided to build three waste treatment plants in the city and in the village. This can be an effective solution to reduce the wastes carried into the landfill site. However, once the citizens knew it, some citizens developed signature activity showing the negative information as shown in Figure 3.27, collected signatures of 10 thousand citizens or more, and submitted their demand to the city council. The city council accepted their demand.

The Energia Incineration Plant is the waste treatment facility which is now actually in operation. It was clarified that numerous number of complaints are sent to the plant. Although sanitary area is prescribed by a law, housing estates advance on the opposite side of Bylytsya Lake as Figure 3.27, and the plant receives the complaints such as bad smell. Although the true cause is not Energia itself, inhabitants living relatively near the plant do not always have a favorable image to the waste incineration plant.

This hints that inhabitants easily follow the insistence of activists, and involve the possibility to easily take objection to the construction project of a new waste incineration plant. In addition to the environmental education to citizens, efforts to improve the present facility, Energia, to an environmentally friendly facility as well as the showcasing of the result to the inhabitants will be required to smoothly proceed with the facility construction projects.

Photograph placed in the petition
Source: Zrada Today "Do we need 3 incinerators?"

Housing estates nearby Energia Incineration Plant
Source: JICA Survey Team

Figure 3.27 Situations on Creating Waste Incineration Plant

3.2.6 Waste Management Plan and Project in Kyiv City

(1) Waste Management Master Plan

The fundamental solid waste management plan of Kyiv City is the Order of the Kyiv City State Administration as of 10 February 2014, “On Approval of Sanitary Cleaning Scheme” and the Decision of Kyiv City State Administration as of 17 March 2016, “On Approval of Complex Target Program of Energy Efficiency and Development of Housing and Communal Infrastructure of Kyiv in 2016 - 2020 and Measures for its Implementation.”

Based on these orders and decisions, the action plan on solid waste management in Kyiv City for 2017-2025 is developed. These are summarized in Table 3.64.

The Kyiv City State Administration aims to rehabilitate Landfill No.5 by 2021 (Projects No.1~4) as well as Landfill No.6 by 2019 (Project No.5), in order to ease the environmental risk in the surrounding area. As for the Energia Incineration Plant, installation of an exhaust gas treatment system (Project No.6) by 2019 and reconstruction of the plant with electricity generation facilities by 2021 (Project

No.7) are scheduled. Besides, the development of a new waste treatment complex with recycling, landfilling facilities as well as a waste to energy facility is planned by 2025 (Project Nos.8~9).

As for the soft components, examination and application of appropriate waste management tariff system for waste generators (Project No.10) and introduction of segregated waste collection system (Project No.11) are currently under promotion.

Table 3.64 Action Plan for 2017 - 2025 Years in the Field of Waste Management in Kyiv City

No.	Project	Implementer	Deadline
1	Registration of lease relations regarding land use on which Landfill No.5 is located	Kyivspetstrans and Pidhirtsi Village Council	2017
2	Reconstruction of Landfill No.5 to ensure its closure and subsequent reclamation	Determined in accordance with the orders of the Kyiv City State Administration	2017-2021
3	Reclamation of Landfill No.5		
4	Providing after reclamation maintenance of Landfill No.5		Constantly
5	Reconstruction and reclamation of Landfill No.6		2019
6	Rehabilitation of Energia Incineration Plant in terms of flue gas cleaning system		2017-2019
7	Reconstruction of Energia Incineration Plant with facilities for electricity generation		2018-2021
8	Creating a system of complexes (plants) for processing of solid waste, including landfills for disposal of recycled or treated waste (if necessary)		2018-2025
9	Construction of additional capacities/ facilities for the generation of heat and electricity that run on alternative fuel from waste		2020-2025
10	Installing and review (if necessary, at least once every three months) the economically justified tariffs for municipal waste removal in Kyiv under the current legislation of Ukraine.	The executive body of the Kyiv State Administration, entities in the field of waste management	Constantly
11	Development of separate waste collection, including increasing the number of appropriate containers and vehicles		Constantly

Source: Kyiv City State Administration (2017) "Decision on December 14, 2017 N 697/3704 on some issues regarding the treatment municipal waste in the city of Kyiv"

(2) Facility Development Plan and Project

As mentioned in the previous section, it is understood that the rehabilitation of Landfill No.5 and Landfill No.6 are the most urgent facility development plan and project in the waste management sector in Kyiv City. In parallel, the city aims to improve the exhaust gas treatment facility of Energia Incineration Plant so as to comply with EU environmental standards. Attention should be paid on the fact that the Kyiv City State Administration has a plan to reconstruct the Energia Incineration Plant in the near future by equipping it with electricity generation facilities. A new waste treatment complex with recycling, landfilling facilities as well as waste to energy facility is planned to be constructed by 2025, which is assumed to be an alternative waste treatment facility after closure of Landfill No.5 and No.6.

(3) Improvement Plan of Energia Incineration Plant

More than 30 years have passed since the Energia Incineration Plant started its operation. As the deterioration of equipment in the plant continues, various equipment and parts of the equipment reach their physical service life. Replacing them completely is necessary but it is insufficiently performed and is only repaired by through the exchange of parts. The technology used for equipment becomes old and mediocritized. In addition, the procurement of spare parts becomes more difficult in time. Operation conditions, particularly the condition of pollution control has been changed and it is now required to comply with EU standards.

As for the physical service life, the crane buckets have been updated multiple times. More than 80% of the heat exchange tubes of the boiler have been replaced. In fact, regular maintenance works become insufficient and long-term maintenance works in which the operation of one furnace has stopped. As a result, the amount of waste incinerated remains at around 260,000 tons per year while the maximum incinerating capacity is 525,600 tons per year.

Design and technologies used for the equipment are obviously old. The operation staff is required to manually operate the plant. Some of the spare parts are no longer manufactured and it becomes increasingly difficult to find engineers and technicians to maintain such old equipment. Some old equipment was replaced to avoid inconvenience in maintenance and to upgrade efficiency. These maintenance works are economically disadvantageous.

In these 30 years, the society has been greatly changed, and the changes about environmental regulation are remarkable. As the plant is only equipped with an electrostatic precipitator, comprehensive improvement of the exhaust gas treatment facility including the acidy components in exhaust gas such as HCl, SO_X and NO_X removal is necessary. Dioxins control shall also be equipped.

The present waste management of Kyiv City is based on “Scheme of Sanitary Cleaning, 10.02.2014”. In the scheme, the reduction of 400 t/day of waste by introducing a waste processing facility is included. This is supported by the approval of the municipal assembly about closing the Landfill No.5 in October 2018. Thus, the plant plays quite an important role.

It is demanded that Kyiv City continue the plant operation for 15 years or more. Actual equipment remodeling includes the following measures, and these measures are being proposed by European companies.

- Replacement of weighing machine from mechanical-type to electric-type and adoption of barcode system for recognition of waste collection vehicles coming into the plant.
- Adoption of hydraulic-type crane bucket
- Improvement of Exhaust gas treatment system

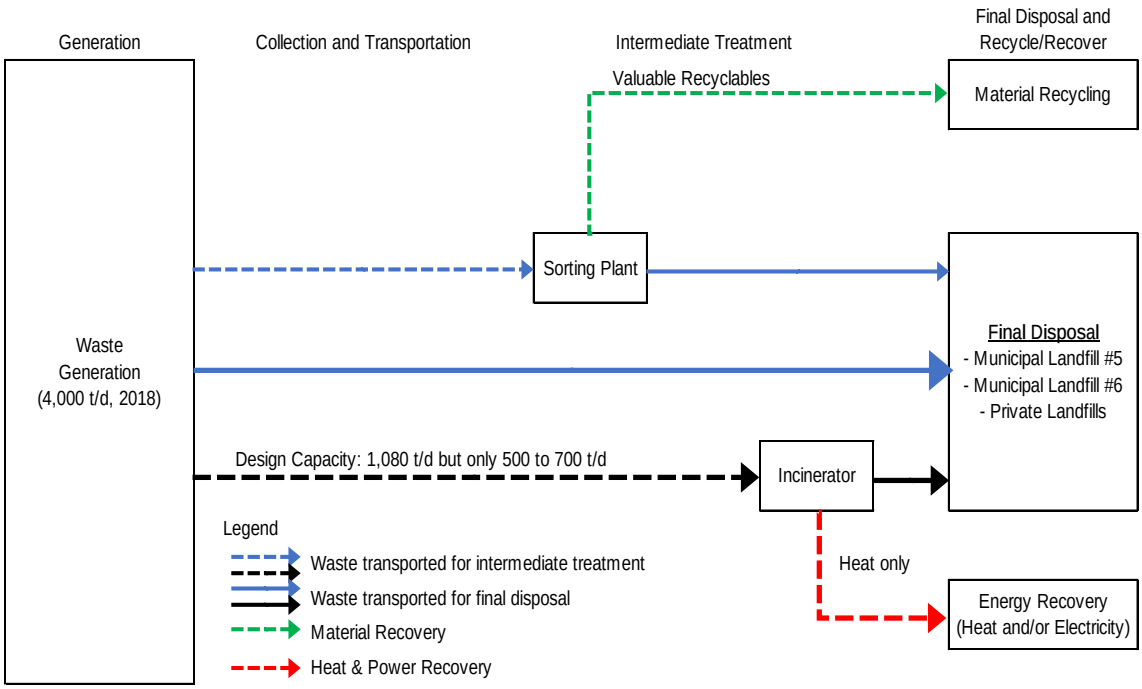
Improvement of the exhaust gas treatment system is an urgent task as the emission standards of exhaust gas is required to comply with the EU emission standard by 2022. The documents for making the contract are already prepared, and a bid is scheduled in 2019. As this project is an environmental measure, and the interest of private investors is low, the project is going to be carried out as a public work with the budget of approximately UAH 300 million.

As previously mentioned, Kyivenergo also proposes the installation of power generation system with 3,000 kW turbine after the improvement of the exhaust gas treatment system in their strategic program up to 2030. In addition, Kyivenergo considers the replacement of the existing Energia Incineration Plant with a new plant with a total capacity of more than 260,000 tons per year with two furnaces.

3.2.7 Current Issues on Waste Management in Kyiv City

Considering the current overall situations of Kyiv City, in general, it could be said that the Kyiv City State Administration makes its best effort to manage the municipal solid waste generated form the city within its available resources. Almost all waste is regularly collected from the generation sources by the private waste collection companies under the control of Kyivkomunservis (KKS), then transported to the designated final disposal sites such as Municipal Landfill No.5 or other private landfills, and the Energia Incineration Plant. Some of the municipal waste are transported to the sorting plant to remove the valuable recyclable materials.

Current waste management process is summarized in Figure 3.28.



Source: JICA Survey Team

Figure 3.28 Current Waste Management Process in Kyiv City (2018)

However, looking into the detailed points on each process and assuming the situations in the near future, several issues have been figured out and are shown below.

i) Uncertainty of Future Landfill Plan
The future development and operation plan of Landfill No.5, a facility that accepts a considerable amount of waste from the city, is not clear. Although the operational enterprise, Kyivspetstrans, has prepared the expansion plan of the current Landfill No.5, it is not clear on how many years the site will be used more. On the other hand, the Kyiv City State Administration announced that Landfill No.5 will be closed by October 2018 at the earliest case, due to the social resistance by the surrounding people, but there is no specific alternative plan that has been set in place.

ii) Existing Illegal Dump
Most if not all waste is surely collected by the waste collection companies, but some of them might be disposed of at unauthorized dumping sites illegally.

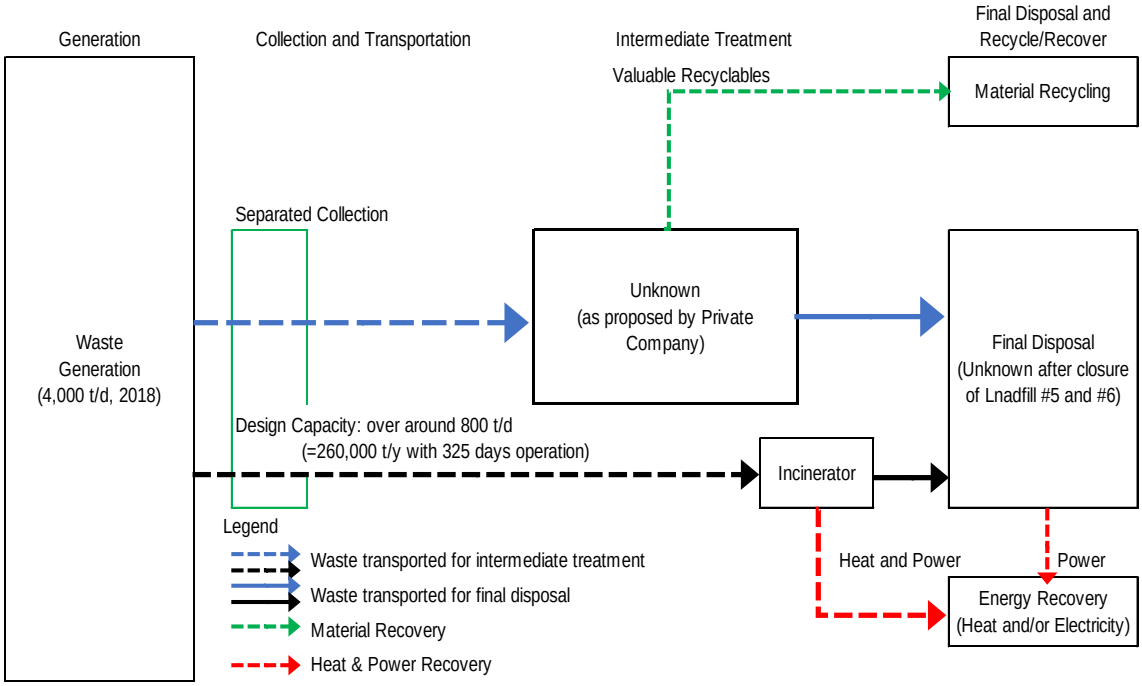
iii) Aging of Energia Incineration Plant
The Energia Incineration Plant was constructed in 1986 and has been in operation for more than 30 years.
Unfortunately, the incinerating amount at the existing plant is very much lower than the original design capacity.
Although some equipment such as the electric precipitators and the waste crane was renewed, the replacement or renewal of the waste furnace itself and other equipment is crucial and necessary in the near future.

iv) Uncertainty of private investment
The Kyiv City State Administration is now preparing the tender for the comprehensive management of municipal solid waste by the private investment for the waste that is currently disposed of at Landfill No.5 and other private landfills. However, this tender is quite dependent on the proposal from the private sector. This means no one knows the baseline on how the waste is treated and how much costs.

v) Difficulty on introduction of segregated waste collection
The Kyiv City State Administration has been making an effort to introduce segregated waste collection but, unfortunately, it could be said that it has not been successful. Regardless of the

efforts for public awareness rising activities by the KKS, recyclables are not always separated and discharged into the designated containers for recyclables and are mostly contaminated as mixed waste.

Waste management process as planned at this moment could be summarized in Figure 3.29. As this figure shows, there is a serious risk for the Kyiv City State Administration to lose the final destination of the waste. This is a possible specially in the case that the private investment project would fail because of the over dependence of the waste management on private investment projects.



Source: JICA Survey Team

Figure 3.29 Plan of Future Waste Management Process in Kyiv City (as of 2018)

3.2.8 Current Situations over Kyiv Oblast

(1) Municipal Waste Management Situations

Within the Kyiv Oblast, an administrative division region consists of 25 administrative districts and 12 cities of regional subordination. In total there are 25 cities, 30 towns, and 1,122 villages, not including the City of Kyiv.

Every year, the Kyiv Oblast generates about 3.49 million m^3 of solid waste, which are fully disposed of at unauthorized landfills and dumps. The region has 36 authorized landfills, seven of which are not certified and two are closed.

Table 3.65 shows the waste collection rate at each administrative municipality.

Table 3.65 Waste Collection Rate at Each Administrative Municipality in Kyiv Oblast

No.	Municipality	Waste Collection Rate %	No.	Municipality	Waste Collection Rate %
1.	Baryshivsky	50	19.	Rokitnyansky	50
2.	Bilotserkivsky	59.6	20.	Skvyrsky	40
3.	Boguslavsky	93	21.	Svyatoshinsky	10.5
4.	Boryspilsky	82	22.	Tarashchansky	75
5.	Borodyansky	73	23.	Tetiivsky	20
6.	Brovarsky	72	24.	Fastivsky	33
7.	Vasilkivsky	70	25.	Yagotinsky	43
8.	Vyshgorodsky	75	26.	c. Berezan	85

No.	Municipality	Waste Collection Rate %	No.	Municipality	Waste Collection Rate %
9.	Volodarsky	93	27.	c. Bila Tserkva	59.6
10.	Zgurivsky	78.3	28.	c. Boryspil	82
11.	Ivankivsky	33	29.	c. Brovary	84
12.	Kagarlytsky	92	30.	c. Bucha	83
13.	Kyiv-Svyatoshinsky	85	31.	c. Vasil'kiv	70
14.	Makarivsky	75	32.	c. Irpin	60
15.	Mironivsky	48	33.	c. Obukhiv	82
16.	Obukhivsky	98	34.	c. Pereyaslav-Khmelnitsky	50
17.	Pereyaslav-Khmelnitsky	80	35.	c. Rzhishchiv	24
18.	Polisky	10	36.	c. Slavutich	100
			37.	c. Fastiv	50

Source: Modern solid waste management system implementation in Kyiv region for 2017-2022

It is recognized that the solid waste problem is very urgent for the Kyiv Region. The increase of waste generation year by year is very significant. Some of these wastes are removed from the generation sources and transported to landfills but most of the landfills are operated improperly, resulting in creating a negative impact on the environment and human health. A low waste collection rate also causes an irregular occurrence of illegal dumping areas. Such problems of solid wastes are partially solved in cities but are difficult to solve in rural areas. In rural areas, there are no programs of solid waste and sanitation schemes to remove and dispose of the waste systematically. As the result of this, many inappropriate open dumps have appeared and made the sanitary condition of settlements worst. It should be concerned that most landfills do not meet the sanitary requirements of operating ranges and these conditions will likely become a serious factor of anthropogenic impact on the environment.

(2) Waste Management Master Plan

There are two fundamental documents which could be considered as the master plan for the solid waste management for the Kyiv Oblast at this moment.

1) Modern solid waste management system implementation in Kyiv Region for 2017-2022

This is the fundamental concept of the introduction of a modern system of municipal waste management in the Kyiv Oblast area, prepared and approved in May 2017.

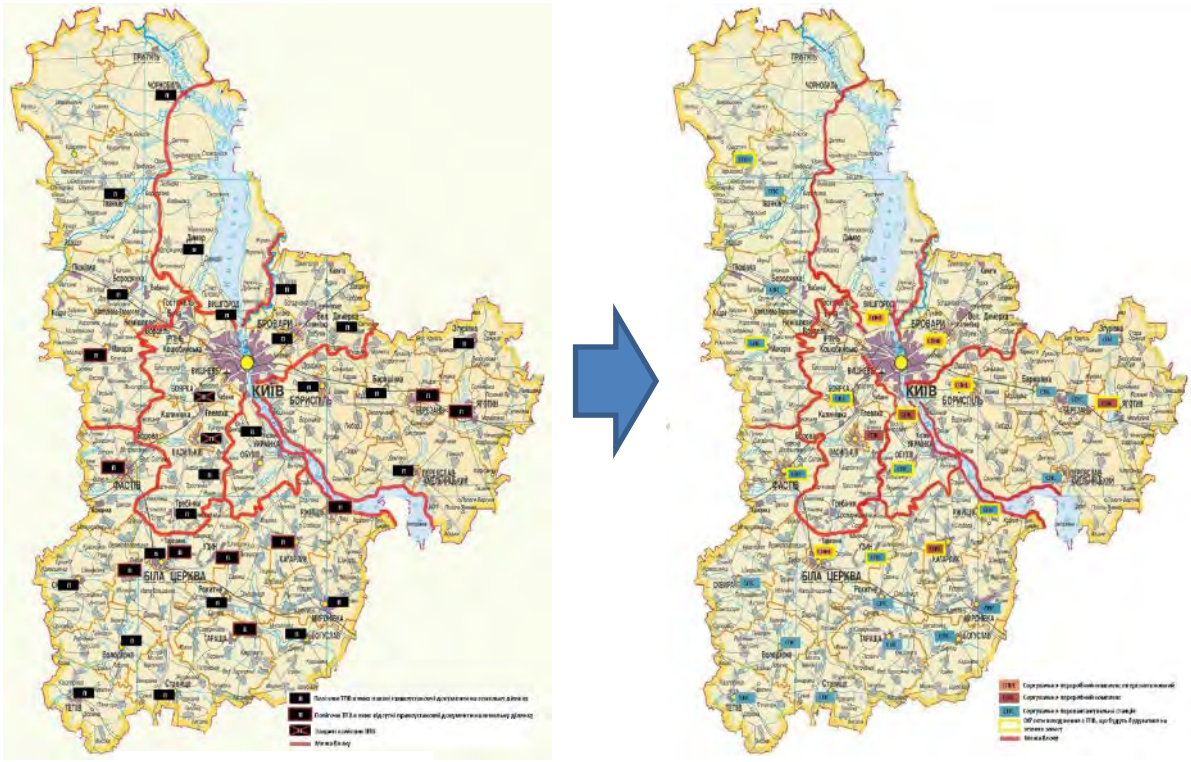
In this document, several waste treatment facilities, such as sorting, incinerating, and fermentation, to reduce the volume of waste to be landfilled are compared, especially from the financial point of view.

With the condition to introduce such waste reduction facilities, the Kyiv Region is divided into seven blocks. Considering the waste generation volume and its composition, logistic methods of waste collection, land availability and other factors, location of final disposal sites and waste treatment facilities are planned in each block. Some blocks have waste processing complex but some others do not, just develop the waste sorting facilities only, depending on the characteristic of each block. For example, regarding the waste processing complex, it was recommended to place a maximum distance of 3 km from energy consumers, with the area of 2 to 5 hectares.

The main directions of the concept as set is described below:

- Introduction of waste sorting in the field of education, conducting educational activities;
- Implementation of comprehensive solid waste management (collection, handling, processing, and disposal);
- Determining the list to close and reclaim the existing waste landfills and dumps, and reconstruction of new landfills; and
- Implementation of efficient waste transportation systems such as waste transfer station.

Figure 3.30 shows the current location of waste dumps and landfill (Black icons) as well as the future allocation plan of waste management facilities (colored icons).



Current Situations

Future Facility Allocation Plan

Source: Modern solid waste management system implementation in Kyiv Region for 2017-2022

Figure 3.30 Current Facility Location and Future Allocation Plan at 7 Blocks in Kyiv Oblast

2) Solid municipal waste management program in Kyiv Region for 2017-2020

This document is the short-term program based on the concept mentioned above, also prepared and approved in May 2017.

In this document, more details about the waste management action plan to be implemented by 2020 are introduced.

For example, in the 1st block where it covers the territory of Bila Tserkva City, Rzhishchev City, Fastiv, Bila, Boguslavsky, Volodarsky, Kagarlyksky, Mironovskiy, Rokitnyansky, Skvyrskyi, Stavischanskaya, Tarashchansky, Tetiiv and Fastovsky areas.

Table 3.66 shows an example of a facility development plan at Bila Tserkva Municipality in Block 1, which will introduce waste sorting-processing complex with a kind of waste to energy plant with the capacity of 200,000 tons per year or about 548 tons per day. In this document, such detailed conceptional plans for all facility development plans over the seven blocks are described.

Table 3.66 Example of Facility Development Plan in Kyiv Oblast

MSWM Object	Location	Projected Capacity k-tons / year	Issues to be Addressed	Year of Execution
Sorting-processing complex energy autonomous (with power units to generate electricity and heat)	Bila Tserkva (land reserve)	200	1.Allocation of land	2017
			2.Development of project documentation	2018
			3.Development of the register card of waste processing and disposal facility (RK OOUV)	2018
			4. Construction of SPCE	2019-2020

Source: Solid municipal waste management program in Kyiv Region for 2017-2020

Appendix 1 of this document is named as PASSPORT, which is the general description of the regional program, consists of 1) the initiator of the development program, 2) date, number and name of the administrative paperwork executive authority on development programs, 3) developing body, 4) collaboration bodies, 5) responsible execution body, 6) participating bodies, 7) duration of the program, 8) list of budget to be used, and 9) total amount for the program, which is estimated approximately at UAH 2,005,433,000. Of which, only UAH 98,305,000 is expected to be disbursed from the regional budget and the remaining UAH 1,907,128,000 shall be provided from other financial sources.

Appendix 2 of this document is the source of the regional program of solid waste, which describes the financial sources for the program to be disbursed in 2017, 2018, 2019, and 2020.

(3) Facility Development Plan and Project

Facility development plan is already prepared and approved as previously mentioned. According to the Kyiv Oblast State Administration, one of the programs which is the re-construction of the landfill site in Mironovka Region is now under implementation and is funded using the national budget.

Other projects are monitored by the state administration and is mostly expected to use the state budget. However, they have yet to secure enough amounts to actually implement the project.

(4) Current Oblast Level Issues on Waste Management

In the documents above mentioned, major issues of Kyiv Region in the field of waste management are summarized and shown below:

- Discrepancy between the existing sanitary standards and requirements of environmental safety at most landfills and waste dumps;
- Outdated system of waste collection, transportation, storage, and disposal;
- Aging of existing machinery and containers for waste collection and inappropriate landfill operation;
- Insufficient implementing capacity of separated collection, sorting and recovering the recyclable materials;
- Inadequate coverage of rural system for waste collection;
- Imperfect legislation and state regulation in the field of waste management; and
- Low prices of waste disposal tariff for removal and disposal of solid waste.

In addition, the Kyiv Oblast State Administration is now revising the existing concept and action plan reflecting the policies under the National Waste Management Strategy approved in November 2017, especially including the introduction of separated collection.

Another issue is the communication with the City of Kyiv for the cases that the municipal solid waste generated from the city will be treated and disposed of at the outside of the city boundary, which means that it is within the oblast boundary in the near future.

3.3 Current Status of Kharkiv City

3.3.1 General Information

(1) Natural Conditions

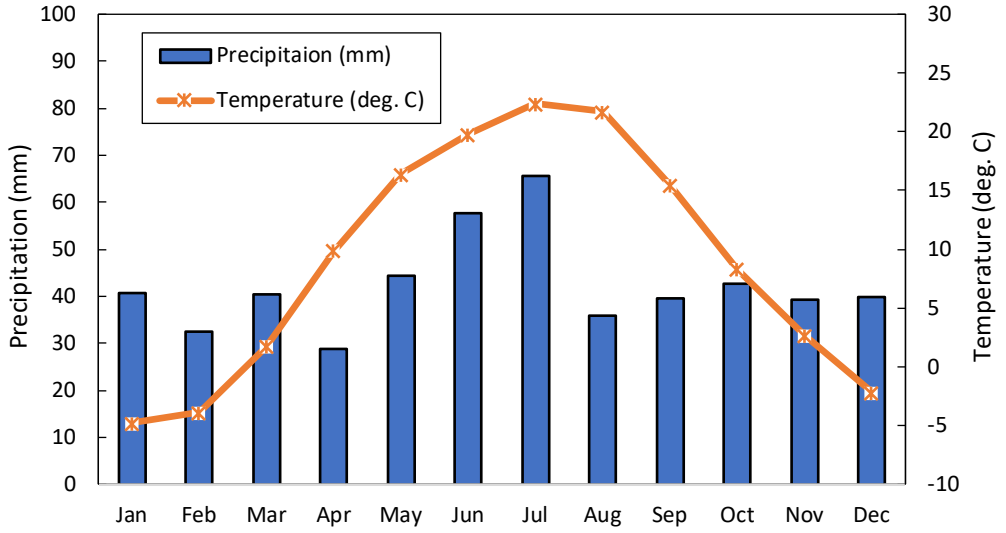
1) Geographical Features

Kharkiv Oblast is located in the northeast of Ukraine, and it occupies the southwest margin area of the Central Russian Hill. The steppe zone is the big part of the region's territory. The northeast part of the territory shares borders with Russia. Kharkiv Oblast has an area of 31,415 km^2, and it is the fourth largest oblast in Ukraine. In the territory of Kharkiv Oblast, landslides, ravines, and erosion create relief of Kharkiv Oblast. Kharkiv Oblast is located in the watershed dividing the Don River and the Dnieper River. There are 156 rivers in the territory of Kharkiv Oblast. The longest river is the Siverskyi Donets River, its length is 380 km within the region.

Kharkiv City is located at a latitude of 49°52" - 50°06" N and longitude of 36°07" - 36°27" E, and has an area of 350 km^2. Kharkiv City is at the center of the northern area in Kharkiv Oblast.

2) Meteorological Phenomenon

Kharkiv City is characterized by having a continental climate, and an annual average temperature of 6.7 °C. The warmest month is July with the average temperature of 18.7 °C, and the coldest month is January with the average temperature of -7.1 °C. The annual average precipitation is 500 mm ~ 600 mm. The snowfall period is around five months from November to March. The snow cover stays from 95 days to 110 days. The summarized monthly climate information is shown in Figure 3.31.



Source: https://www.weatheronline.co.uk/ (as of 5 April 2018)

Figure 3.31 Monthly Temperature and Precipitation in Kharkiv City

(2) Population

As of 1 February 2018, the total resident population in Kharkiv Oblast which includes Kharkiv City is estimated to be 2,676,632 people, while the total present population is 2,692,268 people. As for the City of Kharkiv, the total resident population is estimated to be 1,429,847 people, while the total present population is 1,449,414 people[14].

Of the resident population in Kharkiv Oblast, 46.3% is male and 53.7% is female. Population under the age of 15 is 14.5%,61.5% is from 16 to 59 and 23.0% is over 60.

Detailed demographics of Kharkiv Oblast are shown in Table 3.67. The total area of the oblast is 31,415 km^2 and the average population density is 85.2 people per km^2.

[14] http://kh.ukrstat.gov.ua/index.php/chyselnist-naselennia-shchomisiachna-informatsiia (as of 7 April 2018)

The total area of the City of Kharkiv is 350 km^2 and the average population density is 4,085 people per km^2

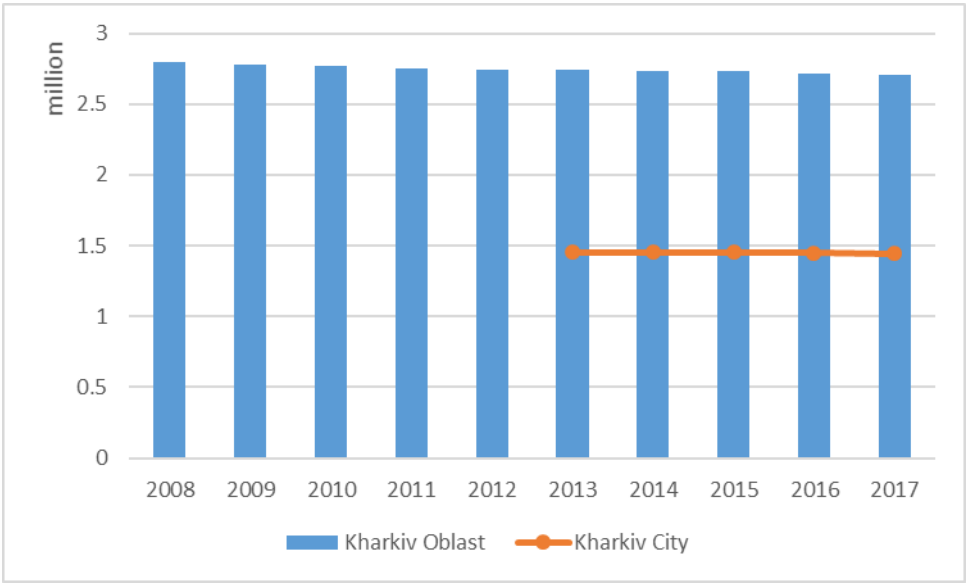
Table 3.67 Detailed Demographics of Kharkiv Oblast

City/Raion	Available Population			
	1 February 2018	Average Number in January 2018	1 February 2018	Average Number in January 2018
Kharkiv Oblast Total	2,692,268	2,693,138	2,676,632	2,677,502
Cities				
Kharkiv	1,449,414	1,449,748	1,429,847	1,430,181
Izium	48,309	48,338	48,326	48,355
Kupyansk	55,646	55,668	55,807	55,829
Lozova	64,599	64,613	65,309	65,323
Lyubotin	23,939	23,939	23,832	23,832
Pervomaisk	29,923	29,927	30,286	30,290
Chuguev	33,083	33,093	32,749	32,759
Raions				
Balakliya	80,428	80,457	80,717	80,746
Barvinsky	21,030	21,043	21,628	21,641
Bliznyuk	18,450	18,470	18,536	18,556
Bogodukhivsky	38,439	38,446	38,570	38,577
Borovsky	16,577	16,582	16,701	16,706
Valkivsky	31,387	31,399	31,688	31,700
Velikoburlutsky	21,870	21,892	22,029	22,051
Vovchansky	45,694	45,716	45,392	45,414
Dvorichansky	17,238	17,251	17,312	17,325
Dergachivsky	94,071	94,118	94,093	94,140
Zahepilivsky	14,938	14,947	15,175	15,184
Zmiyivsky	70,646	70,670	70,528	70,552
Zolochivsky	25,711	25,729	25,718	25,736
Izyumsky	16,889	16,899	17,147	17,157
Kegichevsky	20,831	20,839	20,857	20,865
Kolomatsky	6,893	6,900	6,941	6,948
Krasnogradsky	43,958	43,981	43,982	44,005
Krasnokutsky	27,630	27,638	27,655	27,663
Kupyansky	24,128	24,144	24,426	24,442
Lozovsky	28,377	28,403	28,616	28,642
Novovodolazhsky	32,168	32,182	32,323	32,337
Pervomaisky	15,377	15,388	15,510	15,521
Pechenezhsky	9,814	9,824	9,826	9,836
Sakhnovshchinsky	20,754	20,761	21,138	21,145
Kharkiv	177,517	177,563	177,162	177,208
Chuguevsky	46,349	46,372	46,524	46,547
Shevchenko	20,191	20,198	20,282	20,289

Source: http://kh.ukrstat.gov.ua/index.php/chyselnist-naselennia-shchomisiachna-informatsiia (as of 7 April 2018)

Figure 3.32 shows the population curve in the past ten years of Kharkiv Oblast including Kharkiv City, which indicates that the population has been almost stable.

Unfortunately, future projection of the population for both oblast and city was not obtained in the field survey. According to the City of Kharkiv, however, in its answer to the questionnaire for JICA Survey, it is unofficially observed that its population might have increased up to 1.7 million or 2.0 million recently, due to the recent rapid population inflow from the neighboring eastern oblasts, which are Donetsk and Luhansk.



Source: JICA Survey Team referring the following data sources.
Kharkiv City Couicil for the Questionnaire of the JICA Survey Team
http://kh.ukrstat.gov.ua/index.php/naselennia-1995-2012rr (as of 7 April 2018)

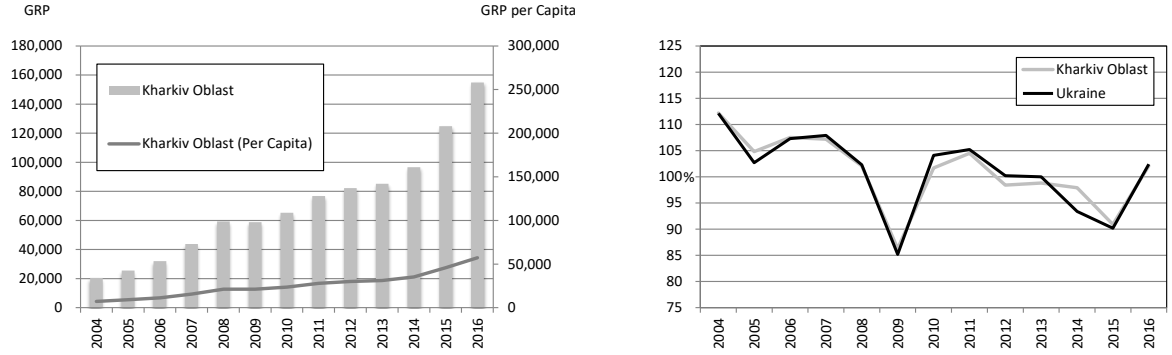
Figure 3.32 Population Curve of Kharkiv Oblast and Kharkiv City (2008 – 2017)

(3) Economic and Industrial Conditions

1) Gross Regional Products

Figure 3.33 shows GRP in Kharkiv Oblast. The Gross Regional Products (GRP) of Kharkiv Oblast Administration in 2016 are UAH 154,871 million, which compromise 6.5% of total national gross domestic product (GDP).

The GRP growth rates of Kharkiv Oblast have similar fluctuations like with the GDP growth rate of the whole Ukraine, falling negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty, etc. In 2016, it became positive.



Source; State Statistic Service of Ukraine Website (http://www.ukrstat.gov.ua/, as of 01April2018)

Figure 3.33 GRP in Kharkiv Oblast (Total, Per Capita, Growth Rate)

2) Industrial and Economic Situation of Kharkiv Oblast

Industrial production index in Kharkiv Oblast increased by 6.1% in 2016 from the previous year of 2015; the largest increase is production of furniture and other products, repair and installation of machinery and equipment (36.1%), metallurgical production, manufacture of fabricated metal products except machinery and equipment (19.1%), and engineering besides repair and installation of machinery and equipment (9.5%). Meanwhile, electricity, gas, steam, and conditioned air production reduced to 14.2% and coke and refined petroleum products also decreased to 7.0%.

In January-November 2017, enterprises of the Kharkiv Oblast sold industrial products worth UAH 149.4 billion, including food, beverages, and tobacco products at 27.8 billion (18.6%), supply of electricity, gas, steam, and conditioned air at 24.0 billion (16.0%), and mechanical engineering at 16.9 billion (11.3%).[15]

The index of consumer prices for goods and services in the Kharkiv Oblast for 2017 amounted to 113.8% (in Ukraine - 113.7%). In 2017, consumer prices for food and soft drinks grew by 19.2%, alcoholic beverages and tobacco products by 21.4%, and clothing and footwear by 1.8%. The level of prices for housing, water, electricity, gas, and other fuels increased by 7.5%. Household appliances and housing maintenance went up by 2.6%. Transport as a whole became more expensive by 15.2%, and communications services by 10.3%. In the healthcare sector, prices have increased by 10.3%, education by 14.7%, recreation and culture by 3.9%. There was a 13.3% rise in the cost of restaurant and hotel services. Various goods and services rose in price by 5.6%.

3) Employment and Unemployment

In 2016, the average number of economically active population aged 15-70 in Kharkiv Oblast was 1,321.2 thousand people, in which 1,236.6 thousand were employed, and the rest (84.6 thousand) were unemployed, i.e., employment rate was 59.7%.

The unemployment rate (ILO standard) of the economically active population aged 15-70 in Kharkiv Oblast was 6.4 (Table 3.68), which is the lowest in all Ukraine (2nd lowest is Kyiv City at 6.7%).

Table 3.68 Employment and Unemployment Ratio in Kharkiv Oblast

	Economically Active Population aged 15-70 (Thousand Persons)			Economically Inactive Population aged 15-70, (Thousand Persons)	Employment Rate (%)	Unemployment Rate (%)
	Total	Including				
		employed	unemployed			
Ukraine	17,955.1	16,276.9	1,678.2	10,934.1	56.3%	9.3%
Kharkiv	1,321.2	1,236.6	84.6	748.8	59.7%	6.4%

Source: Economic Activity of Population in Ukraine 2016 (State Statistics Service of Ukraine, 2017)

4) Household income and expenditure

State Service of Statistics of Ukraine conducted household income and expenditure survey every year. Table 3.69 shows a part of the result.

Average household income in a month of Kharkiv Oblast surveyed in 2016 amounted to UAH 4,951.74/household-month and monthly expense amounted to UAH 4,668.30/household-month.

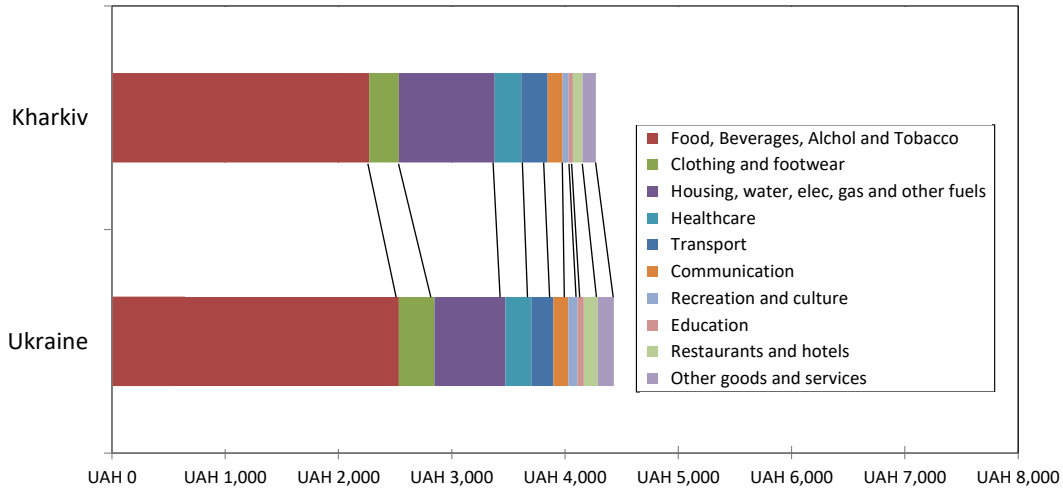
Figure 3.34 shows the monthly expenditure of household on average; people in Kharkiv Oblast spend less money on food, beverages, and tobacco while total payment for housing and communal products and services amounting to UAH 764.03/household-month has the highest ratio (16.4%) to the total expenditure compared with others. Household monthly expenditure of Kharkiv Oblast is a bit less than national average.

Table 3.69 Average Monthly Income and Expenditure in Surveyed Households in Kharkiv

Item	Unit	All Ukraine	Kharkiv Oblast
Number of surveyed households	households	8,168	278
Average persons in a household	person/household	2.11	2.01
Total number of households	thousand households	15,033.40	1,116.60
Total cash income of household (average)	**UAH/household-month**	**5,367.51**	**4,951.74**
Salary of household (average*)	UAH/household-month	2,914.70	2,869.41
Pension of household (average*)	UAH/household-month	1,211.26	1,110.60
Total cash expense in a household	**UAH/household-month**	**4,948.62**	**4,668.30**
Balance (as a reference)	UAH/household-month	418.89	283.44

Source: JICA Survey Team based on Expenditure and Resources of Households of Ukraine in 2016 (State Service of Statistics of Ukraine, 2017)

[15] *Social and Economic situation of Kharkiv Oblast in 2017 (Main Department of Statistics in the Kharkiv Oblast)*



Source: JICA Survey Team

Figure 3.34 Composition of Monthly Expenditure of Household (Average) in Kharkiv

5) Utility and sanitary infrastructure

A) Power supply

Electric power supply in Kharkiv is carried out by Kharkiv CHP-3, CHP-5, Kharkiv TPP-2 and Zmiyivska TPP. The total installed capacity of the Kharkiv power plants is 2,895 MW. The OJSC "Kharkivoblenergo" carries out electric power transmission and distribution within the city.

Annual volumes of electricity consumption in Kharkiv City from 2014 to 2016 are as shown in Table 3.70. it has been decreasing from 2014 to 2016.

Table 3.70 Electricity consumption in Kharkiv City (2014-2016)

Item	Year		
	2014	2015	2016
Electricity consumption (million kWh)	3889.2	3665.7	3310.2

Source: Kharkiv City Council

According to Kharkivoblenergo[16], in March 2018, electricity consumption in Kharkiv City and the Kharkiv Oblast significantly increased up to the capacity. In this regard, Kharkivoblenergo recommends that enterprises in the territory to reduce power consumption during the day and especially in the morning and evening. Kharkivoblenergo requested household consumers to implement energy saving measures and to reduce unevenness of daily power consumption.

B) Water supply and sewerage system

As information of Kharkiv City is not available, that of Kharkiv Oblast is shown hereinafter. The status of water supply and sewerage system in Kharkiv Oblast is as shown in Table 3.71.

Table 3.71 Status of water supply and sewerage system in Kharkiv Oblast

Item	Status
Water supply	- Amount of water supply: 322.5 million m3 (2016) - Water supply coverage rate:100% - Rate of decrease leakage and unaccounted water consumption: 38.8%
Sewerage system	- Total design capacity of sewerage treatment plants: 505.7 million m3 - Amount of generated wastewater: 325.1 million m3 - Amount of wastewater treated at sewerage treatment plants: 202.8 million m^3 - Treatment rate: 62.4%

Source: 1) Development Strategy for Kharkiv Oblast until 2020, 2) Report on the state of the environment in Kharkiv Oblast in 2016

[16] Source: https://vecherniy.kharkov.ua/news/143353/ (as of 25 May 2018)

3.3.2 Administrative Structure

(1) Kharkiv Oblast State Administration

1) Organizational Structure

The organizational structure of Kharkiv Oblast State Administration is as shown in Table 3.72.

Table 3.72 Organization Structure of Kharkiv Oblast State Administration

No.	Department/Division	Seats
-.	Governor First Deputy Governor Deputy Governor	1 1 4
1.	Department of Finance	69
2.	Legal Department	27
3.	Industry Development Administration	18
4.	Department of Economy and International Relations	56
5.	Department of Increase of Competitiveness of the Region	23
6.	Department of Science and Education	32
7.	Department of Agro-industrial Development	45
8.	Administration for Youth and Sport Affairs	19
9.	Administration for Culture and Tourism	20
10.	Division of Public Information Access Provision	9
11.	Sector of Religion Affairs	4
12.	Office of Children's Services	10
13.	Public Record Office	50
14.	Department of Civil Protection	30
15.	Department of Ecology and Natural Resources ▪ Management office of Accounting, Human Resourcing, Administrative and Legal Support ▪ Management office of Rational Use of Natural Resources and Assessment of the Impact on Environment ▪ Management office of Economy of Natural Resource Use and Waste Management - Division of Coordination of Ecological Programs, Economy of Natural Resource Use and Reserve Management **- Division of Waste Management**	30 7 11 11 5 **5**
16.	Department of Defensive, Mobilization Work and Cooperation with Law Enforcement Agencies	24
17.	Department of Social Protection of the Population	80
18.	Administration of Mass Communication	18
19.	Healthcare Administration	26
20.	Department of Capital Construction	41
21.	Administration of Fuel and Energy Complex	19
22.	Department of City Planning and Architecture	23
23.	Department of Housing and Utilities and Infrastructure ▪ **Division of Construction, Road Complex and Municipal Improvement in the Sphere of Housing and Utilities** ▪ Management Office of Housing and Utilities ▪ Management Office of Infrastructure Reforming and Economic Analysis ▪ Human Resourcing Sector ▪ Division of Accounting and Activity Planning	34 **7** 10 9 2 5
-	**Total**	**713**

Source: Kharkiv Oblast State Administration

The departments responsible for the MSWM are "Division of Waste Management", which belongs to the Department of Ecology and Natural Resources, and the "Division of Construction, Road Complex, and Municipal Improvement in the Sphere of Housing and Utilities", which belongs to the Department of Housing and Utilities of the Housing and Communal Services and Infrastructure.

Roles of Division of Waste Management are as follows:

- to control over enterprises, institutions, and organizations observing the rules, regulations, and standards;
- to keep a registry of MSWM facilities and take necessary measures to maintain the registries in compliance with the laws;
- to organize accounting of MSWM facilities and deal with the certification of wastes and take measures for the certification of wastes in compliance with the laws;
- to coordinate the operation of self-governmental bodies which manage collecting and disposal of household and other wastes;

Roles of Division of Construction, Road Complex and Municipal Improvement in the Sphere of Housing and Utilities are as follows:

- to implement state policy in housing communal services and utilities including municipal wastes management;
- to analyze the status of urban and rural landscaping and municipal wastes management;
- to arrange for municipal waste management services and development of landfill site and separate collection of recyclable materials;
- to collect information on municipal waste management from executive committees of raions and cities of regional significance and prepare an annual waste management report of the oblast; and
- to share all laws and regulations which are updated or established newly with executive committees of raions and significant cities and accordingly inform local self-governing bodies, enterprises, and organizations operating in the waste treatment sector.

2) Budgetary Information

The annual expenditure of Kharkiv Oblast State Administration in the past three years and plan for 2018 are shown in Table 3.73. Total budgetary plan of 2018 is UAH 5.3 billion, which is 17.3% increase from the result in 2017.

According to Kharkiv Oblast, in the recent five years, the oblast received UAH 69,412,000 from the State Fund for Environment Protection for the implementation of construction projects of municipal waste treatment complexes in the city of Bohodukhiv and the city of Liubotyn.

Table 3.73 Annual Expenditure of Kharkiv Oblast State Administration

Unit: UAH in thousands

Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
Governance	11,096.9	11,612.8	19,047.1	25,395.9
Education	827,659.1	625,782.5	996,868.8	1,576,692.4
Healthcare	1,331,436.5	1,431,864.8	1,900,337.0	2,201,270.0
Social protection and social security	200,015.5	299,914.9	377,109.2	498,842.4
Housing and communal services	498,843.9	26,242.1	305,868.6	14,130.0
Culture and art	104,241.4	114,287.2	161,050.5	182,445.6
Mass-media	2,044.1	2,931.8	3,900.3	4,018.9
Physical culture and sport	78,106.3	98,745.8	143,013.4	180,214.9
Construction	23,205.9	56,986.8	35,243.6	325,366.2
Agriculture and forestry, fisheries, and hunting	37,229.6	39,611.9	72,658.9	0.0
Transport and public road system	35,767.5	81,831.7	381,723.6	254,509.1
Other services related to economic activity	62,472.5	80,292.3	92,235.9	13,695.9
Environmental protection and nuclear safety	-	-	-	6,500.0
Prevention and elimination of emergencies and consequences of natural disasters	1,008.7	1,093.3	1,590.4	1,779.3
Debt service	-	-	-	0.0
Trust funds	19,911.8	12,632.9	15,225.0	0.0
Waste disposal	-	-	-	0.0
Expenditures not attributed to major groups	2,348.1	117.1	135.1	0.0
Total	3,235,387.9	2,883,948.1	4,506,007.5	5,284,860.6

Source: Prepared by the JICA Survey Team based on the website of Kharkiv Oblast State Administration

3) Development Strategy

Kharkiv Oblast Development Strategy for the period until 2020 had been developed by the working group of the Kharkiv Oblast Development Strategy involving 140 foreign and domestic experts and approved under Decision No. 385 as of 6 August 2014 of the Cabinet of Ministers of Ukraine.

Strategic goals and operational goals have been set based on the analysis of current conditions as shown in Table 3.74. In order to achieve each operational goal, tasks and priority project areas have been determined.

Regarding MSWM, "implementation of MSWM system and waste to energy technology" was determined as one of the 13 tasks to achieve the strategic goal No. 1 "Economic competitiveness and growth GRP", although it is not clear which operational goal under the strategic goal No.1 will be achieved.

Table 3.74 Strategic and Operational Goals under the Development Strategy

Strategic Goals	Operational Goals
1. Economic competitiveness and growth GRP	1. Ensuring the securement of energy by increasing the economic and energy efficiency, development of renewable and alternative energy generated by local resources (biomass, brown coal, solid municipal waste, etc.), and ensuring balance of power systems; 2. Production of energy efficient equipment with the use of modern technologies in the region; 3. Development of a public awareness system for energy-efficient behavior of enterprises and population; 4. Diversification of foreign markets and attractive investment environment, inclusion of regional enterprises in international technological chains, and cooperative networks through the establishment of marketing activities for foreign countries; 5. Transformation of higher education and science into a full-grown sector of the economy for the establishment of innovative entrepreneurship; 6. Development of marketing promotion system as the capital of IT outsourcing of Ukraine; 7. Development of intra-regional recreation and event tourism as a small and medium-sized business sector with high potential for creation of new jobs and expansion of the revenue base of local budgets; 8. Development of intra-regional tourism as an economic and budget-forming sector of territorial communities; 9. Development of chains of adding value to small and medium-sized producers through the formation of cooperative associations, marketing associations, processing enterprises; and 10. Preservation and reproduction of the soil fertility potential.
2. Reducing regional disparities in the quality of life and polycentric development	1. Cooperation of territorial communities to enhance their development opportunities by combining into a joint socio-economic, investment space with a single planning, resettlement, and nature-ecological framework; 2. Determination of clear boundaries, functional specialization, and principles of coordinated management of urban areas through updating scheme of planning the territories of administrative-territorial units; 3. Reconstruction and modernization of water treatment facilities within urban areas and implementation of the "Integrated Plan for Improvement of the Lopan River Basin" with international participation; 4. Application and modernization of existing mechanisms of state housing programs: development of new regional and local programs to reduce the cost of mortgage lending for the construction and acquisition of housing; 5. Widespread involvement of public organizations and business at the rayon and local level in providing social services to the population, and developing healthy lifestyle infrastructure and child infrastructure on the basis of social partnership and outsourcing; and 6. Carrying out inventory, reconstruction, and modernization of treatment facilities within urban areas in order to reduce anthropogenic impact on surface water objects and ensure ecological safety of population's life.

Strategic Goals	Operational Goals
3. Effective management of local development	1. Implementation of principles of public-private partnership in all spheres of regional development management and local communities; 2. Transition from the development of budget funds to project management, focused on a specific result for a specific territory; 3. Overcoming departmental disunity by developing integrated projects to create multiplicative, systemic effects on various sectors of the economy and human development at oblast and local levels. Application of the principles of co-financing and additionality (use of resources of all levels: state, oblast, municipality, and PPP); 4. Systemic involvement in the local development by funds of international financial organizations, projects of international technical assistance, preferential loans, and loans with a grant share; 5. Increase of local budget revenues by expanding the scope of non-tax revenues and improving the efficiency of management of property and land resources; 6. Implementation of the system of e-governance and information provision for the adoption of state management decisions in the work of regional and local authorities; 7. Implementation of a system of municipal energy plans based on energy service contracts for external co-financing of energy efficiency and energy preservation projects; 8. Development and implementation of projects and programs for the reintegration of temporarily internally displaced people from the anti-terroristic operation zone; and 9. Implementation of the benchmarking system for the competitiveness of the region.

Source: Kharkiv Oblast Development Strategy for the period until 2020 (summarized by the JICA Survey Team)

(2) Kharkiv City Council

1) Organizational Structure

The organizational Structure of the Kharkiv City Council is shown in Table 3.75. The Executive Committee consists of the Mayor and ten Deputy Mayors who are representatives from departments. MSWM is under the responsibility of "Department of Housing Services" and "Department of Communal Services".

Table 3.75 Organization Structure of Kharkiv City Council

No.	Department/Division	Seats
-	Executive Committee of Kharkiv City Council ▪ Mayor ▪ City Council Secretary ▪ First Deputy Mayor ▪ Deputy Mayor	 1 1 1 9
1	Apparatus of City Council and Executive Committee ▪ Service of Assistants ▪ Department of Organizational Work ▪ Department of Recordkeeping ▪ Department of Human Resources ▪ Department of Information and Computer Support ▪ Department of Administrative and Economic Activity ▪ Accounting and Reporting Service ▪ Archival Division ▪ Division of Special Work	477
2	Department of Registration	157
3.	**Department of Housing Services** ▪ Division of Current Maintenance & Development of Housing Stock ▪ Division of Accounting and Distribution of Living Space	58
4	**Department of Communal Services** ▪ Division of Maintenance & Restoration of Objects of Urban Improvement ▪ Division of Engineering Infrastructure ▪ **Division of Ecology & Urban Improvement** ▪ Inspection on Urban Improvement and Ecology	59

No.	Department/Division	Seats
5	Department of Cooperation with Law Enforcement Agencies and Civil Protection	43
6	Department of International Cooperation	21
7	Department of Administrative Services and Consumer Market	220
8	Department of Education	25
9	Department of Culture	31
10	Department of Infrastructure	50
11	Department of Land Relations	47
12	Department of Urban Planning, Architecture and City Master Plan	87
13	Department of Family, Youth and Sports Affairs	71
14	Department of Healthcare	43
15	Department of Labor and Social Policy	59
16	District Administrations	1197
-	Total	2657

Source: Website of Kharkiv City (translated by JST)

The Department of Communal Services is basically responsible for the collection, transportation, and disposal of solid waste. In the department, four permanent staff in the Division of Ecology and Urban Improvement are in-charge of MSWM while the implementation is being done by the communal enterprises for MSWM.

2) Budgetary Information

The annual expenditure of Kharkiv City in the past three years and the plan for 2018 are shown in Table 3.76. Total budgetary plan of 2018 is UAH 16.1 billion, which is 15.8% increase from the result in 2017

The total expenditure of the Kharkiv City government in 2017 was UAH 13.9 billion wherein the Department of Housing and Communal Service spent approximately UAH 1.6 billion including UAH 100 million for new vehicles for MSW management and UAH 10 million for the renovation of container park.

Table 3.76 Annual Expenditure of Kharkiv City

Unit: UAH in thousands

Name under the Program Classification of Expenditures and Financing Budget	2015 Result	2016 Result	2017 Result	2018 Plan
Governance	203,167.3	-	611,728.6	753,779.4
Education	1,462,735.8	1,932,100.0	2,614,068.2	3,318,283.6
Healthcare	1,175,589.7	1,319,300.0	1,690,848.5	1,759,940.9
Social protection and social security	1,685,934.1	2,417,300.0	3,478,137.1	3,959,192.4
Housing and communal services	665,590.1	1,121,400.0	1,554,003.2	1,548,304.2
Culture and art	268,411.6	340,000.0	552,773.3	966,118.3
Mass-media	7,384.9	0.0	12,339.2	15,199.4
Physical culture and sport	87,325.6	133,100.0	284,466.2	332,480.6
Construction	502,438.7	638,100.0	759,263.8	1,010,776.3
Agriculture and forestry, fisheries, and hunting	-	-	-	-
Transport and public road system	898,806.6	400,800.0	1,755,161.3	1,815,621.2
Other services related to economic activity	85,834.5	0.0	575,394.0	626,301.4
Environmental protection and nuclear safety	-	-	-	10,952.6
Prevention and elimination of emergencies and consequences of natural disasters	2,416.9	-	4,310.8	9,570.0
Debt service	15,038.1	-	0.2	4.8
Trust funds	26,138.6	-	6,354.5	-
Waste disposal	-	-	-	-
Expenditures not attributed to major groups	27,568.3	-	31,855.5	-
Total	7,114,380.9	8,302,100.0	13,930,704.5	16,126,525.0

Source: Prepared by the JICA Survey Team based on the website of Kharkiv City

3) Development Strategy

A general development plan for 2031 has been prepared by the city council with assistance of institutes in Kharkiv before 2011 and has been amended in 2011 and 2013. In the general plan, priority measures have been proposed in various sectors. The cost for the measures were estimated as shown in Table 3.77.

Table 3.77 Investment Plan of Priority Measures for the Sustainable Functioning of the City's Engineering and Transport Infrastructure

Types of Activities		Estimated Cost (million UAH)
Transport and street network		1,773
Engineering training of the territory	Hydrotechnical measures	643
	Rainwater drainage	616
	Subtotal	1,259
Engineering facilities of the territory	Water supply	1,204
	Household and domestic sewage	818
	Sanitary cleaning	570
	Heat supply	6
	Gas supply	204
	Electricity supply	210
	Subtotal	3,012
Total		6,045

Source: General Plan prepared by Kharkiv City Council (translated by the JICA Survey Team)

MSWM is included in the "Sanitary Cleaning". The priority measures in the sanitary cleaning sector are shown as follows:

i) Completion of construction of a landfill in municipal solid waste;
ii) Closure of the 1st phase of the Dergachi Landfill and its reclamation;
iii) Closing the Rogansky Landfill site in accordance with the requirements of the Air Code of Ukraine;
iv) Construction of car wash at the Dergachi Landfill;
v) Construction of a modern landfill of solid waste 17 hectares in the Kryzhsky Ravine;
vi) Construction of a site for the sorting and processing of solid waste (1st queue); and
vii) Purchase of special vehicles for sanitary cleaning of the city territory, transportation of liquid waste.

3.3.3 Legal System on Waste Management

(1) Kharkiv Oblast State Administration

Regulations of Kharkiv Oblast State Administration related to MSWM are as shown in Table 3.78.

Table 3.78 Regulations Related to MSWM Issued by Kharkiv Oblast State Administration

Date of Issue	Type and Number of Document	Name of Document
29 October 2009	Decision of Kharkiv Oblast Council, No. 1413-V	On Approval of the Complex Environmental Protection Program in Kharkiv Region for 2009-2013 and up to 2020
14 April 2016	Decision of Kharkiv Oblast Council, No. 107-VII	On Approval of the Regional Strategy "Kharkiv Region Ecology" for 2016-2020
23 December 2010	Resolution of Kharkiv Oblast Council, No. 30-VI	On Approval of the Kharkiv Region Territory Planning Scheme

Date of Issue	Type and Number of Document	Name of Document
14 April 2016	Resolution of Kharkiv Oblast Council, No. 101-VI	On Approval of the City Development Documents Program in the Kharkiv Region for 2016-2020
14 June 2016	Resolution of Kharkiv Oblast Council, No. 1229-VI	On Approval of the Program of Creation and Conducting of the City Development Cadaster in the Kharkiv Region for 2015-2018
05 March 2015	Resolution of Kharkiv Oblast Council, No. 1151-VI	On Approval of the Kharkiv Region Development Strategy for a Period of up to 2020
18 June 2015	Resolution of Kharkiv Oblast Council, No. 1227-VI	On Approval of the 2015-2017 Measures Plan for the Implementation of the Kharkiv Region Development Strategy for a Period of up to 2020
31 August 2017	Resolution of Kharkiv Oblast Council, No. 499-VII	On Approval of the 2018-2020 Measures Plan for the Implementation of the Kharkiv Region Development Strategy for a Period of up to 2020
07 December 2017	Resolution of Kharkiv Oblast Council, No. 557-VII	On Approval of the Strategic Developments for Providing the Public Security and Order in the Territory of the Kharkiv Region for 2018-2019

Source: Kharkiv Oblast State Administration

(2) Kharkiv City Council

The regulations of Kharkiv City Council related to MSWM are shown in Table 3.79.

Table 3.79 Regulations Related to MSWM Issued by Kharkiv City Council

Date of Issue	Type and Number of document	Name of document
24 December 2003	Decision of Kharkiv City Council, No. 284/03	On Approval of the Scheme of Sanitary Cleaning in Kharkiv and the Program for the Development of Solid Waste Management System in Kharkiv
16 November 2011	Decision of Kharkiv City Council, No. 504/11	On Establishment of the Rules for the Improvement of the Territory of Kharkiv City

Source: Kharkiv Council

3.3.4 Related Legal System (Energy and PPP)

(1) Kharkiv Oblast State Administration

According to the questionnaire survey and relative interview, the oblast government follows the legislations of national level and no specific legislations in the oblast level.

(2) Kharkiv City Council

According to the questionnaire survey and relative interview, the city government follows the legislations of the national level and no specific legislations in the city level.

3.3.5 Current Municipal Waste Management Situations in Kharkiv City

(1) Waste Generation Quantity and Quality

1) Existing data on waste quantity and quality

A) Amount of MSW

According to the Kharkiv City Council, there is no statistical data on the amount of municipal solid waste generated in the city for the last ten years, however, the City Council estimates current amount of municipal solid waste generation at approximately 400,000 t/year, that is about 1,100 t/day. Among 400,000 tons of municipal solid waste annually generated, 50,000 tons is assumed to be bulk waste. It

is also estimated that 80% of the municipal solid waste is discharged by households while the commercial and administrative sectors discharged the remaining 20%.

B) Physical composition of MSW

The physical composition of the municipal waste in Kharkiv City was surveyed in 2003 and 2012 and their results were shown in Table 3.80 and Table 3.81, respectively. The proportion of food waste in 2003 was more than 40% but it decreased to about 15%~25% in 2012, whereas the proportion of glass was 8% in 2003 an increased at about 10%~20% in 2012. It is also assumed that the difference on category of waste composition as well as contents of 'other waste' or 'residual' affected on this fluctuation of proportion.

Table 3.80 Physical Composition of MSW in Kharkiv City (2003)

No.	Component	Composition (%)
1	Food waste	41.38
2	Polymers	7.67
3	Paper and cardboard	13.45
4	Wood	1.67
5	Textiles	3.81
6	Metal	2.87
7	Glass	7.74
8	Hazardous waste	0.51
9	Other waste	20.90
	Total	100.00

Source: Kharkiv City Council (2003) "Scheme of Sanitary Cleaning of the City of Kharkiv and the Program for the Development of the Solid Waste Management System"

Table 3.81 Physical Composition of MSW in Kharkiv City (2012)

No.	Component	Residential (multi-family)	Residential (single-family)	Enterprise
1	Food waste	26.1	24.1	15.1
2	Paper and cardboard	6.8	7.6	26.9
3	Polymers	13.1	10.2	20.7
4	Glass	20.8	9.6	17.6
5	Ferrous metals	1.3	0.5	1.0
6	Non-ferrous metals	0.2	0.8	0.2
7	Textile	4.8	9.8	3.4
8	Tree	1.0	1.4	1.4
9	Hazardous waste	0.6	0.7	0.7
10	Bone, leather, rubber	2.1	1.8	1.9
11	Combined waste	1.2	0.6	2.0
12	Residual after removal	22.0	32.9	9.1
12.1	Street sweep, leaves	(4.0)	(0.0)	(5.3)
12.2	Sanitary facilities	(5.9)	(7.6)	(0.0)
12.3	Others	(8.9)	(19.3)	(3.8)
	Total	100.0	100.0	100.0

Source: Kharkiv City Council

C) Chemical composition of MSW

There was no available data on chemical composition of municipal solid waste in Kharkiv City.

2) Result of waste composition survey and chemical analysis of JICA Survey

The waste composition survey in Kharkiv City was conducted on 29 March 2018 at Dergachi Landfill and chemical analysis was conducted successively. The physical composition of the municipal solid waste in Kharkiv City measured by the JICA Survey Team was summarized in Table 3.82. Kitchen

waste accounted for 50.8%, followed by paper (13.3%), plastic (11.6%), and glass (10.5%). The 'others' mostly consisted of diapers and napkins. The bulk density of the sample was 0.14 kg/L.

Table 3.82 Physical Composition of MSW in Kharkiv City (2018)

No.	Category	Composition (%)
1	Papers	13.3
2	Kitchen wastes	50.8
3	Woods	1.3
4	Cloths	3.3
5	Plastics	11.6
6	Rubbers and leathers	2.8
7	Metals	0.9
8	Glasses	10.5
9	Crockery and stones	1.7
10	Others	3.8
	Total	100.0

Source: JICA Survey Team

The result of chemical analysis is presented in Table 3.83. Gross calorific value is 3,872 kcal/kg, moisture content is 27.8%, ash content is 6.8%, and loss on ignition is 65.4% in raw waste (wet basis).

Table 3.83 Chemical Composition of MSW in Kharkiv City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	3,872	5,354
2	Moisture content	%	27.8	-
3	Ash content	%	6.8	9.4
4	Loss on ignition	%	65.4	90.6
5	Carbon	%	37	52
6	Hydrogen	%	4.6	6.4
7	Oxygen	%	22	31
8	Nitrogen	%	0.69	0.96
9	Chlorine	%	0.507	0.702
10	Sulphur	%	0.17	0.24

Source: JICA Survey Team

The detailed methodology and records of waste characteristic survey are attached as Appendix 5.

The gross calorific value of 3,872 kcal/kg in the JICA survey (2018), which was analyzed in the certified laboratory by a bomb calorimeter, seems too high when compared with the other two cities as well as average gross calorific value of municipal solid waste in other countries.

As it is difficult to evaluate waste characteristic by a small number of samples and surveys, it is desirable that Kharkiv City periodically implements waste characteristic survey to accumulate reliable data.

(2) Waste Collection and Transportation

1) Implementation structure of waste collection and transportation

The Kharkiv City Council entrusts municipal waste collection and transportation services to the communal enterprise named 'Municipal enterprise of complex on municipal waste removal (KVBO)' and the two private companies i.e., Mega-Trans and Kharkiv Ecoresource as listed in Table 3.84. Currently, around 80% of the municipal solid waste is collected by KVBO and the remaining 20% is collected by the private service providers based on direct contracts with the municipal waste generators. According to the Kharkiv City Council, Kharkiv Ecoresource is not updating its collection vehicles

and equipment and therefore, the State Administration assumes it will exit from the market in the near future. On the other hand, Mega-Trans is updating its vehicles and equipment and it is assumed that they will continue operating on the municipal waste collection service. In Kharkiv City, there were more than 15 private service providers engaged in municipal waste collection service in the past ten years but the number of the service providers decreased in accordance with the enhancement of the operational capacity of KVBO.

Table 3.84 Municipal Solid Waste Collection Service Providers in Kharkiv City

No.	Name of Service Provider	Type of Company
1	Municipal enterprise of complex on municipal waste removal (KVBO)	Communal enterprise
2	Mega-Trans	Private company
3	Kharkiv Ecoresource	Private company

Source: Kharkiv City Council

KVBO's municipal waste collection service is performed seven days a week, although the private service providers are assumed to be operational 2~3 days a week based on the contracts with waste generators. A collective segregated waste collection system is not yet introduced in the city but the Kharkiv City Council has a clear intention to introduce segregated waste collection in the city in the near future.

KVBO has contracts with 420,000 households and 80,000 offices in the city. The amount of municipal waste collected by KVBO reaches to about 300,000 t/year, that is about 820 t/day. About 45% of the municipal waste collected by KVBO is disposed at Dergachi Landfill operated by the public enterprise, MKPV, and the remaining 55% is disposed at another landfill operated by a private company. The collection rate of municipal waste is 100% according to the Kharkiv City Council. The scenery of waste collection in the city is presented in Figure 3.35.

Typical waste containers in the city

Waste collection work by KVBO

Old type containers procured in former Soviet Union era

Recyclable collection containers in the city

Source: JICA Survey Team (April 2018)

Figure 3.35 Scenery of Municipal Waste Collection in Kharkiv City

2) KVBO

KVBO is a communal enterprise providing a major part of the municipal waste collection and transportation service in the city. There are about 400 staff in KVBO and 60% of the staff are collection vehicle drivers. KVBO's municipal waste collection service is operated daily and there are three shifts of 8-hour collection schedules starting from 4:00, 7:00 and 18:00 respectively, so as to avoid traffic jams in the city.

KVBO owns about 170 collection vehicles (including 75 compactor trucks, 28 desorbing body trucks, 20 tractors and some dump trucks and telehandlers) and 3 collection vehicle bases in the city. It manages about 6,950 waste containers in the city. KVBO is currently updating its collection vehicles from the vehicles manufactured in the former Soviet Union to the vehicles of Ford Motor Company manufactured in Turkey. KVBO in cooperation with Ford Motor Company is currently constructing a vehicle workshop within the area of collection vehicle base so that all the vehicle maintenance and repair works can be performed by KVBO.

Besides this, there are 30 collection vehicles which are equipped with GPS, and their operation is controlled and managed by the dispatch center in the collection vehicle base. This operation management system enables efficient management of vehicle operation schedule, fuel consumption, etc. KVBO is planning to equip GPS system to all the collection vehicles in the near future. Figure 3.36 presents some vehicles and equipment owned by KVBO and Figure 3.37 presents collection the vehicle management system of KVBO.

Collection vehicles of Ford Motor Company

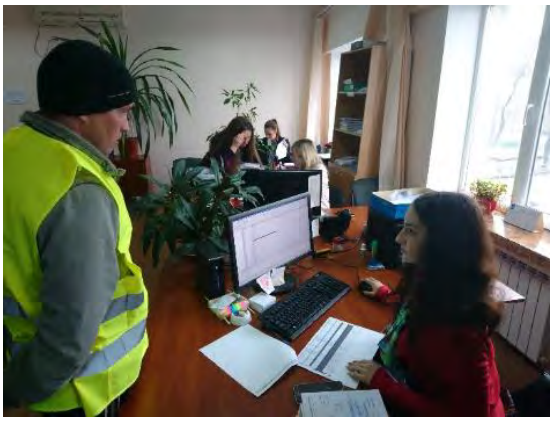
Collection vehicles of former Soviet Union

Typical metal waste containers

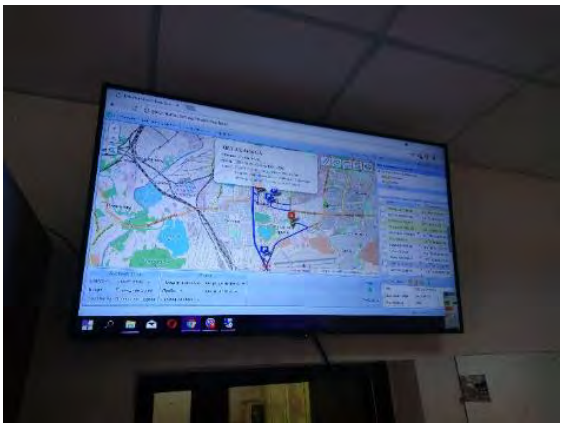
Plastic wastte bins

Source: JICA Survey Team (April 2018)

Figure 3.36 KVBO's Collection Vehicles and Equipment



Dispacher instructing collection schedule to a driver



Vehicle operation management system

Source: JICA Survey Team (April 2018)

Figure 3.37 KVBO's Collection Vehicle Operational Management System

(3) Intermediate Treatment and Recycling

There is no intermediate treatment facility of municipal solid waste in operation in Kharkiv City at the moment, although there is a plan to construct a waste sorting facility as part of the World Bank's sanitary landfill construction project.

As for recycling, the Kharkiv City Council intends to promote segregated waste collection in the city in the near future, however, there is no recycling activity implemented by the City Council so far. The City Council acknowledges the existence of private and informal sectors involved in recycling, but there is little information on those activities.

(4) Final Disposal

The City of Kharkiv and three surrounding counties currently use the following two landfill sites respectively located in the northern and southern parts of the city.

1) Landfill of municipal enterprise "Municipal company of waste management"

The landfill located in the northern part beyond the city boundary and located inside the neighboring municipality Dergachi City, is a communal site owned by the Kharkiv Municipality and operated by the communal enterprise "Municipal company of waste management" as known as MKPV. The area size of the landfill is 13 hectares and it started its operation from 2006 as the second stage of the landfill project, accepting about 250,000 tons of waste annually. According to the current plan, this landfill will be used for about one or two years more until 2019 when the new landfill site is constructed by the support of the WB.

Before this second stage, there is an old landfill named at the first stage, which started its operation in 1973 and has operated until 2005 for more than 30 years.

The area for the landfill used to be owned by the Kharkiv Oblast was given to Kharkiv City for the purpose of development for solid waste management in exchange of a one-time compensation with the amount of UAH 4,000,000.

For the construction of the second stage of the Dergachi Landfill, the design and estimate documentation was developed by the Institute of PRAT "Kharkiv Design and Survey Institute of Transport Objects" (PRAT HARDIPROTRANS).

Design of the landfill basically follows the EU standard. For example, the bottom of the landfill is covered by the clay layer first, then geo-textile layer and geo-membrane layer were set in place to prevent the infiltration of leachate into the ground. The leachate collection piping network was laid on that bottom and covered by large crushed stones. The leachate collected through the collection pipe is accumulated in the storage pond with the capacity of 250 m^3. The leachate is then pumped up and transported to the communal sewerage treatment plant by the tank trucks when the pond becomes full.

Following the landfill operation standard, waste disposed of at the site is spread over and compacted by bulldozers and landfill compactors to make the waste accumulate layers with 2 to 2.5 m of its thickness. The surface of such layers is occasionally covered by natural soil as often as when the soil is brought into the site from outside. Some of the construction waste is crushed and used to strengthen the site road for smooth driving of the trucks in the landfill.

The truck scale was constructed about several months ago to start measuring the weight of waste, instead of counting by volume bases.

There are four monitoring wells dug at the surrounding points of the landfill. Two of them have 30 m depth and another two have 60 m depth. Every three months, ground water, soil, and gas are sampled for analysis for the regular environmental monitoring.

This landfill accepts non-hazardous waste which are municipal solid waste, industrial waste and construction waste, and 80% to 90 % of these are municipal waste.

According to the landfill site manager, there is almost no waste pickers in the landfill. In addition, the manager just observes a few pickers sometimes that enter the site to collect the valuables but they are always ordered by the landfill manager to leave the site.

Figure 3.38 shows the photos of the Kharkiv municipal landfill in Dergachi, taken by the JICA Survey Team on 27 March 2018.

Distant view of landfill area

Operating area

Weighing scale and waste collection trucks

Leachate storage pond

Source: JICA Survey Team (April 2018)

Figure 3.38 Scenery of Kharkiv Municipal Landfill in Dergachi

2) Landfill of private enterprise LLC “Recycling Plant”

The landfill site in the southern part of the city is owned and managed by a private operator named the LLC Recycling Plant. Area size of the landfill is 19 hectares and it started its operation from 2002, accepting about 150,000 tons of waste annually. This landfill is planned to be used for about two more years until 2019. There is no area for additional expansion at this site because it is located within 5 km

of the airport. New regulations in Kharkiv limit landfill locations from being within 15 km of the airport. The private operator has been made aware of the new regulation and has agreed to terminate operations at the site once the landfill reaches its capacity.[17]

(5) Financial Matters

1) Waste collection and disposal fee

Tariffs for municipal solid waste collection and disposal in Kharkiv City are stipulated in the decisions by the Kharkiv City Council as shown in Table 3.85. The tariff includes the fee for waste collection and treatment service as well as disposal fee at the landfills.

Table 3.85 Tariff for Municipal Solid Waste Collection and Disposal in Kharkiv City

Unit: UAH/m^3

Category of Waste Generator	KVBO	Mega-Trans	Kharkiv Ecoresource
Residents	55.56	54.42	67.28
Public institutions	60.84	58.19	73.69
Other waste generators	79.32	68.88	93.25

Source: Kharkiv City Council (2014 and 2016) "Decision of the Executive Committee of Kharkiv City Council dated 19 July 2016 No.472", "Decision of the Executive Committee of Kharkiv City Council dated 5 November 2014 No.646", "Decision of the Executive Committee of Kharkiv City Council dated 23 February 2016 No. 110"

The operational cost of municipal waste collection and disposal service is not fully covered by the waste management tariff paid by the waste generators in Kharkiv City. The Kharkiv City Council gives a budget to KVBO annually amounting to about UAH 100 million. About 60% of this budget is utilized for KVBO's capital investment such as procurement of waste collection vehicles and waste containers. The remaining 40% is spent for operational cost such as maintenance of waste collection vehicles and implementation of waste collection service through small waste bins, as well as salary for KVBO' staff. It is understood that the city council needs to subsidize KVBO as it is politically difficult to increase municipal waste management tariffs for waste generators.

The disposal fee charged by the waste disposal facilities from the waste collection service providers in Kharkiv City is summarized as shown in Table 3.86.

Table 3.86 Fee for Solid Waste Treatment and Disposal in Kharkiv City

Waste Treatment and Disposal Facility	Type of Waste	Disposal Fee
Dergachi Landfill	Waste from household	UAH 7.24/m^3
	Waste from private sector and institution	UAH 10.34/m^3

Source: JICA Survey Team based on interviews with the concerned organizations

2) Budget and expenditure of the organizations related to MSWM

A) KVBO

General information of the company is sorted in Table 3.87.

ME "Municipal waste Disposal Complex" (KVBO was established as a result of separation from MKPV ("Municipal company on waste management"), shown later) – becoming an independent unit, a successor of MKPV in the collection and transportation (removal) of municipal waste.

In accordance with the charter, the main purpose of KVBO's activity is the development of a system for handling municipal wastes in Kharkiv City, implementing decisions of the city council and its executive bodies on collection, transportation (removal) of wastes of production, and consumption in the city. Since 2011, KVBO has been the provider of services for the removal of municipal waste in Kharkiv, as assigned by the Kharkiv City Council.

[17] *Source: Project Appraisal Document on A Second Urban Infrastructure Project by the World Bank, http://documents.worldbank.org/curated/en/864581468313769909/pdf/840650PAD0P132010Box385199B00OUO090.pdf (as of 28 May 2018)*

Table 3.87 General Information of CE "KVBO"

Name	**ME "KVBO" (Rus) / "KVPV" (Ukr)** **Full name**: Municipal Enterprise "Municipal waste Disposal Complex"
Reg. No.	33290649
Authorized Capital	UAH 207,412,317.60
Paid-in Capital	UAH 160,810,000.00
Type of Company	Municipal entity
Shareholder(s) with %	Kharkiv City Council 100%
Year Started	2005 (legally registered on 10January 2005)
Address	Zolotyi lane, 4, Kharkiv, Ukraine
No. of Director(s)	1 Director Fixed-term contract 08-Dec-2015 to 07-Dec-2020
Employees	Approximately 350 to 415
Website	http://musor.kharkov.ua/

Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 22 May 2018)

Income statements in the past three years of the company are shown in Table 3.88 and balance sheet as of 1 January 2018 is shown in Table 3.89. The following are the findings based on these:

- KP "KVBO" is renewing its production assets. According to the KVBO Director, as of 2017, the company replaced 50% of its obsolete machinery. In 2017, the KVBO has purchased 14 units of machinery (including 8 garbage trucks). In 2018, it is planned to acquire another 25 garbage trucks, 10 bunker trucks, and 3,000 new garbage containers.
- Cost of sales in 2017 drastically increased from 2016 (increased by UAH 34 million). All of the cost items such as material, labor, etc. increased but the biggest contribution of it is the increase of depreciation, UAH 22.5 million, which evidences the replacement of assets.
- Other than the abovementioned points, sales and administration expenses are stable in these years. When the company has a deficit in profit before tax, other income (most probably subsidy from city government) fills the gap to make it a surplus.

Table 3.88 Profit and Loss Statement in the Last Three Years of CE "KVBO"

Unit: UAH

Financial Items	FY2015	FY2016	FY2017
Sales revenue	121,096,000	121,573,000	125,719,000
Cost of sales	-117,260,000	-117,250,000	-151,181,000
Gross profit	3,836,000	4,323,000	-25,462,000
Administrative expenses	-8,152,000	-8,278,000	-8,197,000
Other income	23,004,000	36,673,000	40,733,000
Other expenses	-16,826,000	-14,773,000	-17,824,000
Profit (loss) before tax	1,862,000	17,945,000	-10,750,000
Income tax	-215,000	-3,394,000	-
Net profit	1,647,000	14,551,000	-10,750,000

Source: JICA Survey Team based on Statements of Financial Results of KVBO for 2016, 2017

Table 3.89 Balance Sheet of CE "KVBO" (as of 31 December 2017)

Assets			Liabilities		
Current Assets	**UAH**	**USD***	**Current Liabilities**	**UAH**	**USD**
Cash	5,439,000	193,785	Accounts Payable - suppliers	43,060,000	1,534,174
Accounts Receivable	68,124,000	2,427,173	Accounts Payable - fiscal payments	469,000	16,710
Accounts Receivable - fiscal payments	10,562,000	376,311	Short-term Bank Loans	533,000	18,990
Inventory	3,498,000	124,629	Advances Received	1,839,000	65,521
Other Current Assets	4,337,000	154,522	Accrued Income	194,000	6,912
			Other Current Liabilities	16,388,000	583,884
Total Current Assets	**91,960,000**	**3,276,420**	**Total Current Liabilities**	**62,483,000**	**2,226,191**
Fixed Assets			**Long-term Liabilities**		
Fixture and Equipment	120,416,000	4,290,271	Long-term Debt	0	0,
Construction in Progress	5,850,000	208,428	Targeted Financing	0	0,
Other Non-Current Assets	86,000	3,064	**Total Long-term Liabilities**	**0**	**0,**
			Shareholders' Equity		
			Common Stock, Additional Paid-in Capital	160,810,000	5,729,459
Total Fixed Assets	126,352,000	4,501,763	Retained Earnings	-4,981,000	-177,467
Total Assets	**218,312,000**	**7,778,183**	**Total Liabilities and Equity**	**218,312,000**	**7,778,183**

Note: Translation to USD is made for reference based on the year-end exchange rate of USD/UAH = 28.0
Source: Statement of financial position (Form 1) as of 31 December 2017

B) MKPV

The general information of the company is sorted in Table 3.90.

ME "MKPV" was established according to the resolution of the Kharkiv City Council in 2000. The company's main activity, as prescribed in its charter, is collection, processing, transportation, and disposal of consumer and hazardous wastes in Kharkiv. The company is managing the landfill in Dergachi City – the main landfill for the solid wastes generated in Kharkiv City.

In August 2017, the Cabinet of Ministers of Ukraine approved the construction of modern waste processing plant in the area of Dergachi Landfill. The total area of the complex will be over 39 hectares. The enterprise will be built in two stages, with equipment for waste processing and power generation. The total estimated cost of construction is around USD 44 million, financed by the loan to MKPV from the World Bank within its "Second Urban Infrastructure Project No. 2".

Power generated from the landfill gas will be sold to the energy market and the proceeds will be used for repaying the loan from the World Bank.[18][19]

[18] *http://www.city.kharkov.ua/ru/news/kabmin-zatverdiv-proekt-budivnitstva-smittepererobnogo-zavodu-36224.html (as of 28 May 2018)*
[19] *http://documents.worldbank.org/curated/en/300611508448751022/Official-Documents-Project-Agreement-for-Loan-8391-UA, (as of 28 May 2018)*

Table 3.90 General Information of CE "KVBO"

Name	**ME "MKPV"** **Full name**: "Municipal company for waste management" of the Kharkiv City Council
Reg. No.	30990215
Authorized Capital	UAH 23,567,178.00
Paid-in Capital	UAH 68,752,000.00
Type of Company	Municipal entity
Shareholder(s) with %	Kharkiv City Council 100%
Year Started	2000 (legally registered on 27 June 2000)
Address	Podilskiy lane, 17, Kharkiv, Ukraine
Number of Director(s)	1 Director
Employees	Approximately 50 to 75
Website	http://www.city.kharkov.ua/uk/gorodskaya-vlast/ispolnitelnyie-organyi/departamentyi/departament-kommunalnogo-xozyajstva.html

Source: JICA Survey Team based on State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 24 May 2018)

Income statements in the past three years of the company are shown in Table 3.91 and balance sheet as of 31 December 2017 is shown in Table 3.92. The following are found based on these:

- Sales revenue in the past three years is stable and Cost of Sales is increasing year by year, as a result in most cases, annual gross profit becomes negative and other income is supplemented by the city government to fill up such deficit of the company. This is the main structure in these years.
- Administrative cost in 2018 is four times higher the than previous years. This budget is seemed to be preparation cost for new construction under IBRD loan project. High cash balance and long-term debt could also be seen as evidence for such project preparation.

Table 3.91 Profit and Loss Statement in the Last Three Years of CE "MKPV"

Unit: UAH

Financial Item	FY2015	FY2016	FY2017	FY2018 (Plan)
Sales revenue	12,457,000	11,483,000	12,986,000	13,500,000
Cost of sales	-11,042,000	-13,152,000	-16,027,000	-17,959,000
Gross profit	1,415,000	-1,669,000	-3,041,000	-4,459,000
Administrative expenses	-2,470,000	-2,291,000	-2,836,000	-11,940,000
Other income	2,079,000	10,331,000	15,337,000	17,047,000
Other expenses	-928,000	-6,257,000	-7,782,000	-508,000
Profit (loss) before tax	96,000	114,000	1,679,000	140,000
Income tax	-17,000	-515,000	-332,000	-25,000
Net profit	79,000	-401,000	1,347,000	115,000

Source: JICA Survey Team based on Statements of Financial Results of MKPV for 2016, 2017 and Plan for 2018

Table 3.92 Balance Sheet of CE "MKPV" (as of 31 December 2017)

Assets			Liabilities		
Current Assets	**UAH**	**USD***	**Current Liabilities**	**UAH**	**USD**
Cash	89,420,000	3,185,923	Accounts Payable - suppliers	667,000	23,764
Accounts Receivable	16,311,000	581,140	Accounts Payable - fiscal payments	877,000	31,246
Accounts Receivable - fiscal payments	768,000	27,363	Advances received	566,000	20,166
Inventory	257,000	9,157	Accrued income	0	0
Other Current Assets	366,000	13,040	Other Current Liabilities	643,000	22,909
Total Current Assets	**107,122,000**	**3,816,623**	**Total Current Liabilities**	**2,753,000**	**98,086**

FIXED ASSETS			Long-term Liabilities		
Fixture and Equipment	33,991,000	1,211,057	Long-term Debt	101,511,000	3,616,710
Construction in Progress	32,340,000	1,152,234	Targeted Financing	0	0
Other Non-Current Assets	20,000	713	**Total Long-term Liabilities**	**101,511,000**	**3,616,710**
			Shareholders' Equity		
			Common Stock, Additional Paid-in Capital	68,752,000	2,449,548
Total Fixed Assets	66,351,000	2,364,003	Retained Earnings	457,000	16,282
Total Assets	**173,473,000**	**6,180,626**	**Total Liabilities and Equity**	**173,473,000**	**6,180,626**

Note: Translation to USD is made for reference based on the year-end exchange rate of USD/UAH = 28.0
Source: Statement of Financial Position as of 31 December 2017

(6) Private Sector and Informal Sector

As described in the previous sections, involvement of the private sector in the municipal solid waste management in Kharkiv City is observed in the fields of collection and transportation as well as final disposal.

As for the collection and transportation field, the municipal waste collection and transportation service is performed mainly by the communal enterprise; KVBO. However, there are two private service providers who collect about 20% of municipal solid waste generated in the city.

As for the final disposal field, there are currently two landfills that receive municipal solid waste generated in the city. The Dergachi Landfill is operated by the communal enterprise; MKPV and the other landfill located in the southeast part of the city is operated by a private company named Recycling Plant.

There is little information on the recycling field but there is a possibility that the private sector is engaged in recyclable material collection and/or waste sorting and material recovery.

There is little information on the informal sector's activity on solid waste management in Kharkiv City, however, some waste pickers were observed in the Dergachi Landfill when the JICA Survey Team visited. It is also assumed that there may be informal recyclable collectors and traders in the city.

(7) Environmental Education and Public Awareness

The Kharkiv City Council is implementing environmental education and awareness raising activities focused on the solid waste management issue, although the scale and frequency of those activities are quite limited. The Department of the Municipal Services of Kharkiv City Council, which is the main responsible department of solid waste management in the city, has experience implementing awareness raising activities in collaboration with other departments such as the Department of Education. However, there is no experience of collaborated environmental education activity with environmental NGOs so far.

(8) Public Opinions on Waste Management including Incineration

According to the City of Kharkiv, this city is the only city in the country which provides a hotline service to the citizens, dial 1562, to accept complaints about the city services.

Kharkiv City is keeping such complaints in its record but not analyzing the complaints in detail. The complaints related to the solid waste management is not so often claimed. There are some complaints about the private landfill due to its inappropriate management, such as bad odor, littering, fires and smoke.

When the public hearing to the construction of current waste disposal site in Dergachi was conducted as a part of an EIA, there were some negative opinions but it did not affect the project.

There is also the same type of waste incinerator operated at the southern part of Kharkiv City called the Energia Incineration Plant in Kyiv City. The experience of running this waste incineration plant in Kharkiv was negative because the residents who are living in the neighboring area complained about

the colored smoke and smells. As the result of such negative movement, although not only limited to this, the incineration plant was stopped in its operation and demolished. Therefore, it could be said that there is still some population who misunderstood the thermal waste utilization methods.

On the other hand, there are many combustion facilities which are mostly power and heat generating plants within or around the city, but not so many negative opinions about these plants from the public. It is optimistically expected that most of the citizens can allow the installation of the new waste incinerator, considering the incinerator is basically the same facility as a power plant or heating boiler, and not the same as a waste disposal dumping site.

3.3.6 Waste Management Plan and Project in Kharkiv City

(1) Waste Management Master Plan

The Solid Waste Management in Kharkiv City is led by the following three documents;

Table 3.93 Master Plan and Programs of MSWM in Kharkiv City

Date	City Council Decision No.	Title	Summary
2003/12/24	No. 284/03	The Scheme of Sanitary Cleaning of Kharkiv for 2004-2020 (with amendments and additions)	Regulation for sanitation, mechanical scheme, responsibility of each entity, etc.
2003/12/24	No. 284/03	The Program of Development of the Solid Waste Management System in Kharkiv for 2015 – 2026	Waste Management Strategy of Kharkiv City for long term
2011/11/16	No. 504/11	Rules for Landscaping City of Kharkiv (with amendments and additions)	"Rules" relationship between municipality and other 3rd companies/ right and obligation of citizen to let city clean / penalties

Source: JICA Survey Team

(2) Facility Development Plan and Project

In line with city's master plan for solid waste management, IBRD and Clean Technology Fund (CTF) are in preparation to co-finance the solid waste treatment projects named "Urban Infrastructure Project 2 (UIP2)" in Dergachi City, where one of the operating landfills is located.

UIP2 consists of ten sub-projects for wastewater improvement and solid waste improvement in nine local governments in Ukraine. Kharkiv City has two projects, (1) Design and build of wastewater and sludge treatment facility (Total Project Cost: USD 75.8 million) and (2) Construction of a solid waste treatment facility (Total: USD 43.99 million).

Kharkiv City will construct a 34-ha solid waste disposal site with a recycling and sorting facility as well as a biogas collection system that allows for landfill gas recovery and electricity generation. This is the first project of its kind to be developed in Ukraine, and will therefore provide many important lessons to be learned for future replication to other cities across the country. These investments include the following:

i) Construction of a modern landfill site in accordance with the requirements of Ukrainian and European environmental legislation;
ii) Reclamation of the operating landfill of solid domestic wastes;
iii) Installation of a landfill gas collection system at new and adjacent existing landfills;
iv) Installation of a landfill gas recycling system with electricity production and transmission system of generated electricity into the network of the National Energy Company "Ukrenergo";
v) Construction of a sorting line of separately collected waste with the capacity of 40,000 tons per year and mixed waste with the capacity of 80,000 tons per year;
vi) Construction of appropriate structures, engineering networks, and landscaping of the territory.

The full project requires an investment of USD 70 million and is expected to be completed in two phases. The UIP2 project will be funding only the first phase comprising a USD 44 million investment

for a 17-ha site. The site is expected to be operational for ten years after which the second phase of 17 ha will become operational. This second phase is part of a non-bank funded component that will require investment at some point in the future. Table 3.94 highlights the investments for the full project and shows the World Bank's involvement in financing the first phase of the project.

Table 3.94 Investments in Kharkiv City Solid Waste Management Project of UIP2

Unit: USD in Millions

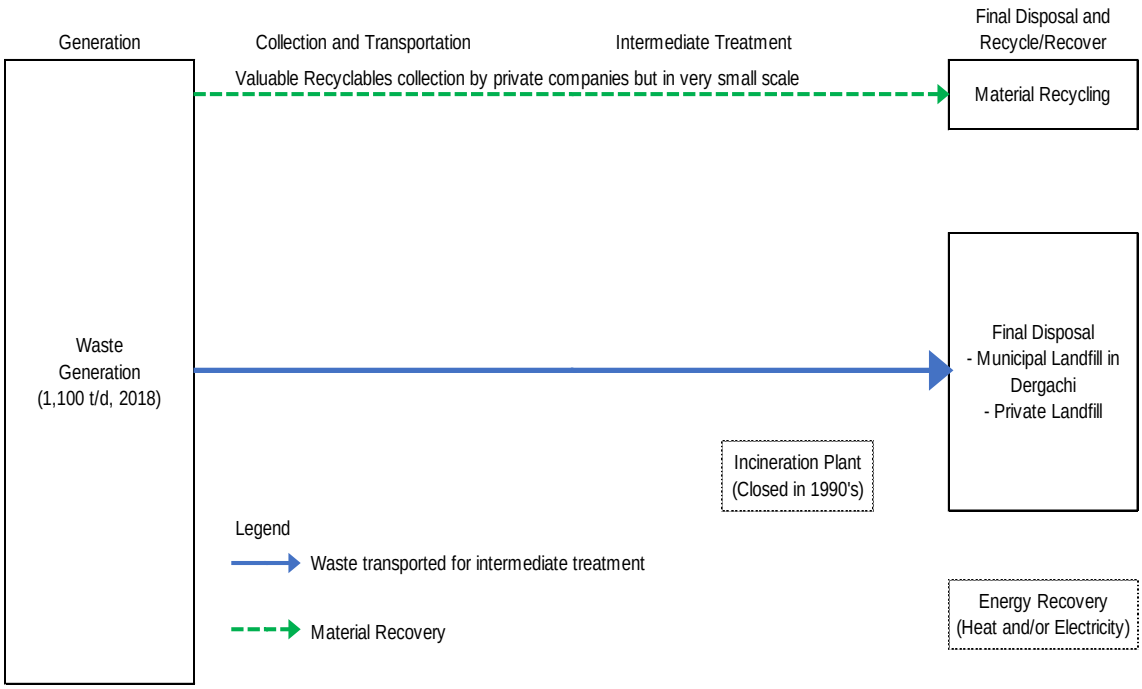
Investment	Phase 1 (UIP2 Project)	Phase 2 Non-Bank Funded (Future Investment)	Total
(i) Solid Waste Landfill Works include excavation; lining, drainage system, leachate removal; weight scales, etc.	21.0	18.0	39.0
(ii) Electric Power Generation Generators; pumps; transformers; 4 km electricity lines	10.4	8.0	18.4
(iii) Solid Waste Recycling Facility Sorting facility; office and amenity building; equipment; recycling containers; public education campaign	8.0	-	8.0
(iv) Land Improvement Roads and Landscaping	4.6	-	4.6
Total	44.0	26.0	70.0

Source; Project Appraisal Document on a Proposed Loan (USD 300 M) and a Proposed CTF Loan (USD 50 M) to Ukraine for a Second Urban Infrastructure Project (Jan. 2014)

3.3.7 Current Issues on Waste Management in Kharkiv City

Considering the current overall situation of Kharkiv City, it could be said that the Kharkiv City Council makes its best effort to manage the municipal solid waste generated from the city within its available resources. Almost all wastes are regularly collected from the generation sources by the municipal enterprise of complex on municipal waste removal (KVBO) and some private waste collection companies. These wastes are then transported to the designated final disposal sites such as the Municipal Landfill in Dergachi or other private landfills, as summarized in Figure 3.39.

There was a waste incineration plant which is the same type of Energia Plant, but it stopped operating in the 1990s. There is no municipal waste processing plant at this moment.



Source: JICA Survey Team

Figure 3.39 Current Waste Management Process in Kharkiv City (2018)

However, looking into the detailed points on each process and assuming the situations in the near future, several issues have been identified and are shown below.

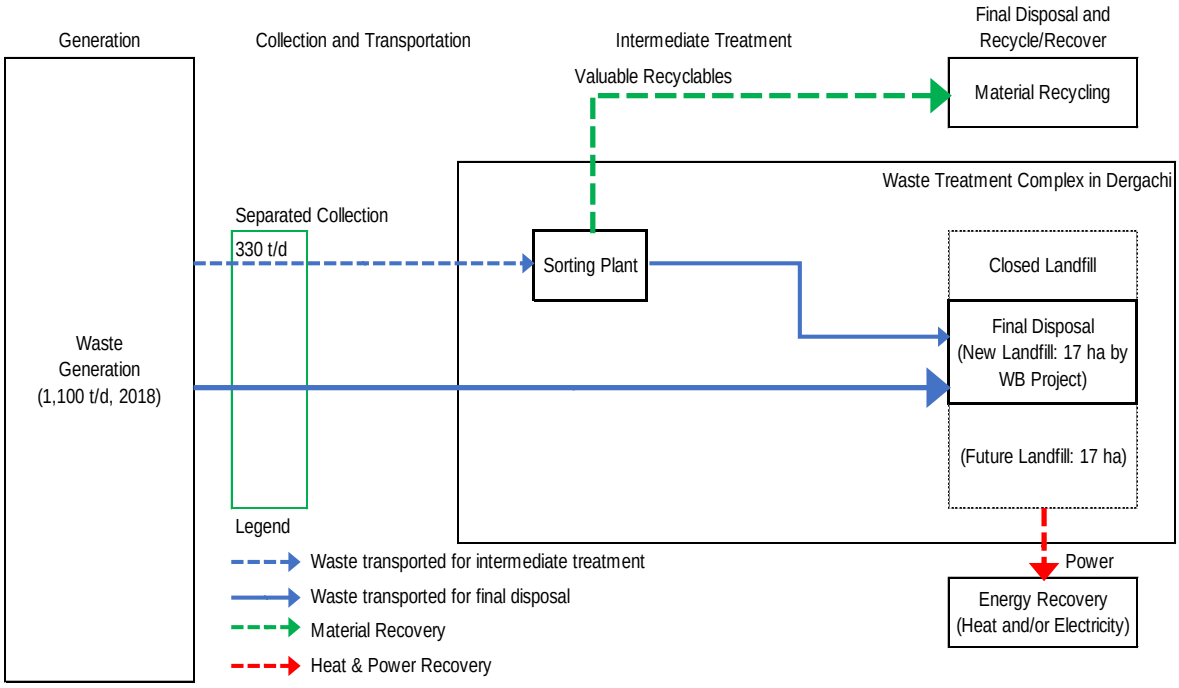
i) Efficiency of Operation of Sorting Plant
It is expected the new waste sorting plant under the construction as part of the WB project will start its operation in fall of 2019. At this moment, however, there is no plan to introduce the segregated waste collection to operate the sorting plant efficiently to remove the recyclables.

ii) Necessity of further waste reduction at the landfill
The facility components of the WB project are the sorting plant, new landfill and landfill gas collection and utilization system. Considering the design capacity of the sorting plant, there might be still a large portion of the municipal waste to be directly disposed of at the landfill. Although such waste will be a potential for bio-gas, the new landfill still requires a large capacity. Considering the principles of the National Waste Management Strategy which is to reduce the amount of waste to be directly disposed of at the landfill, some additional treatment might be necessary in the future.

iii) Existing illegal dumping sites and inappropriate private landfill
Some wastes collected by the private waste collection companies might be disposed of at unauthorized dumping sites illegally.
There is one authorized private landfill accepting the waste generated in Kharkiv City. It is reported that the landfill management there is not always appropriate and it causes some environmental problems against that affected people.

iv) Necessity of efficient operational system for the new sorting plant
It was observed that segregated collection for some recyclable materials such as plastic container and glass or metal bottles at some residential complexes are initiated by the private sector, but in a very small scale. Considering the efficient recovery of recyclables at the new sorting plant constructed by the WB project, recyclables shall be separated and discharged into the designated containers at the generation sources. However, such experiences of the implementation of city-wide segregated waste collection has never accumulated in Kharkiv City.
In addition, Kharkiv City also does not have the operational experience of sorting plant. According to the MKPV who might be the operator of the new plant, they will have to employ many operational staff for the plant including well-skilled engineers and operators.

The waste management process as planned at this moment in Kharkiv City could be summarized in Figure 3.40. As this figure shows, there is a large need for the Kharkiv City Council to introduce the segregated waste collection and reliable sorting plant operation, in addition to the further reduction of the waste to be disposed of at the landfill.



Source: JICA Survey Team

Figure 3.40 Plan for Future Waste Management Process in Kharkiv City (as of 2018)

3.3.8 Current Situations in Kharkiv Oblast

(1) Municipal Waste Management Situations

According to the "Comprehensive Program Environmental Protection of the Kharkiv Region for 2009 -2013 and for the Future Up to 2020", 533,000 tons of municipal waste were generated in 2008 in the Kharkiv Oblast. During those days, 94 landfills or open dumping sites existed in the oblast but most of these were almost full or over the capacity which was 5,038.3 thousand tons over the total area of 303.62 ha. It was estimated that 76.9% of such landfill capacity was already occupied by the buried waste and only 23 of the landfills were operated. Most of the municipal waste was just collected and directly disposed of at such landfills.

Therefore, the Kharkiv Oblast State Administration has been implementing the improvement of the solid waste management situation by closing the over-capacity landfills and dumping sites, constructing the regional landfill for the waste generated from several districts, together with the waste processing facility such as the sorting plant. One of the examples of such development is the waste processing complex in Bogodukhivskyi District.

Landfill in the complex is owned by Bogodukhivskyi District and was developed under the public-private-partnership among the district, Kharkiv Oblast State Administration, and two private companies such as EKOBTOP. This location used to be an illegal dumping site but had been improved and designated as the municipal landfill area. In 2014, it was decided to develop this site with an area of 5.5 ha as the waste processing complex. Estimated budget for this project was UAH 80.95 million and the construction was started in 2014 and completed in 2016. This type of waste treatment complex is, according to Kharkiv City's website[20], the first complex in Ukraine which consists of a landfill, composting, and sorting facilities.

[20] *Source: http://kharkivoda.gov.ua/news/81199 (as of 04 June 2018)*

This complex has been operated by EKOBTOP with 22 staffs under a five-year contract from 2017, and it accepts about 50 to 80 m^3 of municipal solid waste every day from Bogodukhivskyi District and its surrounding municipalities. Separated valuables such as papers, PET or glass bottles, metals, and other plastic goods are sold to the local recycling dealer at market prices. Contract operation price agreed among the district and EKOBTOP is UAH 60 per m^3. The district charges the waste removal tariff to the residents at UAH 15 per person per month. This tariff amount can be reduced in case the financial balance of the complex will become very positive.

Building for administrative office and waste sorting facility

Landfill area with screening equipment for composting

Waste feeding conveyor and trommel of the sorting facility

Manual sorting line

Source: JICA Survey Team (February 2018)

Figure 3.41 Waste Processing Complex in Bogodukhivskyi District

(2) Waste Management Master Plan

There are two fundamental documents which could be considered as the master plan for solid waste management for the Kharkiv Oblast at this moment.

1) Comprehensive Environmental Protection Program for the Kharkiv Region for 2009-2013 and Up to 2020

Kharkiv Oblast State Administration has been implementing “Comprehensive Environmental Protection Program for the Kharkiv Region for 2009-2013 and Up to 2020” approved by the decision of the Kharkiv Oblast Council on 29 October 2009, No. 1413-V, including its amendments. This program reports the various kinds of environmental issues in the region such as wastewater, pesticides and agrochemicals, gas emissions and residual ash from the power plants, industrial and municipal waste, and so on. Seven measures on the rational usage and storage of industrial and municipal waste are planned to be implemented under this program. Of these, four measures are related to municipal solid waste as shown in Table 3.95.

Table 3.95 Activities Related to Municipal Solid Waste Planned in the Program

Unit: UAH in thousands

Activities	Schedule	Responsible Executors	Estimated Cost		
			Stage I	Stage II	Total
			2009 - 2013	2014 - 2020	
Construction of a landfill for Valkivskyi District, Valka City	2010 - 2013	Regional State Administration in cooperation with the State Administration of ONPS and Valka City Council	640	300	940
Construction of a landfill for Valkivskyi district, Old Merchik Village	2010 - 2011	Regional State Administration in cooperation with the State Administration of ONPS and Valkivskyi District Council	781	781	0
Construction of a landfill for Valkivskyi district, Kojagi Village	2012 - 2013		550	300	850
Construction of a new landfill site for Izyum district, Izyum City	2010 - 2013	Regional State Administration in cooperation with the State Administration of ONPS and Valka City Council	1,875	625	2,500

Source: JICA Survey Team based on the Comprehensive Environmental Protection Program for the Kharkiv Region for 2009-2013 and Up to 2020

2) The Regional Strategy "Kharkiv Region Ecology" for 2016-2020

The Regional Strategy "Ecology of the Kharkiv Region" was developed within the framework of the implementation of the Strategy for the Development of the Kharkiv Oblast until 2020. This strategy was approved by the decision of the Kharkiv Oblast Council on 5 March 2015, with the support of the Department of Ecology and Natural Resources, Department of Housing and Communal Services and Infrastructure Development of the Kharkiv Oblast State Administration, the State Ecological Inspectorate in Kharkiv Oblast, and other state enterprises, NGOs, and universities.

The purpose of this strategy is to ensure the ecological safety as a basis for the systematic development of the region. It also aims at solving the environmental problems to introduce a unified approach, to involve the private sector, and to organize the educational systems. Target stakeholders of the strategy are both producers and consumers. The strategy has a long-term nature of implementation due to the continuity of the waste generation process, which is determined on the basis of the dynamics and complexity of the development of a management system for waste management processes as shown below:

- Waste generation;
- Collection and temporary storage places;
- Transportation;
- Sorting and recycling of the secondary resources;
- Treatment and disposal.

The following key approaches are set for implementing the strategy:

- Modern infrastructure;
- Advanced control systems and technologies;
- Appropriate conditions for the public-private partnership;
- Production of renewable raw materials using waste as a secondary resource;
- Dissemination and exchange of experience; and
- Development of guidance materials on the best available technologies.

The strategy shall be considered as a legal basis for further development and implementation of the regional ecological program by introducing a set of environmental measures, local regulatory acts regulating the relations of state control and management bodies with the owners of waste - pollutants of the environment, natural resources, etc.

(3) Facility Development Plan and Project

In accordance with the abovementioned strategy, the planned activities are being carried out in order to develop a unified system for municipal waste management, where most of these are the constructions of regional waste treatment complexes to cover several municipalities in the territory of Kharkiv Oblast. Currently, Kharkiv Oblast State Administration has already prepared the development plan for solid waste management, which plans to construct 22 complexes in the oblast. One of the issues for this plan is to find the appropriate locations for the complexes, but three locations were already identified in March 2018. This plan is still under the approval process by the council and might be approved after the development of the national waste management plan.

(4) Current Oblast Level Issues on Waste Management

The major issues of Kharkiv Region in the field of waste management are summarized and shown below:

- Lack of the reliable actual data of the quantity and quality of the municipal waste generated in each district in the region;
- Improper site development for waste treatment and disposal facilities from the geological view;
- Lack of capacity of waste management operators in the region;
- Discrepancy between the existing sanitary standards and requirements of environmental safety at most landfills and waste dumps;
- Insufficient implementing capacity of separated collection, sorting, and recovery of the recyclable materials;
- Inadequate coverage of rural system for waste collection; and
- Low prices of waste disposal tariff for removal and disposal of solid waste.

Kharkiv Oblast State Administration is now ready to revise the draft of the development plan for the solid waste management in the oblast by reflecting the policies under the National Waste Management Strategy approved in November 2017 and National Waste Management Plan which is expected to be concluded by the end of 2018.

Another issue is the communication with Kharkiv City Council for the cases. One is the case that Kharkiv City's Dergachi Waste Treatment Complex will accept the waste generated in the neighboring municipalities, while the other case is that Kharkiv City will develop the municipal waste treatment complex for the waste generated in the southern part of the city but outside of the city boundary, which means that it is within the oblast boundary.

3.4 Current Status of Dnipro City

3.4.1 General Information

(1) Natural Conditions

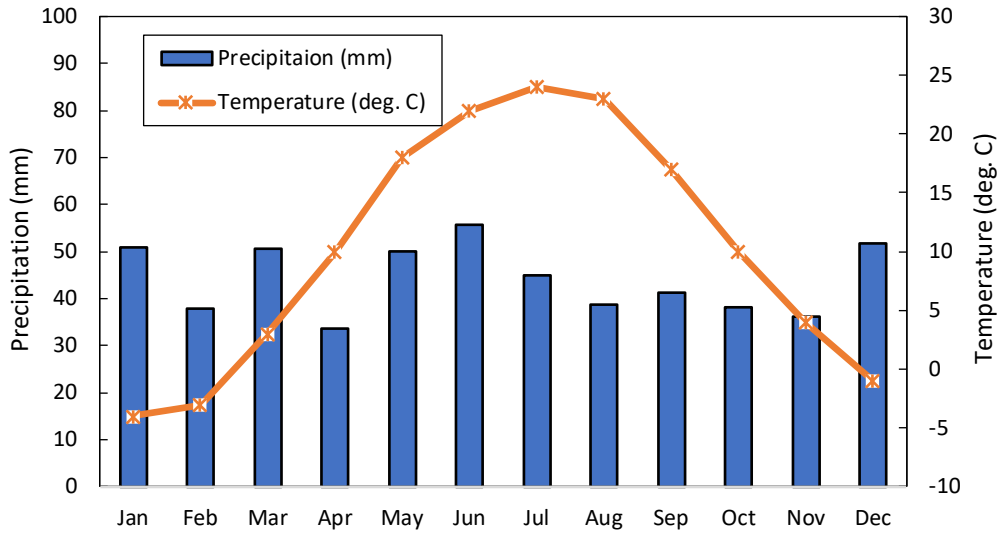
1) Geographical Features

Dnipropetrovsk oblast is located in the middle southeast in Ukraine. The total area is around 31,974 km^2, and it is the second largest oblast in Ukraine. Dnipropetrovsk oblast is located in the steppe zone of Ukraine and mainly flat; along the rivers there are forest areas (about 4% of the territory of the region), many of which are of artificial origin.

Dnipro City is located at latitude 58°21" - 48°34" N and longitude 34°45" - 35°14"E, and has an area of 405 km^2. The Dnipro River separates the city into 2 parts and the river occupies around 15% of the city area.

2) Meteorological Phenomenon

Dnipro City is characterized by steppe climate type. In general, it is characterized by relatively cool winters and hot summer, and dry summers and more humid climates in spring, winter, and autumn. The annual average temperature is around 8 °C. The coldest month is January with an average temperature of -6 °C, while the warmest is July with an average temperature of 23 °C. The annual average precipitation is 400 mm~500 mm. The snowfall period is around 4~5 months from November to March. The summarized monthly climate information is shown in Figure 3.42.



Source: https://www.timeanddate.com/weather/ukraine/dnipro/climate (as of 5 April 2018)

Figure 3.42 Monthly Temperature and Precipitation in Dnipro City

(2) Population and Future Prediction

As of 1 February 2018, the total resident population in Dnipropetrovsk Oblast which includes Dnipro City is estimated to be 3,225,564 people, while the total present population is 3,228,873 people. As for the City of Dnipro, the total resident population is estimated to be 992,207 people, while the total present population is 1,002,339 people[21].

Of the resident population in Dnipropetrovsk Oblast, 45.7% are male while 54.3% are female. Population under age of 15 is 16.3% of the total, while 60.9% are from 16 to 59 years old and 22.9% are over 60 years old.

[21] *Source: http://www.dneprstat.gov.ua/statinfo%202015/ds/2018/ds1_m01.pdf (as of 7 April 2018)*

Detailed demographics of Dnipropetrovsk Oblast are shown in Table 3.96. The total area of the oblast is 31,914 km^2 and the average population density is 101.1 people per km^2 .

Total area of the City of Dnipro is 405 km^2 and the average population density is 2,449 people per km^2.

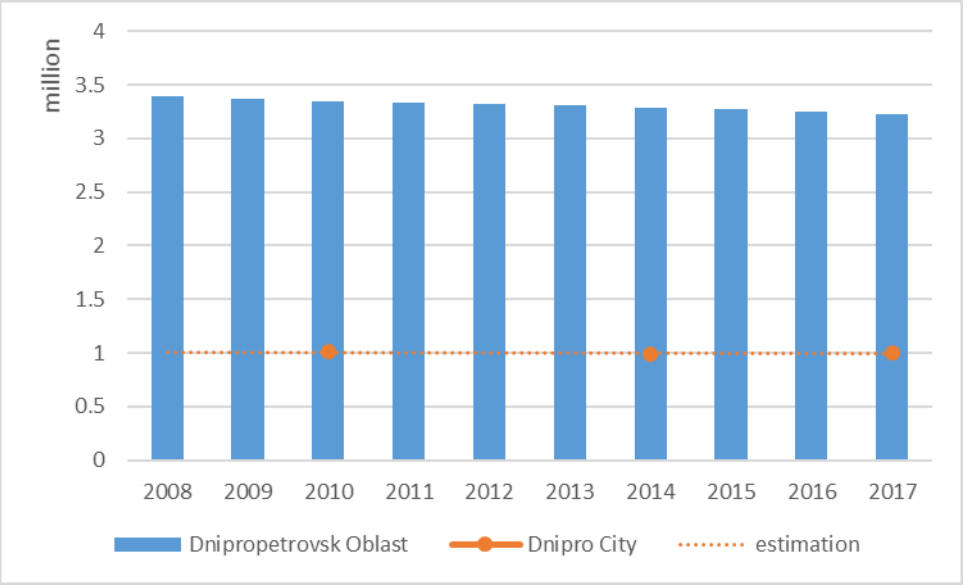
Table 3.96 Detailed Demographics of Dnipropetrovsk Oblast

City/Raion	Available Population			
	1 February 2018	Average Number as of January 2018	1 February 2018	Average Number as of January 2018
Dnipropetrovsk Region	3,228,873	3,230,006	3,225,564	3,226,697
Cities	1,002,339	1,002,641	992,207	992,509
Vylnogirsk	23,217	23,226	23,516	23,525
Zhovti Vody	45,491	45,504	48,503	48,516
Kamynskoe	241,846	241,918	241,288	241,360
Kryvy Rih	631,961	632,191	630,480	630,710
Maranets	48,097	48,118	47,977	47,998
Nikopol	111,940	112,021	113,994	114,075
Novomoskovsk	70,733	70,741	70,232	70,240
Pavlohrad	106,082	106,133	107,025	107,076
Pershotravensk	28,339	28,351	28,590	28,602
Pokrov	41,169	41,182	41,319	41,332
Sinelnikovo	30,726	30,725	30,761	30,760
Ternivka	28,277	28,296	28,512	28,531
Raions				
Apostolic	54,288	54,306	54,629	54,647
Vasylkivsky	31,874	31,897	32,089	32,112
Verhnedniprovsky	52,806	52,832	52,729	52,755
Dniprovsky	83,991	84,011	85,068	85,088
Krivoy Rog	45,043	45,066	44,810	44,833
Krynichansky	34,949	34,962	34,954	34,967
Magdalenivsky	33,591	33,606	33,161	33,176
Mezhivsky	23,230	23,242	23,273	23,285
Nikopolsky	40,024	40,040	40,214	40,230
Novomoskovsk	73,192	73,208	73,902	73,918
Pavlogradsky	27,241	27,247	27,503	27,509
Petrykivsky	25,105	25,108	25,031	25,034
Petropavlovsk	25,908	25,915	25,991	25,998
Pokrovsky	34,191	34,206	34,251	34,266
Pyatihatsky	44,576	44,576	44,653	44,653
Sinelnikovsky	37,621	37,631	37,856	37,866
Soloniansky	38,328	38,336	38,405	38,413
Sofievsky	21,511	21,525	21,565	21,579
Tomakovsky	24,622	24,640	24,450	24,468
Tsarichansky	26,721	26,742	26,761	26,782
Shirokivsky	26,840	26,860	26,844	26,864
Yurievsky	13,004	13,003	13,021	13,020

Source: http://www.dneprstat.gov.ua/statinfo%202015/ds/2018/ds1_m01.pdf (as of 7 April 2018)

Figure 3.43 shows the population curve in the past ten years of Dnipropetrovsk Oblast including Dnipro City, which indicates that the population has been almost stable.

Unfortunately, future projection of the population for both oblast and city was not obtained in the first field survey. However, it could be said that the population will be stable or slightly decrease in near future.



Source: JICA Survey Team referring the following data sources:
Dnipro City Council for the Questionnaire of the JICA Survey Team
http://kh.ukrstat.gov.ua/index.php/naselennia-1995-2012rr (as of 7 April 2018)

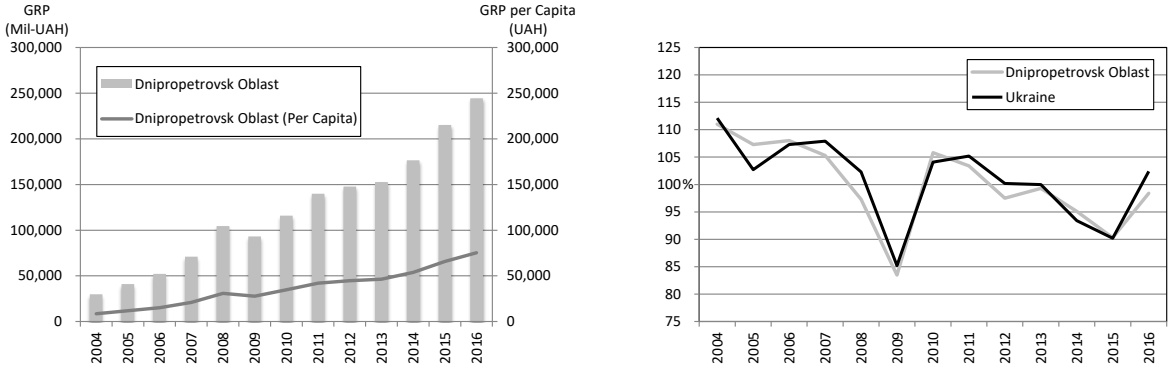
Figure 3.43 Population Curve of Dnipro Oblast and Dnipro City (2008 – 2017)

(3) Economic and Industrial Conditions

1) Gross Regional Products

The gross regional product (GRP) and its growth rate of the Dnipro Oblast Administration is shown in Figure 3.44. The GRP of the Dnipro Oblast Administration in 2016 was UAH 244,478 million, which compromises 10.2% of the total national gross domestic product (GDP).

GRP growth rates of Dnipro Oblast similarly fluctuated with the GDP growth rate of the whole Ukraine, which fell negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty. In 2016, it became positive.



Source; State Statistic Service of Ukraine Website (http://www.ukrstat.gov.ua/, as of 01 April 2018)

Figure 3.44 GRP in Dnipropetrovsk Oblast (Total, per Capita, Growth Rate)

2) Industrial and Economic Situation of Dnipropetrovsk Oblast

Dnipropetrovsk Oblast is one of the key industrial oblasts of Ukraine. The basic industries in Dnipropetrovsk Oblast are the following: mining, coal, metallurgical, machine-building, including rocket-space, chemical, agricultural, construction, and others.

The Dnipropetrovsk Oblast index of industrial production from 2016 to 2017 was 99.7% (0.3% decreased in 2017). Major reduction of industrial output is supply of electric power, gas, steam, and conditioned air (19.5% decreased). Manufacture of clothes, leather, etc. (9.1%) also decreased while manufacture of wood items and papers (12.2%) and processing industry (7.0%) are increased.

3) Employment and Unemployment

In 2016, the average number of economically active population aged 15-70 in Dnipropetrovsk Oblast was 1,547,100 people, in which 1,425,400 were employed, while the rest (121,700) were unemployed, i.e., employment rate was at 59.1%.

The unemployment rate (ILO standard) of the economically active population aged 15-70 in Dnipropetrovsk Oblast was 7.9% (Table 3.97), which is the highest among the targeted three oblasts and one city but it is still lower than the whole Ukraine at 9.3%.

Table 3.97 Employment and Unemployment Ratio in Dnipropetrovsk Oblast

	Economically Active Population Aged 15-70 (thousand persons)			Economically Inactive Population Aged 15-70, (thousand persons)	Employment Rate (%)	Unemployment Rate (%)
	Total	Including				
		Employed	Unemployed			
Ukraine	17,955.1	16,276.9	1,678.2	10,934.1	56.3%	9.3%
Dnipropetrovsk	1,547.1	1,425.4	121.7	866.2	59.1%	7.9%

Source: Economic Activity of Population in Ukraine 2016 (State Statistics Service of Ukraine, 2017)

4) Household Income and Expenditure

Table 3.98 shows a part of the results, which the State Statistics Service of Ukraine conducted the household income and expenditure survey in 2016.

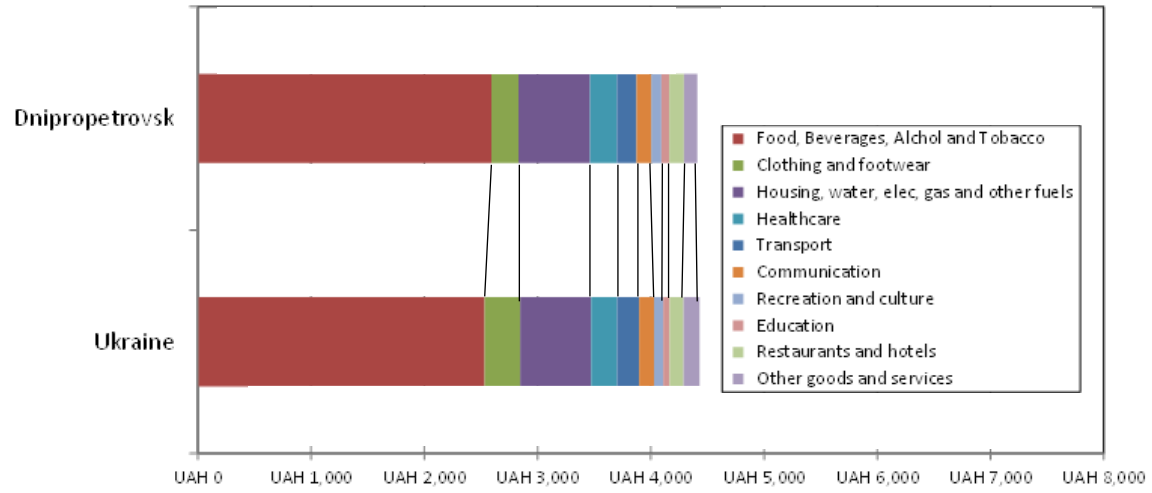
Average household income of Dnipropetrovsk Oblast in a month surveyed in 2016 amounted to UAH 5,110.85/household-month while monthly expenses amounted to UAH 4,857.46/household-month.

Figure 3.45 shows the monthly expenditure of household in average, the composition of consumption of people in Dnipropetrovsk and the whole Ukraine is mostly the same. Total payment for housing and communal products and services is UAH564.48/household-month which is approx. 11.6% of the total expenditure.

Table 3.98 Average Monthly Income and Expenditure in the Surveyed Households in Dnipropetrovsk Oblast

	Unit	All Ukraine	Dnipropetrovsk Oblast
Number of surveyed households	households	8,168	365
Average persons in a household	person/household	2.11	1.96
Total number of households	Thousand households	15,033.40	1,363.00
Total cash income of household (average)	**UAH/household-month**	**5,367.51**	**5,110.85**
Salary of household (average*)	UAH/household-month	2,914.70	2,612.84
Pension of household (average*)	UAH/household-month	1,211.26	1,122.96
Total cash expense in a household	**UAH/household-month**	**4,948.62**	**4,857.46**
Balance (as a reference)	UAH/household-month	418.89	253.39

Source: JICA Survey Team based on Expenditure and Resources of Households of Ukraine in 2016 (State Service of Statistics of Ukraine, 2017)



Source: JICA Survey Team

Figure 3.45 Composition of Monthly Expenditure of Household (Average) in Dnipropetrovsk

5) Utility and Sanitary Infrastructure

A) Power supply

In Dnipropetrovsk Oblast, there are two large thermal power plants (TPP) called Pridneprovskaya TPP and Krivoy Rog TPP constructed around 1970 which are owned by DTEK Dniproenergo. The total capacity is 4657 MW. Annual volumes consumption of electric power in the oblast from 2011 to 2015 are as shown in Table 3.99. According to the table, generally, it has been decreasing since 2012. Though the demand of electric power in the oblast is unclear, the oblast does not have any problem of a shortage of electric power according to the strategy of energy conservation, energy efficiency, and renewable energy Dnipropetrovsk oblast for 2018-2035.

Table 3.99 Consumption of Electric Power in Dnipropetrovsk Oblast (2011-2015)

Item	Year				
	2011	2012	2013	2014	2015
Consumption of electric power (million kWh)	24,140	24,631	22,343	22,380	20,889

Source: The strategy of energy conservation, energy efficiency and renewable energy Dnipropetrovsk oblast for 2018 - 2035

B) Water supply and sewerage system

The status of water supply and sewerage system in Dnipro City is as shown in Table 3.100. In the case of water supply in 2017, the supply volume is more than demands.

Table 3.100 Status of water supply and sewerage system in Dnipro City

Item	Status
Water supply	- Annual water demand: 77.394,45 m^3 (2017) - Water supply (potable water into the city including the purchased water): 105.520,13 m^3 (2017) - Number of population with centralized water supply: 839,278 persons (84%)
Sewerage system	- Annual volume of treated sewage at treatment facilities: 71,941 m^3 (2017) - Number of population with the sewerage services: 659,033 persons (66%) (2017)

Source: Dnipro City Council

3.4.2 Administrative Structure

(1) Dnipropetrovsk Oblast State Administration

1) Organizational Structure

The organizational structure of Dnipropetrovsk Oblast State Administration is as shown in Table 3.101.

Table 3.101 Organization Structure of Dnipropetrovsk Oblast State Administration

Apparatus	
▪ Deputy head of the Apparatus ▪ Management of organizational work ▪ Division of management work ▪ Office for Management and Control ▪ Personnel Management ▪ Office for dealing with citizens' appeals ▪ Office of Financial and Economic Affairs	▪ Department of administration of the state register of voters ▪ Department of regime-secret work ▪ Sector providing access to public information ▪ Sector for the Prevention and Detection of Corruption
Structural Units	
▪ Department of Ecology and Natural Resources ▪ Department of Economic Development ▪ Department of housing and communal services and construction ▪ Department of Information and Public Relations ▪ Department of Capital Construction ▪ Department of Education and Science ▪ Healthcare Department ▪ Department of Social Protection of the Population ▪ Department of Finance ▪ Management of Agro-industrial Development ▪ Office of Interaction with Law Enforcement Bodies and Defense Work ▪ Internal Audit Department ▪ Management of foreign economic activity	▪ Office of Information Technology and E-Governance ▪ Department of Culture, Nationalities and Religions ▪ Department of Urban Development and Architecture ▪ Youth and Sports Department ▪ Management of fuel and Energy Complex and Energy Saving ▪ Office of Protocol and Mass Events ▪ Office of Civil Protection ▪ Legal management ▪ Service for Children ▪ State Archives of Dnipropetrovsk Region ▪ Scheme of Coordination of Activities of Structural units

Source: Website of Dnipro Oblast State Administration (translated by the JICA Survey Team)

The Department of Ecology and Natural Resources as well as the Dnipropetrovsk Oblast Administration is in-charge for the ecology and waste management.

Local authorities, oblast state administrations, and local governments in the sphere of waste management are defined by Articles 20 and 21 of the Law of Ukraine “On Waste”.

By the order of the Head of Oblast State Administration dated 1/11/2018, No. P-6/0/3-18 “On Allocation of Funds on Protection of Natural Environment of the Oblast Budget in 2018”, the amount of funds on protection of the natural environment in the oblast budget for 2018 is approved in the context of measures.

The total amount of funds on the protection of natural environment in the oblast budget on the performance of nature protection measures for 2018 is over UAH 435.3 million, including over UAH 23 million on re-cultivation of the city dumping of municipal waste of Novomoskovsk City and UAH 100 million on purchase of modern special equipment for sanitary purification and community redevelopment.

Besides, within the limits of realization of the Dnipropetrovsk Oblast Integrated Environmental Safety Strategy for 2016–2025, basic enterprises-pollutants and participants of the program are to invest more than UAH 3.1 billion.

2) Budgetary Information

The annual expenditure of Dnipropetrovsk Oblast in 2017 was approximately UAH 18.1 billion, which is 42.6% increase from the expenditure in the previous year of 2016. Table 3.102 below shows the annual expenditure of Dnipropetrovsk Oblast for the last three years.

Table 3.102 Annual Budget of Dnipropetrovsk Oblast

Name under the program classification of expenditures and financing budget	2015 Result	2016 Result	2017 Result
Governance	13,452.2	15,749.5	32,694.4
Education	1,305,941.5	930,541.4	1,497,125.0
Healthcare	1,974,329.8	2,251,111.4	2,834,340.7
Social protection and social security	249,836.2	274,166.5	399,902.3
Housing and communal services	44,970.5	44,922.0	131,568.8
Culture and art	131,977.9	146,724.1	189,503.9
Mass-media	8,751.0	893.5	4,412.2
Physical culture and sport	24,587.4	31,258.0	40,332.7
Construction	312,524.3	786,846.6	1,056,658.4
Agriculture and forestry, fisheries and hunting	79,420.3	87,347.2	103,048.1
Transport and public road system	263,543.5	484,873.5	946,442.9
Other services related to economic activity	47,577.2	47,458.8	125,843.3
Environmental protection and nuclear safety	225,386.8	239.0	66,856.5
Prevention and elimination of emergencies and consequences of natural disasters	15,707.9	7,962.0	5,339.7
Debt service	-	-	-
Trust funds	53,477.9	207,142.6	253,888.3
(including Waste disposal)	5,999.5	25,335.3	28,946.6
Expenditures not attributed to major groups	252,242.6	218,684.0	466,858.1
Sub-Total	5,003,727.0	5,535,920.1	8,154,815.3
Subventions, Grants, Transfers and other expenses	5,987,403.8	7,188,681.4	9,987,044.6
Total	10,991,130.8	12,724,601.5	18,141,859.9

Source: Prepared by the JICA Survey Team based on the information of Dnipropetrovsk Oblast State Administration

3) Development Strategy

The Dnipropetrovsk Oblast Development Strategy for the period until 2020 has been developed by the working group of the Dnipropetrovsk Oblast Development Strategy with the assistance of the EU Project called "Support to Regional Development Policy in Ukraine" and approved under Decision No. 561-27/VI as of 26 September 2014 of the Dnipropetrovsk Oblast State Administration.

Strategic goals and operational goals have been set based on analysis of current conditions as shown in Table 3.103. In order to achieve each operational goal, tasks and priority project areas have been determined.

Under the strategic goal "3. Environmental and Energy Security", there is a goal related to MSWM which is the operational goal "3.2 Improving waste management system".

Tasks and priority project areas to achieve the operational goal "3.2 Improving waste management system" have been determined in the strategy as shown in Table 3.104.

Table 3.103 Strategic and Operational Goals under the Development Strategy of Dnipro City

Strategic Goals	Operational Goals
1. Reducing Economic Imbalances	1.1 Diversification of the economy 1.2 Development of peripheral areas 1.3 Innovative development 1.4 Development of foreign and domestic tourism
2. Rural Development	2.1 Increased value added in agriculture 2.2 Support for rural employment 2.3 Development of rural infrastructure
3. Environmental and Energy Security	3.1 Creating the conditions for improving the environment **3.2 Improving waste management system** 3.3 Eco-net development and recreational areas 3.4 Energy efficiency and development of alternative energy
4. Human Capital Development	4.1 Education for employment 4.2 Increasing public activity of residents 4.3 Community development

Source: Kyiv Oblast Development Strategy for the period until 2020

Table 3.104 Task and Priority Project Areas Related to MSWM under the Development Strategy of Dnipro City

Tasks	Priority Project Areas
3.2.1. Improving the collection and disposal of solid waste	▪ Formation and implementation of MSWM strategy for the oblast; ▪ Introduction of new technologies and equipment for the collection, transportation, sorting, treating, and disposal of solid waste, including specific and hazardous waste generated population; ▪ Construction of landfills that meets the standards; ▪ Building waste management facilities (development of a system of tariffs and charges for waste management); ▪ Providing residential areas with sanitary conditions; and ▪ Creating favorable conditions for business development in the field of municipal waste.
3.2.2. Promoting reduction of volumes in the formation of solid waste	▪ Development and implementation of recycling of organic waste; ▪ Introduction of new MSWM system; ▪ Construction of waste recycling plants; ▪ Conducting a campaign aimed at improving citizens' behavior on solid waste disposal; ▪ Promoting reuse and recycling of waste; and ▪ Introduction of separate collection of waste.
3.2.3. Improvement of recycling industrial waste	▪ Development and implementation of new mechanisms for the disposal of industrial waste; ▪ Disposal of rocket fuel residue; ▪ Certification of storage of hazardous waste generated at the chemical plants; ▪ Development and implementation of recycling programs for collected agrochemical wastes; ▪ Development and implementation of measures to stimulate the reutilization of industrial waste; ▪ Supporting the development of innovative ways in recycling industrial waste; and ▪ Development of the underground collection and treating bishofit (highly mineralized mine water).

Source: Dnipropetrovsk Oblast Development Strategy for the period until 2020

(2) Dnipro City Council

1) Organizational Structure

A list of apparatus and major positions in Dnipro City Council, which was provided by Dnipro City, is shown in Table 3.105. According to the list, there are 36 departments or divisions and about 1,200 people at the maximum working under the Dnipro City Council. Municipal Solid waste management (MSWM) is under the responsibility of the Department of Environmental Policy of Dnipro City Council.

Table 3.105 Organization Structure of Dnipro City Council

No.	Department/Division/Unit	Seats
1	City Mayor	1
2	City Mayor Secretary	1
3	Head in-charge of the Affairs of the City Council Executive Committee – Director of the Department for the Provision of Activity of Executive Bodies	1
4	Deputy Mayors on issues of activity of executive bodies 3 Deputies combined with: ▪ Director of Department of improvement and infrastructure ▪ Director of the Department of Economics, Finance and City Budget ▪ Director of the department of health protection of the population	6
5	Department of Economics, Finance and City Budget	90
6	Department for Dealing with Assets	113
7	Department of Urban Improvement and Infrastructure	79

No.	Department/Division/Unit	Seats
8	Department of Housing Services	60
9	Department of Social Policy	72
10	Department of Healthcare	35
11	Department of Administrative Services and Authorization Procedures	180
12	Department of Public Order and Civil Protection	21
13	Department of Legal Support	43
14	Department for the Provision of Activity of Executive Bodies	99
15	Department for the Provision of Activity	28
16	Management of the Property of the Former Town Settlement Taromske	9
17	Division of Audit and Control	19
18	Division of State Architectural and Construction Control	21
19	Division of Information Technologies	20
20	Division for Dealing with Citizens' Requests	21
21	Department of Transport and Transport Infrastructure	31
22	Department of Humanitarian Policy	83
23	Inspection on Urban Improvement	25
24	Department of Local Self-Government, Internal and Information Policy	54
25	Department of Innovation Development	15
26	Department of Strategic Development and Investment	22
27	Department of Trade and Advertising	16
28	**Department of Environmental Policy**	27
29	Inspection on Labor and Employment of Population	25
30	Department of Energy Efficient Technologies and Initiatives	20
-	Total	1,237

Source: Decision of Dnipro City Council as of 08 June 2016 No. 26/9 (as amended by the City Council decision as of 21 February 2018 No. 38/30) (translated by the JICA Survey Team)

The responsible body for MSWM is the Division of Solid Waste Management and the Department of Ecological Policy of the Dnipro City Council. The Department of Ecological Policy has 27 officers, consisting of two divisions, i.e., MSWM Division and Ecological Division.

2) Budgetary Information

The annual expenditure of Dnipro City in 2017 was approximately UAH 12.5 billion, which is 17.4% increase from the expenditure in the previous year of 2016. Table 3.106 below shows the annual expenditure of Dnipro City for the last three years and plan for 2018.

Table 3.106 Annual Expenditure of Dnipro City

Name under the program classification of expenditures and financing budget	2015 Result	2016 Result	2017 Result	2018 Plan
Governance	65,904.2	135,228.3	230,315.7	337,544.9
Education	191,079.2	393,416.2	2,647,854.3	3,314,484.9
Healthcare	989,822.8	1,052,125.7	1,299,608.9	1,325,617.6
Social protection and social security	74,159.4	134,942.4	168,581.4	269,084.1
Housing and communal services	618,044.6	1,198,950.3	1,478,355.3	1,804,341.8
Culture and art	154,799.8	191,128.6	246,786.3	140,451.4
Mass-media	2,125.9	11,408.4	16,641.8	16,812.3
Physical culture and sport	79,979.9	97,348.1	128,319.3	139,292.6
Construction	115,060.7	794,798.9	184,105.9	326,131.0
Agriculture and forestry, fisheries and hunting	1,432.8	334.8	1,654.9	9,491.5
Transport and public road system	267,287.8	324,988.5	529,269.0	2,154,277.8
Other services related to economic activity	333,023.8	1,228,432.0	1,724,109.1	86,985.1
Environmental protection and nuclear safety	10,318.2	485.1	-	27,459.8

Name under the program classification of expenditures and financing budget	2015 Result	2016 Result	2017 Result	2018 Plan
Prevention and elimination of emergencies and consequences of natural disasters	217.6	578.1	58.6	2,453.3
Debt service	57,980.1	21,447.1	24,738.2	32,714.0
Trust funds	15,133.0	33,025.0	51,720.3	0.0
(including Waste disposal)	99.0	1,686.8	2,707.6	8,000.0
Expenditures not attributed to major groups	-	-	228,649.2	-
Sub-Total	2,976,369.9	5,528,635.3	8,957,324.9	9,987,142.0
Subventions, Grants, Transfers and other expenses	2,333,560.8	5,081,093.4	3,499,063.7	2,891,500.2
Total	5,309,930.7	10,609,728.7	12,456,388.6	12,878,642.2

Source; Prepared by the JICA Survey Team based on the information of Dnipro City Council

As shown in Table 3.107, the budget of the Department of Ecological Policy in 2018 is approximately UAH 31.4 million (0.23% of the total budget of the city), in which, about UAH 25 million will be spent for MSW management. Around UAH 9.5 million will be used for the elimination of illegal dumping sites, UAH 5 million for equity investment for new communal enterprise named "Ecopolis", which will provide waste removal and transport service for the whole city. About UAH 11.05 million will be invested to the existing CE Eco-Dnipro for its No. 4 cell of landfill development.

Table 3.107 Budgetary Plan of the Department of Ecological Policy in 2018

(UAH)

Budget Item	2017 Result	2018 Plan
Department of Ecological Policy, Total (2018 Plan)	**18,163,397**	**31,388,388**
Public Administration		
Organizational, Informational, Analytical, and Logistical Support of Activities	4,133,918	5,781,261
Management and Administration in the Corresponding Sphere	1,378	25,000
Housing and Communal Property		
City Landscaping/ Elimination of Illegal Dumping Sites	2,400,000	9,532,127
Economic Activity		
Other Programs and Activities Connected to Economic Activity		
Contributions to the Authorized Capital of Economic Entities	5,146,000	5,000,000
Expenditures for the Prevention and Liquidation of Emergencies and the Consequences of Natural Disasters	17,700	
Protection and Rational Use of Natural Resources	270,000	
Waste Disposal	319,800	
Other Activities		
Environmental Protection Activities on Account of Trust Fund	566,401	11,050,000

Source: Dnipro City Council Website (https://dniprorada.gov.ua/uk/articles/category/zviti-pro-vikonannya-byudzhetu/, as of 25 May 2018)

3) Development Strategy

According to the economic and social development program of the city in 2018 as provided by Dnipro City, it seems that the city council would have prepared "the Strategic Plan of the City of Dnipro 2020" and the provided program for a single year would have been prepared based on the strategic plan for 2020. Thus, the strategy has to be obtained and studied in the second field survey.

Table 3.108 is prepared based on the single-year program; funds from the city budget is estimated at UAH 2,175.9 million; and budget for MSWM is UAH 10 million.

Table 3.108 Budget under the Program of Economic and Social Development of the City (2018)

Items	Budget (million UAH)
1. Funds from the city budget	2,175.9
1.1 Development budget	2,165.9
1.1.1 Construction projects (including design work)	34.0
1.1.2 Reconstruction of objects (including design work)	276.8
1.1.3 Subway (Project / I and II launch complex)	10.0
1.1.4 Construction (purchase) of housing	60.0
1.1.5 Contributions to statutory funds	680.1
1.1.6 Other capital expenditures	1,109.88
1.2 Urban Environmental Fund	10.0
1.2.1 Design, construction and remediation of "Right bank complex" for recycling and storage of waste	10.0
2. Subventions from the state budget for the completion of the subway	1,367.5
3. Capital investment plan for 2018: the city and state budgets including construction and reconstruction of 38 objects	1,752.5 (Including the city budget of UAH 385.0 million.)

Source: Program of Economic and Social Development of the City in 2018

3.4.3 Legal System on Waste Management

(1) Dnipropetrovsk Oblast State Administration

Regulations of Dnipropetrovsk Oblast related to MSWM are as shown in Table 3.109.

Table 3.109 Regulations Related to MSWM Issued by Dnipropetrovsk Oblast State Administration

Date of Issue	Type and Number of Document	Name of Document
26 September 2014	Decision of Dnipropetrovsk Oblast Council, No. 561/27-VI	On Approval of the Development Strategy of Dnipropetrovsk Region for the Period until 2020
21 October 2015	Decision of Dnipropetrovsk Oblast Council, No. 680-34/VI	On Approval of the Dnipropetrovsk Regional Integrated Environmental Safety Strategy for 2016 – 2025
29 July 2016	Decision of Dnipropetrovsk Oblast Council, No. 80-5/VII	On Approval of the Dnipropetrovsk Regional Strategy for Solid Municipal Waste Management

Source: Dnipropetrovsk Oblast State Administration

(2) Dnipro City Council

Regulations of Dnipro City Council related to MSWM are shown in Table 3.110.

Table 3.110 Regulations Related to MSWM Issued by Dnipro City Council

Date of Issue	Type and Number of Document	Name of Document
28 November 2007	Decision of Dnipro City Council, No. 25/25	On Approval of the Norms of the Solid Municipal Waste Generation for Residential Buildings of the Territorial Community of Dnipropetrovsk, regardless of Ownership and for Non-productive Enterprises
31 August 2011	Decision of the Executive Committee of Dnipro City Council, No. 1147	On the Tariffs for Services on the Collection, Transportation and Disposal of Solid and Large-scale Municipal Waste for all Groups of Consumers
24 April 2012	Decision of the Executive Committee of Dnipro City	On Approval of Waste Management Rules in the City of Dnipropetrovsk

Date of Issue	Type and Number of Document	Name of Document
	Council, No. 403	
27 February 2013	Decision of Dnipro City Council, No. 31/32	On Approval of the Scheme of Sanitary Cleaning of Dnipropetrovsk
27 November 2013	Decision of Dnipro City Council, No. 44/43	On Approval of the Rules for the Improvement of the Territory of Dnipropetrovsk
30 March 2016	Decision of Dnipro City Council, No. 26/5	On Integrated Program of the Environmental Safety and the Implementation of Sustainable Environmental Low-carbon Development of Dnipro in 2016-2020
06 December 2010	Decision of Dnipro City Council, No. 2/27	On Approval of the Program of Economic and Social Development of the City for 2018

Source: Dnipro City Council

3.4.4 Related Legal System (Energy and PPP)

(1) Dnipropetrovsk Oblast State Administration

According to the questionnaire survey and related interview, oblast government follows the legislations at the national level and there are no specific legislations at the oblast level.

(2) Dnipro City Council

According to the questionnaire survey and related interview, the city government follows the legislations at the national level and there are no specific legislations at the city level.

3.4.5 Current Municipal Waste Management Situations in Dnipro City

(1) Waste Generation Quantity and Quality

1) Existing Data on Waste Quantity and Quality

A) Amount of MSW

According to the Ukrainian Research Institute for Development and Implementation on Public Utility Program and Project (2017), the amount of residential solid waste generated in the city was estimated at 299,093 t/year and the amount of municipal solid waste was estimated at 334,985 t/year~367,885 t/year. It can be calculated that the daily generation of municipal solid waste in the city is 920 t/day~1,000 t/day and residential waste accounts for 81%~89% of the municipal solid waste.

B) Physical Composition of MSW

The physical composition of municipal waste in Dnipro City was surveyed in the two reports in 2017 and the results were summarized in Table 3.111. The proportion of food waste was 31%~40%, plastic at 9%~10%, glass at 8%~9%, and paper at 6%~8%.

Table 3.111 Physical Composition of MSW in Dnipro City (2017)

No.	Component	Composition (%)	
1	Food waste	39.36	31.34
2	Paper and cardboard	5.74	7.94
3	Plastic	8.97	9.56
3.1	PET (beverage container)	2.14	2.22
3.2	Film bag	3.66	3.90
3.3	Other polymers	3.17	3.44
4	Bone, leather and rubber	2.21	2.54
5	Glass	8.00	9.06

No.	Component	Composition (%)	
6	Ferrous metals	1.01	1.02
7	Non-ferrous metals	0.18	0.13
8	Textile	4.03	2.38
9	Tree	2.53	2.14
10	Hazardous waste	0.07	0.07
11	Packaging combination	2.44	3.19
12	Street sweep, stone	14.72	9.94
13	Others	10.75	20.69
	Total	100.01	100.00

Source: Ukrainian Research Institute for Development and Implementation on Utility Program and Project (2017) "Research on the characteristics of solid waste generated in residential building of Dnipro City" and "Report on scientific and technical research on the development of a proposal for the implementation of public-private partnership for the construction of a waste recycling facility on the territory of the regional waste recycling complex of rational use and storage of municipal wastes "Pravoberezhny" of the Communal Enterprise "EcoDnipro""

C) Chemical Composition of MSW

There was no available data on three components (moisture, combustible, and ash content) and the elemental property of municipal solid waste in Dnipro City; however, the Ukrainian Research Institute for Development and Implementation on Public Utility Program and Project (2017) studied the calorific value of municipal waste and its average value was 5,950 kJ/kg, which is equivalent to 1,422 kcal/kg.

2) Result of Waste Composition Survey and Chemical Analysis of JICA Survey

The waste composition survey in Dnipro City was conducted on 23 March 2018 and the chemical analysis was conducted successively. The physical composition of municipal solid waste in Dnipro City measured by the JICA Survey Team was summarized in Table 3.112. Kitchen waste accounted for 46.5%, followed by plastic (20.4%), glass (9.2%), and papers (9.0%). The others mostly consisted of diapers. The bulk density of the sample was 0.19 kg/L.

Table 3.112 Physical Composition of MSW in Dnipro City (2018)

No.	Component	Composition (%)
1	Papers	9.0
2	Kitchen wastes	46.5
3	Woods	0.4
4	Cloths	1.8
5	Plastics	20.4
6	Rubbers and leathers	0.3
7	Metals	1.3
8	Glasses	9.2
9	Crockery and stones	0.7
10	Others	10.4
	Total	100.0

Source: JICA Survey Team

The result of chemical analysis was presented in Table 3.113. Gross calorific value was 2,486 kcal/kg, moisture content was 45.2%, ash content was 8.6%, and loss on ignition was 46.2% in raw waste (wet basis).

Table 3.113 Chemical Composition of MSW in Dnipro City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	2,486	4,541
2	Moisture content	%	45.2	-
3	Ash content	%	8.6	16
4	Loss on ignition	%	46.2	84.3
5	Carbon	%	27	50
6	Hydrogen	%	3.7	6.8
7	Oxygen	%	15	27
8	Nitrogen	%	0.44	0.80
9	Chlorine	%	0.234	0.427
10	Sulphur	%	0.13	0.24

Source: JICA Survey Team

The detailed methodology and records of waste characteristic survey were attached as Appendix 5.

The chemical characteristic of municipal waste was firstly studied in the JICA survey. As it is difficult to evaluate waste characteristic by a small number of samples and surveys, it is desirable that Kharkiv City periodically implements waste characteristic survey to accumulate reliable data.

(2) Waste Collection and Transportation

1) Implementation Structure of Waste Collection and Transportation

At the time when this JICA survey was commenced in February 2018, the Dnipro City Council was entrusting the municipal waste collection and transportation service to a private company named “Dniprokomuntrans”. The company was carrying out collection and transportation of municipal waste from the households, public institutions, and other municipal waste generators in accordance with the terms of the contracts.

According to the Dnipro City Council, the City Council is not satisfied with the current performance of Dniprokomuntrans because of reasons such as delay in collection service and occasional illegal dumping of collected waste as observed. The current contract with Dniprokomuntrans will expire in August 2018 and the Dnipro City Council has an intention to change its collection service provider from Dniprokomuntrans to other enterprises through a public tender. As for this reason, the communal enterprise named “Ecopolis” was established in September 2017 to prepare for the participation in the next tender.

When the waste collection crisis occurred on 19 March 2018 due to the unexpected heavy snow, Dniprokomuntrans could not collect the waste for several days which resulted to serious waste scattering over the city. However, Ecopolis was not ready to take over the waste collection from Dniprokomuntrans at that time. Considering such situations, Dnipro City Council had decided to terminate the contract with Dniprokomuntrans and let other two communal enterprises, "Zhilservis-2" and "Housing Service of the Samara Region", handle the road sweeping and city cleaning and collect the waste under the tentative contract until the next tender. The city had provided 4,000 waste containers with a capacity of 1.1 m^3 and 27 waste collection vehicles, which are a part of equipment that Dnipro City Council had already procured. Table 3.114 shows the communal enterprises who tentatively collect the waste until the next tender.

Table 3.114 Communal Enterprise for Waste Collection in Dnipro City as of June 2018

No.	Name of Communal Enterprise	Service Area
1	Zhilservis-2	Within the boundaries of Chechelevsky, Central, Shevchenkivskyi, Soborny, Novokodatsky districts
2	Housing Services of Samara Region	Within the Samara, Amur-Nizhnedneprovsky, Industrial Regions

Source: Dnipro City Council

The collection service is provided daily and collective segregated waste collection system is not yet introduced in the city. There is no information on the amount of collected waste but 70% of municipal waste collected is transported to the municipal landfill at the Right Bank Waste Treatment Complex, according to Dnipro City Council. Assuming that 920 t/day~1,000 t/day of municipal waste is currently generated in the city, it is calculated that the amount of municipal waste transported to the municipal landfill is about 640~700 t/day. Other waste is collected by the private waste hauler and disposed of at the private landfill on the left bank. The scenery of waste collection in the city is presented in Figure 3.46.

Typical waste containers in the city

Waste collection work by Dniprokomuntrans

Source: JICA Survey Team

Figure 3.46 Scenery of Municipal Waste Collection in Dnipro City

(3) Intermediate Treatment and Recycling

There is no intermediate treatment facility of municipal solid waste in operation in Dnipro City at the moment, although there are plans to construct a waste sorting facility and a biogas electricity generation plant under the public-private partnership (PPP) scheme project with Stopford Project Limited and to construct a waste sorting facility by Eco-Dnipro at the Right Bank Waste Treatment Complex.

As for recycling, there is no ongoing recycling activity implemented by the City Council and there is little information on recycling activity led by the private and informal sectors. The communal enterprise named ‘Dnieprekovtorresurs’ is collecting used furniture, personal computers, tires, and so on from public institutions in the city, and sells them to second hand product market, although the amount is very minimal.

According to the Dnipro City Council, a waste collection service provider once implemented a pilot project on segregated waste collection and set up about 200 segregated waste containers. However, this project was cancelled as waste pickers in the city took the accumulated plastics in the containers; also, it was not profitable for the service providers. With this experience, the City Council puts low priority on the introduction of segregated waste collection and intends to leave the activities to the private and informal sectors. On the other hand, the City Council plans to promote organic waste recycling as there are no actors in this field by means of biogas electricity generation plant through a PPP project with Stopford Project Limited.

(4) Final Disposal

1) History of the Development of the Current Final Disposal Site

Final disposal of the waste generated from Dnipro City is mostly done by the waste treatment complex called "Right Bank” (Pravoberezhny) facility under the management of the Communal Enterprise Eco-Dnipro of the Dnipro City Council.

The "Right Bank" facility is located in the Ptashyna Valley, on the territory of the Novo-Aleksandrovsky Village Council of Dnipropetrovsk District of the Dnipropetrovsk Region.

There is a state act for the right of permanent use of the land with an area of 131.5 hectares issued to the Communal Enterprise Eco-Dnipro. Its cadastral number is 1221486200:04:008:0031, allowing

Eco-Dnipro the placement and operation of main and auxiliary buildings and facilities of the waste treatment complex.

The economic activity of the Communal Enterprise Eco-Dnipro on daily, quality, and uninterrupted provision of municipal waste disposal services at the "Right Bank" facility is carried out in accordance with the Resolution of the National Committee of Government Regulation in the Field of Energy and Municipal Services of 07.09.2017 No. 1087 "On Issuance of the License for the Disposal of Municipal Waste to CE Eco-Dnipro, service provided in Dnipropetrovsk Region, facility of buildings and structures No.11".

In accordance with the design solutions, the Communal Enterprise Eco-Dnipro and the General Designer PJSC Institute Dneprokomunproekt (State license series AB No.614096 from 06.02.2012) completed works on the development of design and cost estimate documentation for the construction of the "Right Bank" complex.

Design capacity of the municipal solid waste landfill is 5,322 million m^3 or 4.25 million tons, design capacity of the industrial waste landfill is 1,001 million m^3 or 1.3 million tons.

According to the design data, operation of the "Right Bank" facility for rational use and storage of municipal waste is designed for 50-80 years, taking into account the construction of a sorting facility with a capacity from 100 to 350,000 tons/year, and further building up and implementation of waste treatment and disposal technologies.

As part of the design and cost estimate documentation, the following are completed:

- Development of the urban-planning documentation on the stage "Design Proposals" and "Urban-Planning Substantiation" concerning the location of the "Right Bank" facility;
- Engineering survey on the area of 131.5 hectares;
- Engineering-geodetic survey (on the area of 131.5 hectares, M1: 5000);
- Engineering-geodetic survey (on the area of 10.0 hectares, M1: 500);
- Engineering-geological survey;
- Design and cost estimate documentation of the stage "Feasibility Study (F/S)" for the whole facility (1st and 2nd stages of construction);
- Design and cost estimate documentation for the "Stage Project" for the first stage of construction includes four components (landfills for municipal waste and industrial inert and construction waste of grade 4) with the total area of 24 hectares. At present, 1-2 components (landfills of municipal waste and industrial waste) have been constructed and operated, with the area of 6 hectares. Years of operation - from 01/11/2012 up to this time;
- "Environmental Impact Assessment (EIA) "as the part of design documentation was developed by the Institute of Nature Use and Ecology Issues of the National Academy of Sciences of Ukraine (state license series AB No.194913 of December 8, 2006) in accordance with the requirements of DBN A.2.2-1-2003 "Composition and Content of EIA Sections";
- Design and cost estimate documentation “Detailed Design" (in Ukraine it is named – “Stage “R”) was developed for the “1st stage of construction. Components 1-2. Municipal waste landfill and industrial waste landfill”;
- Revision of the design and cost estimate documentation “Stage R” of the components, municipal waste landfill and industrial waste landfill;
- On the basis of the Decision of the Dnipropetrovsk Regional Council No. 150-16 / VI of March 14, 2012, the State Enterprise "Urban Development Cadastre" (State License Series AG No. 576476 of 10 May 2011) completed;
- “Revision of the regional planning design of the Dnipropetrovsk Region regarding the location of the “Right Bank” facility”, which was reviewed and recommended for approval by the Regional Urban Development and Architecture Council;
- Development of the "detailed plan of the territory of the communal production zone in the northern part of the Novooleksandrivsky Village Council of the Dnipropetrovsk Region, regarding the location of the "Right Bank" facility”;
- Statement "On the Intentions Concerning the Construction of the "Right Bank” Facility” is approved by the Department of Regional, Urban Development and Architecture of the

Dnipropetrovsk District State Administration; Dnipropetrovsk Department of Natural Environment Protection; Chief Sanitary Doctor of the Dnipropetrovsk Region;

- Statement of Intent is published in the relevant media;
- Statement "On the Environmental Impact of the Designed Activity on the Construction of the "Right Bank" Facility" has been published in relevant media;
- The intention "On the Development of the Territory (Communal Industrial Zone) in connection with the Construction of the "Right Bank" Facility" was published on the website of the Dnipropetrovsk Regional Council in order to introduce to the public the intentions of the development of the territory (public hearings) and the provision of proposals;
- "The Land Management Project", as a result of the above, was considered and approved by the decision of the Dnipropetrovsk Regional Council. In accordance with the procedure established by the current legislation, it is submitted to the Dnipropetrovsk Regional State Administration for approval;
- By the Order of the Head of Dnipropetrovsk Regional State Administration, a land plot of 131.5 hectares has been provided for permanent use to the CE Eco-Dnipro. It has been envisaged by the State Act for the right of permanent use by CE Eco-Dnipro.

According to the "State Sanitary Rules of Settlements Planning" June 19, 1996, No. 173, sanitary protection zone of 500 m is defined for the municipal solid waste landfill.

The closest residential areas to the boundaries of the facility land plot are at the following distances: the village of Diivka - 0.6 km; buildings of the military town - 1.7 km; the village of Krasnopillia – 2.0 km; Hospital No. 4 – 1.7 km.

Design and cost estimate documentation of "Stage P" and "FS" for the construction of the "Right Bank" facility were examined by the branch of SE Ukrderzhbudekspertiza (State Expertise) in Dnipropetrovsk Region, and a positive conclusion was obtained.

Design documentation was approved with the provision of the sanitary and technical passport of the landfill of solid municipal and industrial waste. "Urban-planning conditions and restrictions on land plot development" were obtained.

2) First Stage of Construction

A) Component 1

Based on the Permit for Construction Works on the First Stage of the Construction of the State Architectural and Construction Inspection in Dnipropetrovsk Region from 28 September 2012 No. DP11512177191, the construction of the "Right Bank" facility, which are component 1 and 2 of the First stage to be used for both municipal solid waste and industrial waste, was commenced. The construction of Component 4 is still under preparation.

Component 1 was operated based on the Certificate of Readiness for Commissioning of 29 November 2012, Series DP No.16512202209 by the State Architectural and Construction Inspection in Dnipropetrovsk Region. The reception of municipal solid waste started from 31 November 2012 and the operation lifespan of Component 1 is expected to be three or four years from 2012 to 2015. The volume of municipal solid waste received at Component 1 is over 408.65 thousand tons (510.81 thousand m^3).

B) Component 2

Component 2 was operated based on the Certificate of Readiness for Commissioning of 23 September 2014, Series ІУ No.165142660067 by the State Architectural and Construction Inspection in Dnipropetrovsk Region. The reception of municipal solid waste started from 2015.

In 2017, CE Eco-Dnipro submitted its application for the Independent Environmental and Expert Estimation of the Operation of the Landfill and obtained a positive conclusion.

Solid waste disposal is carried out by shifting, with strict compliance on the sizes and boundaries of the solid municipal and industrial waste landfills. Taking into account the absence of its own material and technical base in CE Eco-Dnipro, all works are executed by Dniproekovtor, LLC., in accordance with the outsourcing contract, namely:

- Receipt of municipal solid waste and industrial waste is made solely on a contractual basis.
- Accounting of the solid municipal waste/ industrial waste receipts is made exclusively through the weighing station (entry control), with the registration of the relevant certificate (ticket) on the actual tonnage.
- Radiometric control of special vehicles is constantly carried out.
- Placement, planning, transporting, and storing of solid waste on the landfill are carried out by modern technical means - bulldozers of the brand SHANTUI.
- Timely compulsory sealing of solid waste is carried out by modern technical means for planning and reliable sealing of solid waste - bulldozer-compactor of the brand SHANTUI (compactor).
- Timely and fully layered filling of compacted solid waste by soil is carried out.
- Constant appropriate measures are taken to disinfect vehicles leaving the landfill (seasonally adjusted).
- Constantly maintained in proper condition, the system of ventilation columns on passive diversion of biogas is being developed in a timely manner.
- During the work day, two systems of bird scarers are constantly present, sound and propane (gun - sound (gas) bird scarer).
- Timely deratization of the landfill is carried out.
- The filtrate is collected into the appropriate storage tank, and pumped through the venting columns into the landfill. A chemical reagent (VTA 510D, Hidro D Sludge) has been found in the search for a solution to the problem of eliminating unpleasant odors that occasionally occur seasonally during the operation of the landfill, and it is intended to eliminate the unpleasant odors at the area of solid waste storage.
- The upstream and by-pass ditches for collecting and discharging rain and melt water are maintained in the appropriate condition.
- On the territory of the landfill and sanitary-protective zone, measures are taken to clean it from litter, fallen leaves, snow, plastic bags, etc., on a daily basis.
- All the permitting and design documentation are available.
- Timely and full payment of relevant taxes, including environmental taxes.
- The Administrative Building (AB) has been connected to the centralized water supply.
- The estimated operation lifespan of Component 2 is until May–September 2018.
- The volume of municipal solid waste received at Component 2 is over 610.0 thousand tons (762.5 thousand m3)

C) Component 4

CE Eco-Dnipro, taking into account the limitation of time and urgency of solving the problem regarding the construction of a new facility of Component 4 in 2016, based on the existing positive conclusions of the State Expertise on the Stages "FS" and "Project" and positive experience in the construction and operation of Components 1-2, completed the following:

- Design and cost estimate documents for the “Stage “R” for the "Construction and Reclamation of the “Right Bank” facility. First stage of construction. Reclamation of Component 2. Construction of Component 4”, developed by the General Designer: PJSC Institute Dniprocommunproekt in accordance with the Agreement No. 5417-7.
- Design and cost estimate documentation for the “Stage R” on the "Reclamation of the "Right Bank" Facility. First stage of construction. Reclamation of Component 1”, developed by the General Designer: PJSC Institute Dniprocommunproekt in accordance with the Agreement No. 5417-8.
- Design and cost estimate documentation was submitted for the evaluation by the State Expertise in the part of cost estimate in the current prices of 2017 and obtained positive conclusion regarding the construction of Component 4, reclamation of Component 1 and Component 2.

Such decision made it possible during the construction of Component 4 to use the soil removed to fill the municipal solid waste landfill of Component 2 (at this time, the deficit of soil) and start the reclamation of Components 1-2.

3) Second Stage of Construction

According to the design solutions, the second stage of the construction of the "Right Bank" facility was commenced.

A) Component 1: Construction of the Waste Treatment Unit

The General Designer PJSC Institute Dneprocommunproekt, taking into account DBN A.2.2-3-2014, DSTU B D.1.1-7: 2013, according to DK 021: 2015 71245000-7, developed the design and cost estimate documentation, namely:

- Stage "Project" for the construction of the "Right Bank" facility. Second stage of construction. Component 1. Waste Treatment Unit"; and
- Stage "R" for the construction of the "Right Bank" facility. Second stage of construction. Component 1. Waste Treatment Unit".

According to the promising decision, the basis of the waste sorting line with a capacity of 100,000 tons of solid waste per year is the mechanobiological technology (several different technologies of municipal waste treatment), which is as follows:

- Large-scale and inert waste is removed from solid municipal waste, as well as incombustible waste fraction;
- From the solid municipal waste there is separation and sorting of surplus waste (metals, plastics, PET, glass, paper, etc.), which is realized by the recycler of the secondary raw materials
- In the future, it is planned to gradually increase the capacity of the facility, and so on.
- Design and cost estimate documentation was submitted for a comprehensive state expertise.

During the construction of the second stage, it is planned that the removed soil will be used for backfilling and reclamation of Components 1 and 2 in the 1st stage of construction.

In 2018, due to budget financing provided to CE Eco-Dnipro, the procedure for the second stage of construction has started, which is Component 1 "Waste Processing Unit", which consists of series of mechanical and manual sorting line, with a capacity of 50,000 tons per year per line. Two lines of sorting facility will be constructed first, then another five lines will be added later. In total, 350,000 tons of municipal solid waste will be annually sorted out at the facility.

The main task of CE Eco-Dnipro is the construction and development of a modern regional waste treatment facility with phased implementation of modern technological solutions for the removal of resource-consuming components from solid waste and the placement of solid waste residues at the landfill.

Accepted daily amount of waste - taking into account seasons and weather conditions, daily amount of municipal solid waste receipt is 500 tons/day - 600 tons/day.

4) Current Situations of the Landfill

Figure 3.47 shows the photos of Dnipro Municipal Landfill in the "Right Bank" Waste Treatment Complex, taken by the JICA Survey Team on 20 March 2018.

More than 30 waste pickers were observed when the JICA Survey Team visited the area. According to the Eco-Dnipro, these waste pickers are Ukrainian coming from the western area near the national border of Hungary. Most of them speak Hungarian but not Ukrainian or Russian. They are temporarily living near the landfill site but out of the site boundary, and come and go as they please.

Weighing Scale

Signboard for Driving Route in the Site

Landfill Operation Area

Waste Pickers

Source: JICA Survey Team (April 2018)

Figure 3.47 Scenery of Dnipro Municipal Landfill in "Right Bank" Waste Treatment Complex

(5) Financial Matters

1) Waste Collection and Disposal Fee

Tariffs for municipal solid waste collection and disposal in Dnipro City are stipulated in the decision by the Dnipro City Council No. 1147, as of 31 August 2011, as shown in Table 3.115. The tariff includes the fee for waste collection and treatment service as well as disposal fee at the landfill.

Table 3.115 Tariff for Municipal Solid Waste Collection and Disposal in Dnipro City

Category of Waste Generator	Tariff for Municipal Waste		Tariff for Bulky Waste	
	UAH/m^3	UAH/t	UAH/m^3	UAH/t
Residents	35.00	218.75	65.00	406.25
Public institutions	47.25	295.31		
Other waste generators	70.00	437.5		

Source: Dnipro City Council (2011) "Decision of the Executive Committee of Dnipro City Council dated 31 August 2011 No. 1147"

According to Dnipro City Council, the operational cost of municipal waste collection and disposal service is fully covered by the waste management tariff paid by the waste generators in Dnipro City. However, the Dnipro City Council acknowledged the necessity to increase the tariff as it has not been revised from 2011 up to now. The residents pay waste management fee directly to Dniprokomuntrans according to the bill issued by the Unified Calculation Center, which manages the billing of public utility service.

Table 3.55 summarizes the disposal fee charged by the waste disposal facilities to the waste collection service providers in Dnipro City.

Table 3.116 Fee for Solid Waste Treatment and Disposal in Kharkiv City

Waste Treatment and Disposal Facility	Type of Waste	Disposal Fee
Dnipro Municipal Landfill on the Right Bank Waste Treatment Complex	Municipal solid waste (including bulky waste)	UAH 13.08/m^3

Source: JICA Survey Team based on interviews with the concerned organizations

2) Budget and Expenditure of the Organizations Related to MSWM

A) CE "Eco Dnipro"

General information of the company is sorted in Table 3.117.

The CE "Eco Dnipro" was established according to the resolution of the Dnipro City Council. The company has the following objectives prescribed in its chapter (first three among over 30 listed):

- To manage the collection, storage, processing, transportation, removal, neutralization, and conservation of solid and large consumer wastes, wastes from production and consumption, industrial and construction wastes;
- Design, construction and utilization of wastes' management facilities;
- Construction of the modern wastes processing enterprises on wastes' separation, processing and disposal of solid wastes, regional waste-processing «Complexes of rational use and storage of wastes – Pravoberezhnyi (literally – "Complex on the right-bank") and Livoberezhnyi ("Complex on the left-bank").

CE "Eco Dnipro" has submitted an Investment Plan for UAH 10 million (approx. USD 380,000) to the Dnipro City Council for the construction of the waste collection complex. The Investment Plan has been approved by the Dnipro City Council on 25 April 2018. The funds are intended for the Complex of the rational storage and use of consumer wastes "Pravoberezhniy" ("On-the-right-bank"), in particular – for:

- Stage-1 - Construction of the new landfill; and
- Stage-2 - Launching construction of the waste sorting complex.

According to the investment plan, the waste sorting complex will be based on the mechanic-conveyor sorting technology that will separate the recyclable items (plastic, paper, glass, metals etc.) – for further recycling. The research stage of construction was performed in 2017.[22]

Table 3.117 General Information of CE "Eco Dnipro"

Name	**ME "Eco Dnipro"** **Full name**: Municipal enterprise "Eco Dnipro" of the Dnipro City Council
Reg. No.	34985811
Authorized Capital	UAH 5,250,000
Paid-in Capital	UAH 1,235,900 (as at 30/09/2017)
Type of Company	Municipal entity
Shareholder(s) with %	Dnipro City Council 100%
Year Started	2007 (legally registered on 14 March 2007)
Address	Budivelnykiv Str., 23, Office 510, Dnipro, Ukraine
No. of Director(s)	1 Director
Employees	14
Website	https://dniprorada.gov.ua/uk/page/komunalne-pidpriemstvo-eko-dnipro-dniprovskoi-miskoi-radi-

Source: JICA Survey Team based on the State Register, Ministry of Justice (https://usr.minjust.gov.ua/ua/freesearch, as of 20 May 2018)

[22] *Source: http://dniprograd.org/2018/04/10/miskrada-dnipra-vidilit-10-milyoniv-komunalnikam-yaki-postiyno-zlivayut-tenderi-na-smittya-privatniy-firmi_66610*

Income statements in the past three years of the company are shown in Table 3.118 and balance sheet as of 31 December 2017 is shown in Table 3.119. The following are the findings based on these.

- Gross profit in the past three years are increasing year by year, however, these costs of sales do not include the operational costs of the right bank landfill such as electricity, environmental tax, depreciation, and others. Profit before tax after deduction of these operational costs, net profits in every year are becoming almost zero or negative, and
- Even though, considering the not so big total amount of "other income, deemed as subsidy from local government", management of CE "Eco Dnipro" is better than other landfill management communal or semi-communal enterprises in other cities.

Table 3.118 Profit and Loss Statement in the Last Three Years of CE "Eco Dnipro"

Unit: UAH

Financial Items	FY2015	FY2016	FY2017	FY2018 (Plan)
Sales revenue	9,709,600	14,541,700	17,165,000	26,145,000
Cost of sales	-8,838,500	-12,200,300	-11,855,000	-16,680,000
Gross profit	871,100	2,341,400	5,310,000	9,465,000
Other income	738,700	1,775,400	319,000	1,150,000
Administrative expenses	-	-	-1,550,000	-1,977,000
Other expenses	-1,599,600	-5,440,200	-5,431,000	-7,671,000
Electricity for the landfill	-	-	-3,294,000	-,467,000
Environmental tax	-	-	-	-3,754,000
Depreciation	-	-	-1,149,000	-2,342,000
Other	-	-	-988,000	-1,108,000
Profit (loss) before tax	10,200	-1,323,400	-1,352,000	967,000
Income tax	-1,800	-	-	-174,000
Net Profit	8,400	-1,323,400	-1,352,000	793,000

Source: JICA Survey Team based on Statements of Financial Results of Eco Dnipro for 2017 and Plan for 2018

Table 3.119 Balance Sheet of CE "Eco Dnipro" (as of 30 September 2017)

Assets			**Liabilities**		
Current Assets	**UAH**	**USD***	**Current Liabilities**	**UAH**	**USD**
Cash	397,400	14,984	Accounts Payable - Suppliers	13,228,000,	98,773
Accounts Receivable	3,031,100	114,290	Accounts Payable - Fiscal Payments	851,000	32,088
Accounts Receivable – Profit Tax	0	0	Advances Received	0	0
Inventory	4,500	170	Accrued Income	0	0
Other Current Assets	120,500	4,544	Other Current Liabilities	521,900	19,679
Total Current Assets	**3,553,500**	**133,988**	**Total Current Liabilities**	**14,600,900**	**550,539**
Fixed Assets			**Long-term Liabilities**		
Fixture & Equipment	7,995,000	301,458	Long-term Debt	-	-
Construction in Progress	0	0	Targeted Financing	99,796,000	3,555,606
Other Non-current Assets	903,400	34,063	**Total Long-term Liabilities**	**99,796,000**	**3,555,606**
			Shareholders' Equity		
			Common stock, additional paid-in capital	1,235,900	46,601
Total Fixed Assets	8,898,400	335,522	Retained Earnings	-3,384,900	-127,630
Total Assets	**12,451,900**	**469,509**	**Total Liabilities and Equity**	**12,451,900**	**469,509**

Note: Translation to USD is made for reference - based on the year-end exchange rate USD/UAH = 26.5
Source: Statement of financial position, as of 30 September 2017

(6) Private Sector and Informal Sector

As described in the previous sections, the involvement of the private sector in municipal solid waste management in Dnipro City is observed in the fields of collection and transportation, and final disposal.

As for the collection and transportation field, municipal waste collection and transportation service were provided by an entrusted private company "Dniprokomuntrans" until June 2018, when the contract was terminated. There are some other private waste collection enterprises, especially on the left bank. A private enterprise "Ecology of Ukraine" operates its landfill on the left bank.

As for the final disposal field, the operational landfill in the Right Bank Waste Treatment Complex area is operated by the communal enterprise Eco-Dnipro but Eco-Dnipro is planning to install a waste sorting facility in the landfill area in collaboration with private companies. Besides, the City Council has a plan to construct a waste sorting facility and a biogas electricity generation plant under the PPP scheme project with Stopford Project Limited.

There is little information on a recycling field but it is assumed that the private sector is engaged in recyclable material collection and/or waste sorting and material recovery.

There is little information on informal sector's activity on solid waste management in Dnipro City; however, considerable number of waste pickers were observed in the operational landfill in the Right Bank area during the JICA Survey Team visit. It is also assumed that there may be informal recyclable collectors and traders in the city.

(7) Environmental Education and Public Awareness

According to Dnipro City Council, the City Council could only conduct little activity regarding environmental education and awareness raising focused on solid waste management issues mainly due to the lack of budget. The City Council acknowledges the necessity of awareness raising for citizens and has an intention to conduct such activities especially for students as soon as budget is secured.

(8) Public Opinions on Waste Management including Incineration

1) Situations on Landfill Site

Citizens basically have an unfavorable impression toward landfill site. In Dnipro City, the landfill site at the Right Bank was constructed to prepare for a comprehensive development plan including the Right Bank Waste Treatment Complex, in combination with a waste processing facility. While the landfill site was carefully operated by experienced staff, smooth operation of the landfill site was disturbed when the wastes coming from farther areas were newly carried into the landfill site, and the inhabitants strongly protested against it and claimed to stop receiving wastes from farther areas.

Some people such as environment-associated NGOs who have strong interest in the environment, positively tried to study the state of waste disposal facility and reported to the public what they found in the site. In Dnipro City, the NGO named "Eco Patrul" voluntarily reported the situation of the landfill site and pointed out the fears and adverse effect to health.

2) Situations on Creating Waste Incineration Plants

A waste incineration plant once existed in Dnipro City. The plant was constructed in the early 1990s by the former Soviet Union. The plant was managed by the city for ten years. Subsequently, the management was entrusted to a private company, but the operation state was not satisfactory and it received many complaints from the inhabitants. In 2011, the contract was terminated and the plant was abolished.

In spite of the negative background, the officer of the Dnipro City Council has an optimistic view saying that inhabitants do not like landfill sites but prefer waste incineration plant if the plant is obviously better than the previous plant.

3.4.6 Waste Management Plan and Project in Dnipro City

(1) Waste Management Master Plan "Scheme of Sanitary Cleaning of Dnipro"

The fundamental plan for the solid waste management of Dnipro can be stated on "the Scheme of Sanitary Cleaning of Dnipropetrovsk (No. 31/32) (hereinafter called as "the scheme")" approved on

27 February 2013 which was developed based on "the Waste Management Rules in the City of Dnipropetrovsk (No. 403)" approved on 24 April 2012.

(2) Position of the Scheme in MSWM System of Dnipro City

According to the scheme, it is understood that inefficient waste collection, transport and disposal, public sanitation including public lavatories, road cleaning (not only trash but also snow and fall leaves) shall be reconfirmed as city's responsibility, and separation of waste removal tariff from combined communal tariff, introduction of competitive bidding, and the elimination of 65 illegal dumpsites in the city shall be implemented by proper budget planning based on the scheme.

As for the procedure of budget planning, number of waste bins, vehicles, and labor are calculated based on the projection of future population.

For the intermediate waste treatment and final disposal, the necessity of some kind of intermediate processing facilities is needed because of the termination of operation of the incineration plant in 2012, which started its operation from 1992 with highest received record of 120,000 t/year. However, detailed and specific description is only the acceptance quantity on the right bank (350,000 t/year = 950 t/day) and left bank (140,000 t/year = 350 t/day) and no specific technologies even mass burn, biogas, or pyrolysis.

Table 3.120 below shows the summary of the scheme based on the category and order, which is required in waste treatment master plan in Japan.

Table 3.120 Summary of the Scheme of Sanitary Cleaning of Dnipro City (2011)

Year (Target)	Present Situation (2011)	Short-term (2015)	Long-term (2035)
Population (persons)	1,007,300	1,007,300	1,007,300
Waste Quantity	334,000 tons per year	Same with left	Same with left
Waste Mass Flow	None	None	None
Responsibility of waste producers	Payment of removal tariff	Same with the left	Same with the left
Collection and Transportation	To be decided by competitive bidding including tariff	Same with the left	Same with the left
Intermediate Treatment	Wrote on incinerator with heat generation (capacity: 768,200 m^3 or 250,000 t/year) operated from 1992 to 13 February 2012	No description at all	No description at all
Landfill (bury)	Mention on the "Left bank" 29 ha owned and managed by a private company "Ecology of Ukraine". And there are 65 illegal dumping sites in the city.	The total landfilling area in Dnipro City will increase to 39.4 ha which consists of: 1) Right bank waste management complex (10 ha) will be developed to accept 350,000 t/year (950 t/d) with segregation area, 2) Left bank waste management complex (29.4 ha) to accept 140,000 t/year (350 t/d).	The total landfilling area in Dnipro City will increase to 63.4 ha. No specific area is mentioned but most likely either complexes of the right or left.
Removal Tariff (UAH/m^3)	Tariff as of 2011 Source / 2011 / In future Residents 20.0 35.0 Budget (Public) Organization 27.0 47.25 Commercial 40.0 70.0	Source / 2015 Residents 35.0 Budget (Public) Organization 47.25 Commercial 70.0	Same with left
Major capital investment (no specific finance resource)	No description	1) Construction of landfill for MSW; (UAH 132,750,000) 2) Construction of landfill for construction waste; (UAH 42,500,000) 3) Recycling Plant (UAH 1,212,000)	No description

Note: The scheme is developed in 2011 but approved by the Dnipro City Council in 2013.
Source: Scheme of Sanitation in City of Dnipropetrovsk (2011)

(3) Facility Development Plan and Project

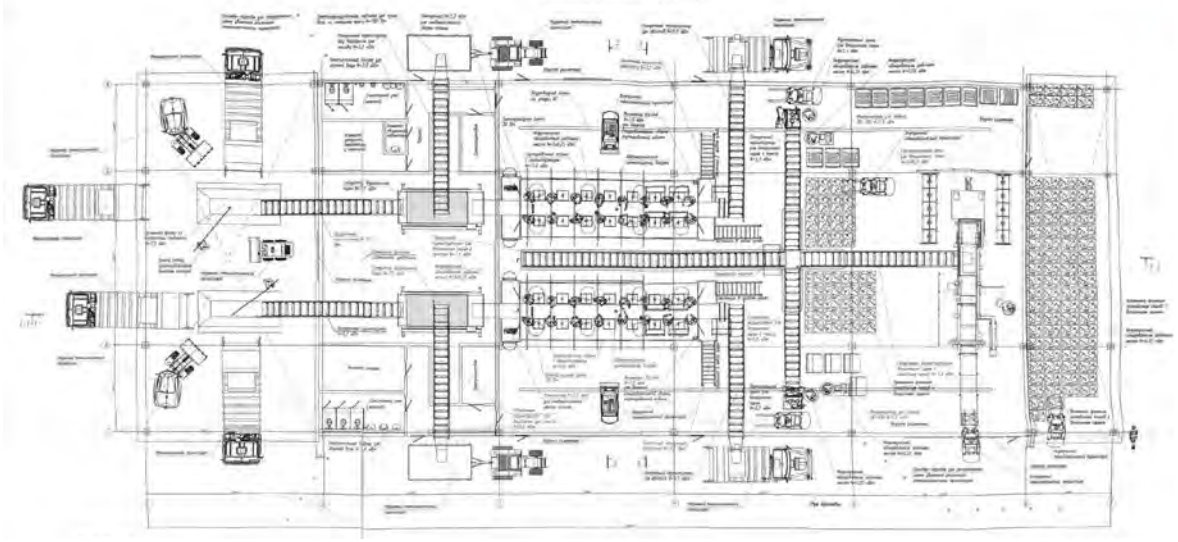
As mentioned above and in line with the scheme, the facility development plan called as TEO "Technical-Economic Justification" for the Right Bank Waste Management Complex is prepared in 2012 and some of the facilities have been constructed and put in operation mostly as planned in TEO as described in Figure 3.48.

According to the plan, Eco-Dnipro, which is the authorized operator of the Right Bank Waste Treatment Complex, made a contract with PJSC Institute Dneprokomunproekt to conduct works on the development of design and cost estimate documentation, called "Stage-Project' or "Stage-P", for the construction of a series of landfills, the components 1 to 4, in the Right Bank Waste Processing Complex. These works also include field investigation such as topographical and geological investigation, and EIA. EIA was prepared by another institute, the "Institute of Nature Use and Ecology Issues of the National Academy of Sciences of Ukraine".

The components 1 and 2 of the landfill were already constructed in the past, and now a new development of component 4 is underway, together with safe closure of component 1.

In addition to the development of landfill component, Eco-Dnipro is proceeding to construct the waste sorting facility at the designated area within the complex.

The development of sorting facility is divided into two stages, the first stage is to construct two sorting lines with a capacity of 50,000 tons per year per each line, in total, 100,000 tons per year by 2018. Figure 3.48 is the layout drawing of the first stage sorting facility.



Source: EcoDnipro

Figure 3.48 Layout Plan of Waste Sorting Plant

In the second stage, another five lines of waste sorting facilities will be constructed with a capacity of 250,000 tons per year. After its completion, the total sorting capacity will be 350,000 tons per year.

An additional idea in the "Technical-Economic Justification" is proposed, which is the construction of a series of small-scale waste pyrolysis units. According to Eco-Dnipro, it will not be so complicated to propose other waste processing technologies instead of waste pyrolysis, if the new technology can be considered feasible.

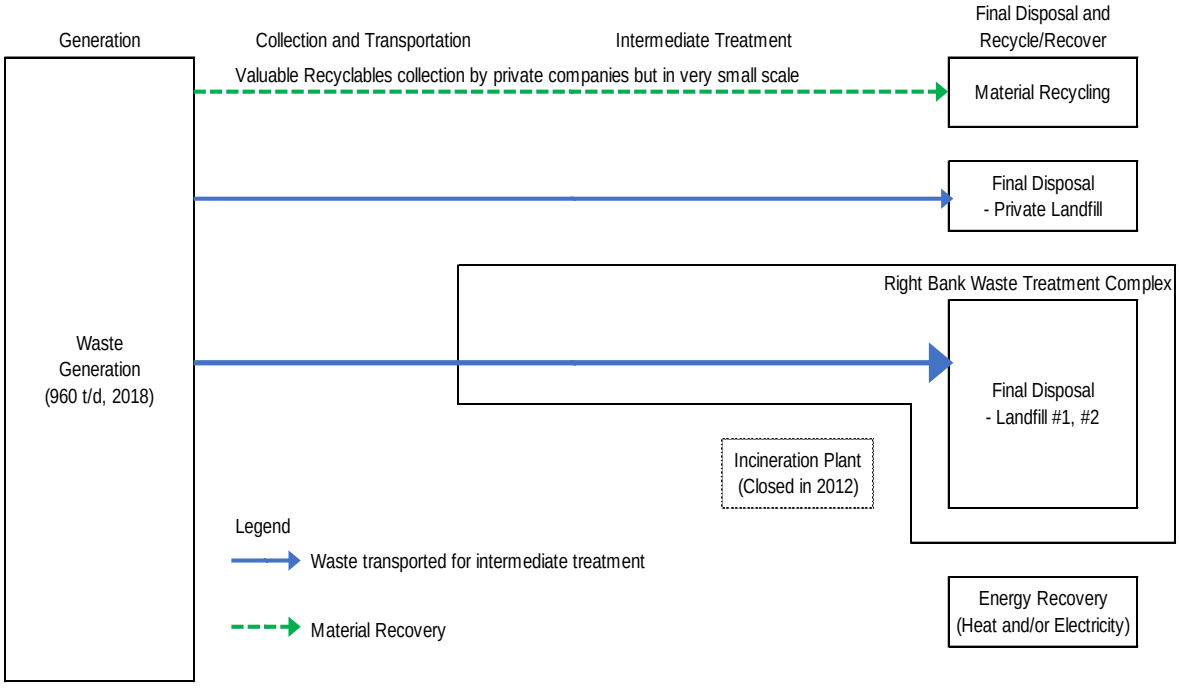
In 2017, Dnipro City also conducted another feasibility study for the development of waste processing facility in the boundary of "Right Bank" Waste Treatment Complex under the PPP scheme. Component of this PPP project is a combination of waste sorting plant and digestion plant that produces biogas for its energy recovery.

Based on the feasibility study, Dnipro City conducted the international tender to select a private investor who will implement the project. As a result of the tender, a British company named "Stopford Project Limited" was selected and invited for negotiation. However, by the end of July 2018, the negotiation is still ongoing and no progress is reported.

3.4.7 Current Issues on Waste Management in Dnipro City

Considering the current overall situations of Dnipro City, in general, it could be said that the Dnipro City Council makes its best effort to manage the municipal solid waste generated from the city within its available resources. However, some areas within the city boundary are still not covered by municipal waste collection services and about 30% of waste is directly managed by private enterprises mostly on the left bank. Private waste collection company named Dniprokomuntrans had been collecting the municipal solid waste under the direct contract with the Dnipro City Council but the contract was terminated on 1 June 2018 because its business performance has not satisfied the City Council for long time, and made the administration became impatience during the waste collection crisis which occurred on 19 March 2018 due to unexpected heavy snow fall. Therefore, the Dnipro City Council is tentatively entrusting the waste collection services to the existing communal enterprises such as "Zhilservis-2" under the limited contract until the next tender in August 2018. These enterprises were provided waste collection trucks and containers by the Dnipro City Council. After the tender, the Dnipro City Council expects that the waste collection system will be improved by the new contractor for the waste collection. As for the waste disposal, collected waste is directly disposed of at the municipal landfill constructed on the Right Bank Waste Treatment Complex where Dnipro City Council had secured the land outside of the city boundary. The communal service named "Eco-Dnipro", which is operating the landfill, is now developing waste sorting facilities. There was a waste incineration plant, which is the same type of Energia Plant, but it stopped its operation in 2012 due to the inappropriate operations done by the private company.

Current waste management process could be summarized in Figure 3.49.



Source: JICA Survey Team

Figure 3.49 Current Waste Management Process in Dnipro City (2018)

Looking into the detailed points on each process and assumed situations in the near future, several issues have been identified as shown below.

i) Uncertainty of private investment

The Dnipro City Council conducted the tender for the PPP project, which is the construction of waste processing facilities through private investment, in 2017 and has selected a British company, "Stopford Project Limited", for the contract negotiation. Proposed component of the project is the combination of waste sorting plant and bio-gas plant. However, details of the facility plan have not been disclosed, including the treatment capacity of the plant.

Furthermore, Dnipropetrovsk Oblast State Administration is also proceeding with the construction procedures of another waste treatment facility, possibly waste incineration plant, proposed by an Austrian company without the consensus of Dnipro City Council. However, at this moment in July 2018, no progress is made for this project.

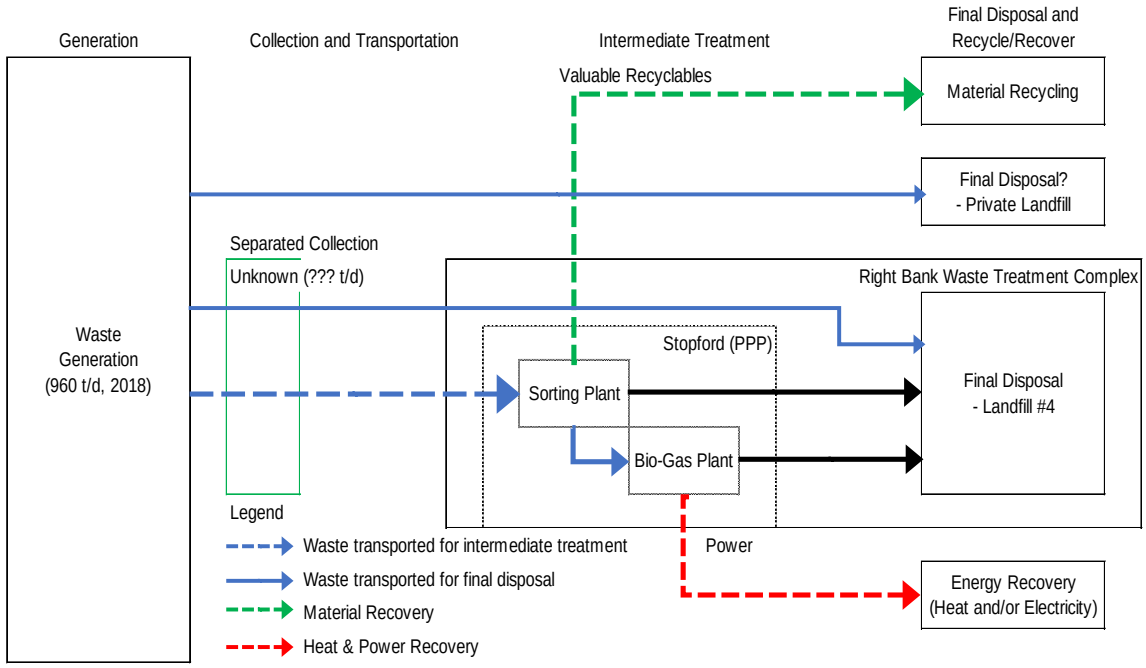
ii) Existence of illegal dump and uncollected waste

As mentioned above, waste collection rate is still considered to be 70% while the remaining 30% of waste is sometimes not collected regularly and disposed of at unauthorized dumping sites, mostly on the left bank.

iii) Hesitation in the introduction of segregated waste collection

Eco-Dnipro is strongly suggesting to Dnipro City Council to introduce the segregated waste collection for efficient recyclables recovery at the new waste sorting plant that is expected to start its operation in the middle of 2018. The City Council, however, hesitates to introduce the waste segregated collection at this time because of the uncertainty of said PPP project and unreliability of the private waste collection company that currently collects the waste in the city.

Waste management process as planned at this moment could be summarized in Figure 3.50. As this figure shows, there is the risk for Dnipro City Council to reconsider the waste processing plan in case the PPP project will fail.



Source: JICA Survey Team

Figure 3.50 Plan for Future Waste Management Process in Dnipro City (as of 2018)

3.4.8 Current Situations over Dnipropetrovsk Oblast

(1) Municipal Waste Management Situations

According to the "Dnipropetrovsk Regional Complex Program (Strategy) for Environmental Safety and Climate Change Prevention for 2016-2025", every year, Dnipropetrovsk Region generates about four million m^3 of municipal solid waste. In 2013, it was estimated that 1,225,491 tons of municipal waste were generated in the territory of Dnipropetrovsk Region. At this moment, in Dnipropetrovsk Region, there are 347 waste disposal sites, in which, 244 sites are authorized as landfill but the other 103 sites are counted as unauthorized waste disposal sites. Most of the existing landfills, unfortunately, are required to be closed because they do not meet the health and environmental standards.

Concerning such situations, Dnipropetrovsk Oblast State Administration has been implementing the improvement and development of project on the landfills. One of these projects is the landfill in Zhovti

Vody City where the JICA Survey Team visited last 28 February 2018. This new landfill with an area of 2.5 ha has been operating since 2012 after the closure of the previous dumping site, which had been used for more than 50 years. Design capacity for waste acceptance at the landfill is 70,000 m^3 per year and approximately 58,000 m^3 of the municipal waste collected from Zhovti Vody City and its neighboring municipalities are disposed of at this site annually. Impermeable plastic sheet is spread over the bottom of the landfill to prevent the penetration of leachate in the underground. Leachate is collected through the collection pipes and pumped up for circulation into the surface of the landfill. There are several monitoring wells dug around the site to check the quality of underground water. Construction cost of the site was UAH 9,000,000. Plastic wastes are recovered at the landfill and sold to the local recycling dealers. Figure 3.51 shows the photos of the municipal landfill in Zhovti Vody City.

Landfill area with Bulldozer

Disposed Waste

Source: JICA Survey Team (February 2018)

Figure 3.51 Municipal Landfill in Zhovti Vody City

(2) Waste Management Master Plan

There are two fundamental documents, which could be considered as the master plan for the solid waste management in Dnipropetrovsk Oblast at this moment. One is the "Dnipropetrovsk Oblast Development Strategy for the period until 2020", which is already explained in the previous section 3.4.2. (1) 3).

The other one is "Dnipropetrovsk Regional Complex Program (Strategy) for Environmental Safety and Climate Change Prevention for 2016-2025" approved by the Decision of the Regional Council dated 21 October 2015 № 680-34/VI. This program was developed by following the abovementioned strategy.

This program listed the following tasks and activities to improve the environmental conditions of the region:

- Protection and improvement of air quality;
- Protection and sustainable use of water resources;
- Waste management;
- Protection and rational use of land;
- Energy efficiency and energy saving;
- Developing and improving regional environmental monitoring system of the Dnepropetrovsk Region;
- Protection, conservation and restoration of biological resources, ecological network formation and development of natural reserve fund;
- Other conservation measures (measures on gardening, repairing fish protection devices, research detection of genetically modified organisms (GMOs) , etc.); and
- Increased social environmental awareness.

Especially, the following directions for the solid waste management are also proposed:

- Developing optimal scheme for waste management which aims for the environmentally safe collection, storage and recycle as secondary resources;
- Creating a system of economic mechanisms focused on the development of regional market of recycled goods produced from secondary resources;
- Organizing new production facilities for processing and recycling of waste; and
- Minimizing "end of waste" approach followed by their environmentally sound disposal.

Expected outcome for the solid waste management from the program is set as shown below:

- Reduction of solid waste by 30%; and
- Level of coverage of services for the collection of solid waste by 100%.

(3) Facility Development Plan and Project

In the framework of "Dnipropetrovsk Regional Complex Program (Strategy) for Environmental Safety and Climate Change Prevention for 2016-2025", "Dnipropetrovsk Regional Strategy for Solid Municipal Waste Management" has been developed and approved by the Decision of the Regional Council dated 29 July 2016 № 80-5/VII.

This regional strategy considers the following four scenarios to optimize the solid waste management system by introducing the long-term plan of establishing joint local communities:

- Solid waste management system in each individual community, one landfill in one community;
- Solid waste management system for several communities, one landfill for several communities;
- Solid waste management system for several communities to use the existing facilities; and
- Establishment of centralized solid waste management system.

This regional strategy also aims to introduce the following actions:

- Introduce a separate collection of solid waste in the settlements of the region;
- Optimize costs for transporting waste and renewal of special vehicles for sanitation of settlements;
- Introduce the mechanized sorting of solid waste for the removal of valuable recyclables and subsequent recycling of materials and products;
- Energy recovery and utilization of waste as secondary raw materials;
- Reduce the amount of waste to be landfilled; and
- Attract the budgetary and extrabudgetary investment in solid waste management.

Based on such considerations, Dnipropetrovsk Oblast State Administration proposed to divide the region into six zones. A regional landfill which satisfy the EU standard will be developed in each region, while 12 waste transfer stations with sorting functions will be constructed in the region. All locations of regional landfills including "Right Bank Waste Processing Complex" have been already identified and disclosed to the public, according to Dnipropetrovsk Oblast State Administration. Five of these are existing landfills and one landfill is planned to be newly developed.

- Implementation procedures of the strategy are proposed as listed below.
- Development of feasibility study for the construction of waste transfer station to optimize the waste transportation efficiency;
- Construction of regional landfills;
- Introduction of conventionally separate collection of solid waste; and
- Support of the local communities for recovering valuable recyclables by sorting of solid waste.

(4) Current Oblast Level Issues on Waste Management

As previously mentioned, Dnipropetrovsk Oblast State Administration has been implementing the actions proposed in their strategy and program but is also facing some issues for smooth implementation. One of the issues is the security of financial resources for implementation such as construction of waste management facilities. One of the financial resources is the budget allocation

from ecological tax but recently allocation rate of the tax to the oblast has been reduced from 55% to 35%, while also reducing from 30% to 15% to the municipalities.

The other issue is the lack of communication with Dnipro City on the development of waste processing facility. According to Dnipropetrovsk Oblast State Administration, there is a PPP project plan proposed by an Austrian company to construct a waste-to-energy plant, waste incinerator with power generation, with a capacity of 300,000 tons per year. The status of this project is under the expertise by the authorities on the project document. After the completion of expertise, public hearing will be conducted. However, the location of the plant has not been determined and also the source of waste to be incinerated is still unclear. This depends on the proposal of that private company. On the other hand, Dnipro City Council is away from this project and is implementing other options such as PPP project by the British company or public investment project in cooperation with the international donors. Details of such development plans of Dnipro City Council are not always shared with Dnipropetrovsk Oblast State Administration.

Fundamental policies under the current strategy of the oblast seem to be very similar to the policies under the National Waste Management Strategy, which was approved in November 2017, but some modifications will be necessary when the National Waste Management Plan will be developed and disclosed by the end of 2018. When the oblast will revise the current strategy, and develop the waste management plan of the oblast, the following will be key topics to be considered:

- Obtain reliable actual data of the quantity and quality of the municipal waste generated in each district in the region;
- Evaluate the environmental conditions for the current regional landfills;
- Involve the private sector on separated collection, sorting, and recovering the recyclable materials, together with the improvement of the communal services;
- Implement the oblast-wide environmental education to the public to cooperate with the solid waste management policies of the oblast; and
- Establish a feasible financial system including amendment of the current tariff rate for waste removal and disposal.

3.5 International Donor's Assistances

3.5.1 EBRD

The European Bank for Reconstruction and Development (EBRD) has supported the improvement of solid waste management in Ukraine by various types of assistance; new challenges as well as experiences in other countries such as Georgia, Belarus, and Uzbekistan are highlighted.

In 2015, EBRD conducted a market research on solid waste management including research on organizational capacity for both public and private sectors in Ukraine. As a result of this research, EBRD had recognized that there could be large business potentials in the field but there is a lack of concrete and appropriate strategy. Upon this, EBRD has strengthened the capacity of concerned ministries by providing assistance to develop the National Waste Management Strategy, in cooperation with other international donors such as GIZ.

In addition, EBRD had conducted project findings survey hiring the Danish consultant, "Ramboll". As a result of the survey, three projects were picked up and recommended to implement the F/S for further development. In June 2018, it was announced that EBRD would support to improve the solid waste management in Lviv in cooperation with other international donors such as the Eastern Europe Energy Efficiency and Environment Partnership and Clean Technology Fund. Total financing package is up to EUR 35 million to be used support the rehabilitation of the Hrybovychi landfill and the construction of a municipal solid waste mechanical biological treatment plant in Lviv reducing greenhouse-gas emissions.[23]

Concerns about the solid waste management sector in Ukraine are tariff setting and corruption. Current tariff value is too small to satisfy the implementation of appropriate waste management system. Usually, 1% to 1.5% of household income can be paid for waste management in other countries but its ratio is fifteen times more than the current price in Ukraine. It could be easily projected that such increase of waste disposal tariff will never be accepted by both public and politicians in the short term.

Principal stance of EBRD for solid waste management is very clear that it should comply with the waste hierarchy and very negative on mass waste burn system.

3.5.2 GIZ

Same as EBRD, the German Corporation for International Cooperation (GIZ) has also supported Ukraine in the field of solid waste management. Regarding the preparation of the National Waste Management Strategy, GIZ had worked with the Ministry of Environment and Natural Resources, Ministry of Regional Development, Construction, Housing and Communal Services, and Ministry of Economic Development and Trade through the Ecological Modernization of the Economy Project.

Ukrainian-German cooperation under GIZ currently focuses on the following areas:

- Good governance
- Energy efficiency
- Sustainable economic development

When the JICA Survey Team had a meeting with GIZ on 23 February 2018, it was informed that GIZ would be very positive to continue to support the Ukrainian side in the solid waste management field but did not have any specific project at that moment. However, one of the proposed ideas was to support the rural municipalities, not large urbanized cities, to establish an appropriate regional waste management system following the concept under the new national strategy, as part of the decentralization reform. Then, at the other meeting held on 27 July 2018, it was shared that GIZ would implement the support for promoting regional waste management system among small-scale municipalities in Dnipropetrovsk Oblast and Volynsk Oblast in about 18 months.

GIZ had also given technical support in the field of energy efficiency but it mostly targeted increasing energy efficiency at the municipal housing and properties, and not focused on renewal energy.

[23] *Source: https://www.ebrd.com/news/2018/ebrd-and-international-donors-improve-solid-waste-management-in-lviv.html (as of 16 July, 2018)*

GIZ pointed out that one of the issues related to the improvement of solid waste management in Ukraine was how to raise public awareness due to strong civil societies established over the country.

It was also mentioned that PPP project in the field of solid waste management is still premature, considering the existing difficulties on the conditions in implementing the businesses by private investment.

3.5.3 World Bank

The World Bank (WB) Group is also one of the key international donors which has been involved in the solid waste management sector in Ukraine.

The International Finance Corporation (IFC) under the WB group published the "Municipal Solid Waste in Ukraine – DEVELOPMENT POTENTIAL" to propose scenarios for developing the municipal solid waste management sector. It concluded the necessity of introduction of innovative waste recycling technologies and management models in the sector. It was also mentioned that structural reforms were also needed, such as an introduction of a programmatic approach with clearly defined performance targets at the national and local levels, and introduction of new economic and institutional arrangements via legislation and authorization.

The World Bank also is now conducting the "Second Urban Infrastructure Project (UIP2)" which includes project related to solid waste management.

The objective of UIP2 is to improve the quality and efficiency of water, wastewater, and solid waste services in selected cities in Ukraine. There are three components of the project; the first component is Urban Infrastructure Improvement. This component will finance the rehabilitation, reconstruction, and upgrading of water, wastewater, and solid waste facilities in about ten cities. Total project cost for UIP2 is USD 350 million.

One of the projects, as previously mentioned, is the solid waste management project for the City of Kharkiv with an amount of USD 44 million. It will construct a 17 ha solid waste disposal site with a recycling and sorting facility as well as a biogas collection system that allows for landfill gas recovery and electricity generation. Figure 3.52 shows the photos of the construction works at Dergachi waste processing area.

Site preparation for landfill area

Area for mechanical processing lines for waste sorting, biogas utilization and leachate treatment

Source: JICA Survey Team (22 May 2018)

Figure 3.52 Site Development by UIP2 at Dergachi Waste Processing Area

According to the Ukraine Office of the WB, other project related to the waste management by the WB has not been determined in the five-years assistance plan for Ukraine that was recently released. In addition, it is also being recognized the necessity of review of ideas for the UIP2 project in Kharkiv City by following the new waste management hierarchy because the project was planned before the development of National Waste Management Strategy.

3.5.4 Others

There are no specific projects or activities conducted by other international donors observed during the first field survey period, but the following might be related to solid waste management:

(1) Swiss-Ukrainian Project "Support of Decentralization in Ukraine" DESPRO

According to Kharkiv Oblast State Administration, on 17 November 2017, the Memorandum of Understanding and Cooperation was signed by the Swiss-Ukrainian Project "Support of Decentralization in Ukraine" DESPRO, Kharkiv Region State Administration and Kharkiv Region Council. For the purpose of solving the tasks as established by this memorandum, DESPRO supports the combined territorial communities, providing expert and consultation assistance for best practices as concerns on solid municipal waste treatment in communities of the Kharkiv Region.

In the website of DESPRO[24], the project mission is to optimize the management system and to promote effective local development in Ukraine, which, in turn, creates an impetus to democratic processes and to provide services at the community level. The project has three phases: Phase I (2007-2009), Phase II (2010-2012), and Phase III (2013-2017), but it is being continued up to now.

According to the recent DESPRO news, some news mentioned about waste management and recycling in the rural municipality level through interviews with environmental expert.

In addition, DESPRO is also participating in the working group for the preparation of legal system related to the waste management which is initiated by MENR. Furthermore, DESPRO would implement the following assistance activities, targeting the area of Vinnytska Oblast, for the establishment of the regional waste management system among the several municipalities.

- Assistance for legal system development for the regional waste management by December 2018
- Suggestion and preparation of guidelines for the regional waste management by November 2018

(2) Others

When the JICA Survey Team had a meeting with the State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE), it was informed that the Government of Finland had supported SAEE to conduct case studies for the introduction of green tariff on solid waste management. Details of the donor who supported them were not disclosed but could be said that the Nordic Environment Finance Corporation (NEFCO) was involved under the framework agreement between the Government of Ukraine and NEFCO[25].

[24] Source: *http://despro.org.ua/en (as of 10 April 2018)*

[25] Source: *http://www.saee.gov.ua/en/activity/mizhnarodne-spivrobitnytstvo (as of 10 April 2018)*

Chapter 4 Identified Assistance Needs

4.1 Overall Needs in Ukraine

4.1.1 Assistance for Inexperienced Field of Solid Waste Management

In Ukraine, following the approval of the "National Waste Management Strategy" in November 2017, an existing fundamental law related to waste management, which is the "Law on Waste", will be drastically renewed as a Waste Management Framework Law like an EU directive "On Waste (2008/98/EC)".

Together with this framework law, many related specified laws which had not been in existence in Ukraine before such as "on municipal waste", "on electric and electrical equipment waste", "on cells and batteries", and "on packaging waste" should be considered. Because such new legal system related to waste management will be a quite inexperience system to Ukraine, it is considered that certain periods of years will be necessary for the deep settlement of the system to implement the action plans under the new system.

The "National Waste Management Plan" will also be developed based on the waste management hierarchy, in parallel with the establishment of a new legal system. Local governments such as the oblasts and cities will have to develop its own local waste management plan according to the national plan. However, the status of this local waste management plan for the existing planning procedures such as "schemes of sanitation and cleaning", or "technical-economic justification (TEO)" is very unclear. Therefore, practical methods and procedures to develop the local waste management plan shall be prepared.

This local waste management plan will be a kind of master plan for each municipality to implement its waste management activities from waste collection to final disposal and recycling. Such plan can be prepared as usual before by the joint works among the local government, private or communal institutes for designing and engineering of Ukraine, but it is rather effective to cooperate with the foreign donors who have various experiences in these fields.

4.1.2 Urgent and Crucial Needs for Assistance on Waste Management

(1) Urgent and Appropriate Review and Renewal of the Existing Plans

As previously mentioned, existing plans related to waste management will be reviewed and revised as the local waste management plan, reflecting the concept of waste management hierarchy. The current scheme of sanitation and cleaning at each municipality shall be the essential basis for such planning, but the contents of the scheme are not always appropriate for planning. For example, fundamental data of waste management such as generated quantity and quality of waste is sometimes not based on the actual measurement, and its analysis is also not enough for appropriate planning. Material balance on the process of waste management is not carefully studied, and it results in the difficulties to determine the capacity of waste treatment facilities. Since the financial plan for the implementation of the scheme is also unclear, it is observed that enough public investment budget is not allocated to the project or that municipalities easily and fully tend to depend on the proposal of the private enterprises. Existing plans are not regularly monitored and timely updated under the "Plan-Do-Check-Action (PDCA)" cycle.

Therefore, in order to develop the appropriate local waste management plan and its monitoring, the following actions are needed as the candidate targets for future assistance.

(2) Collection of Reliable Data

The most fundamental point for the development of waste management master plan is how to collect a reliable data and to analyze these appropriately, to project the future situation. The most crucial data of municipal solid waste are the generation quantity and quality of waste. In fact, there are such data existing already in Ukraine, especially waste composition data in large cities. Since the survey methods for such waste composition are unclear, standardized waste survey methods shall be necessary. As for the waste generation quantity, unit generation volume of municipal solid waste has been set to be 2.1

m^3 per person per year in Ukraine. Considering the recent change of lifestyle due to economic growth, unit volume itself and its composition must be different than before. In addition, generation quantity and quality of municipal waste often differ at the regions, in terms of population and industrial characteristics. Upon such background, detailed waste generation quantity survey at the target area for the new master plan should be indispensable to conduct.

(3) Research and Creation of Recycling Market

In the National Waste Management Strategy, the target number of recycling facilities to recover secondary raw materials will reach to 800 units by 2030 in Ukraine. While this target aims to recover the recyclables from the municipal waste as much as possible, it should be noted that this proposed system can only function with the existence of the business market for recovered secondary raw materials. On the other hand, as generally known, such recycling market is unstable and sensitively affected by the global economy such as large importers like China. Therefore, a kind of mandate in creating market for the recyclables will be created under the national policy for "Extended Producer's Responsibility (EPR)". As for this approach, assistance based on experiences of the countries who had already introduced the EPR policy in Europe or Japan could be very beneficial to Ukraine.

(4) Introduction of Segregated Waste Collection

It is reported and observed that segregated waste collection has already been introduced in some settlements or municipalities in Ukraine, but the scales of these are very small and it is believed that the introduction of segregated waste collection in large cities takes certain period of years. The target number of settlements who introduce the segregated waste collection is set to be 5,000 settlements by 2030 in the national strategy. There are various methods of segregated waste collection such as door to door collection or curbside collection depending on the characteristics of settlements. Therefore, based on the experiences in other countries, implementation of some pilot projects on segregated waste collection in different types of settlement with different collection method is quite effective for future expansion over the country.

(5) Public Awareness Raising and Environmental Education

Segregated waste collection should not be introduced without obtaining a positive cooperation of residents coupled with their correct understanding on the solid waste management and necessity of waste segregation at home. As for this cooperation, effective ways on public awareness raising and environmental education to different generation from children to adults shall be developed. It is also expected that the understanding of the residents on the necessity of appropriate charges on waste removal will be deepened through public awareness raising activities. There are various ways which are not only focused on development of environmental education tools, but also collaboration with medias, coordination with schools, community based organizations (CBOs) or non-governmental organizations (NGOs), and this is necessary to be implemented in a long-term perspective.

(6) Adoption of Appropriate Technology and Business Scheme

As stipulated in the national strategy, modern and appropriate technology, and business scheme shall be adopted for the improvement of existing waste treatment facilities or construction of new facilities. Since it is planned to develop the "Best Available Technology for Waste Management" in the near future. Therefore, any concerned governmental officials working in the field of waste management should be familiar with such suitable technologies and schemes.

(7) Appropriate Waste Removal Tariff Setting

New municipal waste management system established in the future with the improvement of current conditions should be accompanied with the advanced state-of-art technologies, and will significantly increase the cost, in both capital expenditure (CAPEX) and operating expenditure (OPEX), being much more expensive than the current amount which only depends on the direct landfilling. Developed countries that use such advanced system are generally charging its cost to the residents, and the amount is around 1% of the household income. If same net amount of cost will be charged to the residents in Ukraine when the system will be renovated, this amount will be much beyond 1% of an average Ukrainian income. As this is an unrealistic tariff setting in Ukraine in short term, it is necessary to

consider the appropriate amount of waste removal tariff together with a series of financial support to the municipalities such as government subsidy.

(8) Private Sector Involvement and Evaluation of PPP Project

Many private enterprises have been approaching the municipalities in Ukraine for their sales on waste management equipment, plants, or businesses. However, in general, these municipalities do not have sufficient ability to evaluate these technologies properly, and often fall into a situation where they are easily entrusted with waste processing and disposal projects as just proposed by private enterprises, which are significantly infeasible. Therefore, it is necessary to improve the technical capacity of concerned governmental officials and to share such information among others in order to evaluate the proposed private projects objectively and appropriately.

(9) Globalization of Existing Engineering Standards

According to the local waste management plan, which will be updated upon the development of the national waste management plan, prioritized project for the construction of waste treatment or disposal facilities proposed in the plan will be implemented. In Ukraine, as the leading industrial core of the region in the past from the era of Soviet Union, all kinds of technical and engineering norms have been prepared for the construction of infrastructures. It might be said, unfortunately, that some of these norms are not always timely updated to match the renovated global standards, which remained old and rigid. When the waste processing facilities will be constructed in cooperation with the foreign assistance and with the participation of foreign manufacturers in the future, globalization of such existing norms will be also necessary.

(10) Provision of Training and Education Opportunity

Capacity development of individuals of concerned waste management authorities is very crucial to implement the waste management plan sustainably, together with the improvement of the organizational and social capacities. In addition to the On-the-Job Training through the daily works, provision of training opportunities abroad in developed countries to such individuals should be effective to improve their capacity, as well as organizing the related seminar or workshop in Ukraine, to learn about the experiences of other countries.

(11) Coordination among Ministries, Oblasts, and Municipalities

As one of the actions proposed in the action plan for the National Waste Management Strategy, a central executing body on waste management will be formulated. This body will function as a state agency led by the Ministry of Ecology and Natural Resources. The detail of this organization will be discussed for its formulation later but one of the functions is proposed which is the “coordination and regulation of activities of participants in the field of waste management”. This function will surely contribute to strengthen the relationship among ministries, oblasts, and municipalities with more systematic coordination. In fact, construction and operation of regional waste treatment and disposal facilities will require a closer coordination among those in the central and local governments, under the consistent waste management policies.

4.2 Specific Needs at the Central Government

Including the common needs described in the previous section, specific needs for assistance at the central government are tentatively identified as listed below.

- Training and education for the enhancement of the “central executing body on waste management” which will be newly established;
- Establishment of network among concerned ministries, oblasts, and municipalities for strengthening their cooperation, together with the creation of regular opportunities for sharing the experiences and information;
- Development of technical guidelines and standards for the preparation and implementation of the local waste management plan; and
- Establishment of monitoring structure on waste management with the data management system.

4.3 Specific Needs in Kyiv City

Identified specific needs for the assistance in Kyiv City are tentatively listed below.

- Life-expansion or closure of Landfill No. 5;
- Closure of Landfill No. 6;
- Development of new landfill(s) after the closure of No. 5 and 6;
- Development of waste processing facilities to reduce the waste to be directly landfilled;
- Fundamental improvement of Energia Incineration Plant (chemical and physical gas treatment, power generators);
- New construction of substitute plant of Energia Incineration Plant by around 2030;
- Introduction and expansions of segregated waste collection, including public awareness raising;
- Renew the conceptual and master plan of solid waste management including facility development plan and its implementation plan as the city's solid waste management plan, updating related schemes of sanitation and cleaning or other project documents.

4.4 Specific Needs in Kharkiv City

Identified specific needs for the assistance in Kharkiv City are tentatively listed below.

- Efficient operation of sorting plant constructed by IBRD project;
- Introduction of segregated waste collection, including public awareness raising;
- Future facility development plan for the second phase of landfill and waste processing plant (17 ha) after IBRD project;
- Consideration of further waste reduction at the landfill, following the National Waste Management Strategy; and
- Renew the conceptual and master plan of solid waste management including facility development plan and its implementation plan as the city's solid waste management plan, updating related schemes of sanitation and cleaning or other project documents.

4.5 Specific Needs in Dnipro City

Identified specific needs for the assistance in Dnipro City are tentatively listed below.

- Preparation of alternative facility development plan against the PPP project plans, which are currently being done by both city and oblast;
- Efficient operation of sorting plant in case Eco Dnipro will be constructed;
- Introduction of segregated waste collection, including public awareness raising;
- Renewal of the conceptual and master plan of the solid waste management including facility development plan and its implementation plan as the city's solid waste management plan, updating related scheme of sanitation and cleaning or other project documents.

Chapter 5 Tentative Evaluation for the Introduction of Waste-to-Energy System

5.1 Methodology of Evaluation

To construct a waste-to-energy plant as one of the options for waste treatment is not only a Japanese domestic issue but common challenge in the cities in countries where urbanization and economic development are remarkable. Since the first waste-to-energy plant in Japan which was waste incinerator with power generation was constructed in 1960s, there are 358 waste-to-energy plants among more than 1.1 thousand waste incinerators constructed throughout in Japan in 2016. Based on such long years and various experiences of Japan, the Government of Japan such as the Japan International Cooperation Agency, referred to as "JICA", Ministry of Environment, or Ministry of Economy, Trade and Industry, have provided assistance to countries which are trying to introduce a waste-to-energy plant. However, cases that actually constructed a plant are not many. Besides, it was found out that some plant constructed stopped the operation in short period in the past due to its high operation cost as well as other technical, social or environmental reasons.

Recently, on the other hand, the electric power fixed price purchase system, called as "FIT", is applied for the electricity which is generated in waste-to-energy plant in many countries. As FIT provides another financial resource to the waste management organizations in addition to conventional tipping fee for waste disposal, the conditions to introduce a waste-to-energy plant are greatly changing from the past.

Therefore, it is very important to consider the situations including background of development and locality of the target city when the cooperation to introduce a waste-to-energy plant is proceeded. To effectively develop such cooperation, the necessary conditions including social-economic situation, the state of urban infrastructure, legal system, capacity of the government, and level of available technologies shall be carefully considered.

Upon such background, JICA has been developing the guideline for the introduction of a waste-to-energy plant with the "draft pre-check list" in which, the conditions are shown as evaluation indexes so that the situations can be evaluated objectively and stakeholders are able to push forward the project under common understanding. In "draft pre-checklist" which is attached in Appendix 7, evaluation factors are categorized into six aspects, which are 1) social conditions, 2) understanding by residence, 3) institutional aspect, 4) governance capability of government, 5) financial aspect, 6) technical aspect, and each category includes items.

As a part of this survey, the possibility to introduce waste-to-energy system, which is one of specified needs, is examined in the targeted three cities, i.e., Kyiv City, Kharkiv City, and Dnipro City, using "pre-checklist" which was drafted by JICA.

The items, which vary among the cities, are examined individually and common items in overall Ukraine are examined as a whole. Each evaluation item is scored with five different level, which are "high", "relatively high", "medium", "relatively low" and "low".

5.2 Social Aspect

5.2.1 Population of the Target City

Evaluation Index：The target city population is 100,000 or more. (Or plant capacity is 70 tons/day or more).

(1) Kyiv City

The population of Kyiv City is approximately 2,900,000 as of February 2018. Although the official population remains at the same level in the past ten years, it is supposed that there are more than one million people that did not register. Also, the city developed the plan in which the population will reach approximately 3,300,000 until the year 2030. Thus, since the population of Kyiv City greatly exceeds the evaluation index, it is possible to secure enough facility scale while waste generation control policies are considered. Thus, it could be concluded to be "high".

(2) Kharkiv City

The population of Kharkiv City is approximately 1,400,000 where there is no obvious change for the past ten years. A considerable population inflow is seen by the uneasiness of political situation in the neighborhood of the Russian border recently from Donetsk. The population of Kharkiv City greatly exceeds the evaluation index, then it is possible to secure enough facility scale for this reason. Thus, it could be concluded to be "high".

(3) Dnipro City

The population of Dnipro City is approximately 1,000,000 which remains at almost the same level for the past ten years. Although slight decrease of the population is anticipated in the future, the population exceeds the evaluation index with a margin and there is an inflow of waste from the outskirt districts into the disposal site, which is the Right Bank. Consequently, it is clear to secure enough facility scales. Thus, it could be concluded to be "high".

5.2.2 Social Needs

Evaluation Index : There are high social needs such as "the remaining capacity of final disposal sites is limited." "Sanitary waste treatment is highly required."

(1) Kyiv City

Landfill No. 5 is accepting the municipal wastes generated in the city, excluding waste incinerated, bulky waste, and construction waste. Although this disposal site is located in the sanitary zone, which is 500 meters or more away from the residential area and operated by such appropriate means like covering waste with soils and leachate treatment, neighboring citizens repeatedly and strongly complained about the landfill of waste. The Kyiv City Council approved the closing of Landfill No. 5 by October 2018 based on such situation. Thus, reduction of waste to be landfilled is now strongly wanted in Kyiv City. Thus, it could be concluded to be "high".

(2) Kharkiv City

The present landfill area in Dergachi disposal site for the waste generated in Kharkiv City is now almost full after accepting the waste for the past 12 years and scheduled to be completed its operation within a year. As a new landfill area is now under construction in an adjacent division financed by the World Bank, there is little uneasiness in the shortage in landfill capacity. Enough considerations to the environment are delivered by such means as covering waste with soil, leachate control, and washing tires of vehicle before going out of the disposal site. Thus, it could be concluded to be "medium".

(3) Dnipro City

The disposal site of Dnipro City, which is called the Right Bank, has a large area of approximately 131.5 hectares and accepts both municipal waste and industrial waste. Citizens demand for landfill operation is significantly severe, and the city had the experience receiving intense protest on accepting waste from another city. Therefore, the city authority is now very careful in the disposal site operation and earnestly seeks for the reduction of waste landfilled; and proceeding with the project to construct a "waste treatment complex". Thus, it could be concluded to be "relatively high".

5.2.3 Development Status of Social Infrastructure Pertaining to Environmental Sanitation

Evaluation Index : Administrative services of power and water supply, and sewerage works are provided in the target city without problems.

This index is common throughout the three cities.

As well as the electric supply is stable enough and undergrounding of electrical wire widely spreads in every city, there is no obvious problem about water supply. The wide area sewage treatment plant such as the Bortnychi Sewage Treatment Plant in Kyiv City covers almost all areas of the city. In addition, the central heating system using the CHPs incorporated with the pipeline network is operated in every city. The arrangement of the social infrastructure is highly advanced. Thus, it could be concluded to be "high" for all cities.

5.2.4 Integration of Environmental and Social Considerations

Evaluation index : Laws with regard to pollution prevention and environmental impact assessment (environmental laws, etc.) have been developed and enacted in target countries and target areas.

This index is common throughout the three cities.

As shown in Section 3.1.6, the Law on the Environment Impact Assessment is enacted in the whole Ukraine. The facilities that generate specified environmental load, including waste treatment facilities, are required to be mastered from environmental aspect in each process of the construction project. In addition, examinations in the preparation and arrangements of laws and ordinances founded by EU standards are being pushed forward for EU participation. Thus, it could be concluded to be "high" for all cities.

5.3 Public Understanding Aspect

5.3.1 Cooperation of residents in waste sorting

Evaluation Index : Cooperation of the residents concerning the sorting of wastes can be obtained. (Contamination of unsuitable wastes waste-to-energy can be controlled.)

As for the sorting of wastes at the generation source, the situations are almost the same in three cities. The boxes to collect used dry cells are installed in some places such as the entrance of city halls. These three cities are also considering enhancing environmental education focusing on school students to achieve better understanding.

Other municipal wastes are discharged altogether by residents, and some valuables such as PET bottles, metal cans, used paper, and cardboard are collected by waste pickers at generation source. The city authorities are seeking for the construction of sorting facilities to reduce the waste controlling illegal recycling. Thus, it could be concluded to be "relatively high".

5.3.2 Understanding of Residents about Waste-to-Energy System

Evaluation Index : Understanding of the residents about waste-to-energy system has been obtained.

(1) Kyiv City

The Energia Waste Incineration Plant continues its stable operation for a long time while the plant occasionally received complaints from neighboring inhabitants especially on the bad smell. But inhabitants listen to the explanation of the plant staff that such smell comes from the sewerage treatment facility located nearby and understood it. Opposite opinions were also expressed and signature activities were promoted for the idea to construct new plants in the past. However, most oppositions were not on the incinerating waste but mostly on site selection. The Kyiv City Authority thinks that the citizens basically understand the necessity of the plant. Thus, it could be concluded to be "relatively high".

(2) Kharkiv City

The argument about the introduction of a waste-to-energy system is not performed as the Kharkiv City has a large disposal site and the construction projects of a new landfill and a waste sorting facility are being proceeded through the financing of the World Bank. A waste incineration plant existed in the city before, but it was demolished because of maintenance problem accompanied by long-term operation. Although understanding of residents to a waste-to-energy system is not clear now, the city authority is rather optimistic for getting the understanding of the residents. Thus, it could be concluded to be "relatively high".

(3) Dnipro City

The Dnipro City Council is trying to construct a waste processing complex in the Right Bank waste disposal site. The waste-to-energy system is not excluded in the plan of a waste processing complex. The Dnipropetrovsk Oblast State Administration has a plan to construct some waste-to-energy plants in the Oblast Region, and thinks that it may not be so difficult to get inhabitants understand the waste-

to-energy system. However, this is not clear as the idea is not actually shown to the inhabitants. Thus, it could be concluded to be "relatively high".

5.4 Institutional Aspect

5.4.1 Development of Laws, Enforcement Orders and Rules

Evaluation Index : Following to laws with regard to solid waste management, their enforcement orders and rules have been developed.

This index is common throughout the three cities.

As the example of the enforcement of regulations, the Energia Incineration Plant in Kyiv City operates following the Ukrainian emission standards. In addition, the laws related to waste management such as Law on Package Wastes and the Law on Hazardous Wastes are scheduled to be enacted after establishing the Law on Waste, which is the fundamental framework law of waste management. Establishing these laws are little behind the schedule, but it is forwarded steadily. Thus, it could be concluded to be "relatively high" for all cities.

5.4.2 Stability of Administrative Organization

Evaluation Index : There is an administrative organization in-charge of the project for construction and operation of waste-to-energy system and the organization is stable. Also, there is a personnel management system enabling long-term employment (for three years or longer) of the core staff.

(1) Kyiv City

Kyiv City has an advantage on the administrative organization for construction and operation of a waste-to-energy plant because of the existence of Energia Incineration Plant.

Department of Housing and Communal Infrastructure is the responsible department for municipal waste management, in cooperation with the concerned communal enterprise who is "Kyiv Commune Service" for the overall management of waste collection. Core staffs who are deal with the municipal waste management works on the front are mostly kept their position while the executive staffs tend to change upon the political change. Thus, it could be concluded to be "high".

(2) Kharkiv City

Department of Housing Services and the Department for Communal Services are the responsible organizations for municipal waste management and its demarcation is clear. As for the implementation of the municipal waste management, two communal enterprises are established, KVBO for waste collection and MKPV for waste disposal. Although there is no specified organization to waste-to-energy system, Kharkiv City manages the project to construct a new landfill site and a sorting facility financed by the World Bank and IBRD. As well as Kyiv City, Core staffs who are deal with the municipal waste management works on the front are mostly kept their position. Thus, it could be concluded to be "relatively high".

(3) Dnipro City

Department of Environmental Policy is responsible department for municipal waste management, in cooperation with the concerned communal enterprise who is "Eco Dnipro" for the overall management of waste treatment and disposal. As for the waste collection, Dnipro City had faced difficulties on the management of the contracted private waste collection enterprise due to its under expected performances. Therefore, the city is now intending to control the waste collection more directly with other communal enterprises. As for the core staff who are deal with the municipal waste management works on the front are mostly kept their position as well as other cities. Thus, it could be concluded to be "medium".

5.4.3 Adequacy of the Construction Site

Evaluation Index：Construction site in which a waste-to-energy system can be built is available.

(1) Kyiv City

As for the construction of a new plant, there is only a few small areas within the city boundary including the adjacent space of Energia Incineration Plant. In case such small areas will not be enough for the new plant, Kyiv City should consult with other minimalities in the Kyiv Oblast. In addition, considering the signature activity against the construction of the plant was happened before, the city authority deeply recognizes the importance of site selection. Thus, it could be concluded to be “medium”.

(2) Kharkiv City

A waste incineration plant existed and was operated in the past time, but was demolished now. The plan to construct a waste-to-energy plant did not materialize and the construction site was not determined. In case that a waste-to-energy plant is constructed in the existing disposal site, there is enough area to be secured within the site boundary. Thus, it could be concluded to be “relatively high”.

(3) Dnipro City

Dnipro City Authority plans to construct a waste processing complex in the Right Bank disposal site, and considers the waste-to-energy system as one of the alternatives. The site is proper in constructing a waste-to-energy plant because waste incineration plant has existed before and was operated by the year 2012 near the place. Thus, it could be concluded to be “high”.

5.5 Administrative Governance Aspect

5.5.1 Positioning of Waste-to-Energy System in Upper Level Plan

Evaluation Index：Waste-to-energy system has its position in the upper level plans (comprehensive plan, regional development strategy, etc.).

This index is common throughout the three cities.

The National Waste Management Strategy was developed. In the strategy, it was clarified that 20 thermal treatment facilities would be constructed by year 2030 while the ratio of waste processing would be increased to 10% and the ratio of direct landfill of wastes would be decreased to 30% from present ratio of 96%. In addition, it is aimed to establish the Law on Waste Incineration within 2018, following the development of the Law on Waste which will be the new framework law for waste management in Ukraine. Thus, it could be concluded to be “high”.

5.5.2 Political Stance of the Head of Local Government

Evaluation Index：The head of local government is positive towards the waste-to-energy system.

(1) Kyiv City

It is considered that the mayor of Kyiv City is positive to the waste-to-energy system. As the city council approved the closure of Landfill No. 5, the reduction of waste becomes an urgent task. The amount of waste which is transported to Landfill No. 5 will then be reduced. The mayor understands the significance of the Energia Incineration Plant and has approved the renovation work of the plant. As the short-term renovation works are mostly environmental countermeasures such as installation of physical-chemical gas treatment equipment, private investors are not interested in investing such works. Therefore, Kyiv City is planning to implement such renovation works with their public financial resources. Thus, it could be concluded to be “high”.

(2) Kharkiv City

The construction project of waste processing facility with the area of 17 ha including the new landfill by the WB is stably proceeded. There is another area of 17 ha also already secured for the following phase of the facilities. These development had been carefully assessed and implemented under the strong leadership of the political decision makers of the city which aims to improve the waste

management of the city. On the other hand, the stance of the mayor towards waste-to-energy system is rather negative only in case that the introduction of waste-to-energy system will require the significant increase of waste disposal tax to the city residents. Thus, it could be concluded to be “medium”.

(3) Dnipro City

Dnipro City Council is proceeding with the construction project of the waste processing facilities such as the waste sorting plant or energy recovery plant in the Right Bank Waste Treatment Complex by accepting the proposal submitted by private company or communal enterprise. Both the mayor and deputy mayor are very much interested in a waste-to-energy system by waste incineration as the effective option for the waste treatment and they often go to foreign countries such as Japan and the United Kingdom to study the system. Since the city is still deliberating to determine which waste treatment technology will be adopted for the city, it could be concluded to be “relatively high”.

5.5.3 Performance Capability of the Government

Evaluation Index：The government is able to utilize the committees comprising the external experts and external specialist organizations, such as consulting firms, to perform the project appropriately.

(1) Kyiv City

The Kyiv City Authority is planning the renovation works to extend available period and upgrade the performance of waste gas treatment system of the Energia Incineration Plant, which is considerably aged based on the findings through the technical inspection done by international consultants. Thus, it could be concluded to be “relatively high”.

(2) Kharkiv City

The construction project including new landfill site, sorting facility, and electricity generation system using landfill gas is now being proceeded as a part of UIP 2 of the WB. The staff in-charge understood clearly the content of works and smoothly pushes forward the works making effective use of a German consultant and a Polish contractor. Thus, it could be concluded to be “high”.

(3) Dnipro City

The project is being proceeded effectively utilizing waste management experts who have enough experience in designing, construction, and construction work supervising of a waste disposal site and waste processing facility. Thus, it could be concluded to be “high”.

5.5.4 Technical Standards and Operation Pertaining to Selling Electricity

Evaluation Index：By concerned Energy Department or Electric Power Company, technical standards and operation pertaining to selling electricity, and selling price of electricity are set forth.

This index is mostly common throughout the three cities.

Although the system to sell the electricity especially generated in a waste-to-energy plant has not been prepared yet, it is now examined to apply the feed-in-tariff system (FIT) to the biomass component contained in waste. On the other hand, the system to sell heat energy is already established in Ukraine as the central heat and hot water providing system using CHP has been prepared in the urban areas of each city. Actually, for example, the Energia Waste Incineration Plant sells the heat generated in the plant, where the income obtained by selling heat energy accounts for 60% of the overall revenue. Thus, considering existing advantage, it could be concluded to be “high” for Kyiv City and to be “relatively high” for other two cities.

5.6 Financial Aspect

5.6.1 Securing of Financial Resources

Evaluation Index：Project cost (construction cost and operating cost) of waste-to-energy system can be secured. The government is prepared to bear the costs such as tipping fee (fee for outsourcing disposal) and reliable investors are expected to participate in the project.

(1) Conditions for Evaluation(Common for 3 Cities)

According to the "Law on Waste", municipal solid waste management is under the responsibility of the local government such as overall plan, project identification, financing, and implementation of such project. In the aspect of finance, it is firstly required to identify the financial plan for the capital expenditure and operational expenditure throughout the facility lifetime for the purpose of evaluating the viability and sustainability of the project.

As for the capital cost, it is deemed a few hundred million US dollars for a waste-to-energy facility with a capacity of 300 to 500 tons per day shall be procured through the local budget, subsidies from national government and/or oblast state administration, or private investor under PPP.

BOT or BOO, parts of PPP modalities, which a private participant pays the initial cost instead of government authority, enable plant construction without huge financial requirement in the city side. However, there are still many problems for the private companies to make a decision to invest in solid waste management field in Ukraine. For example, credit capacity of city governments is not so high for the long-term payment of the concession fee (tipping fee), insufficient data of waste characteristics provides big uncertainty for the project cash flow coming from power/heat sales, cost for exhaust gas treatment and cost for stabilization of the ash, and high foreign exchange risk considering the present currency movement in case of foreign direct investment. At this moment, it can be said that waste-to-energy PPP market is not matured in Ukraine and it is very difficult to expect even a few investors to be interested in.

Therefore, the evaluation of "securing financial resources" in this category will be based on the following:

- Local government shall finance the initial cost from its special development budget or using national or international subsidies and/or loans, thus, financial capability of the city for initial cost is excluded from this evaluation criteria while capability and experience of international donors' fund arrangement will be evaluated;
- Local government shall budget the operation and maintenance cost of the waste-to-energy facility by its own budget, thus, capability to allocate annual O&M cost will be evaluated.

(2) Kyiv City

Kyiv City has already recognized that it is high risk when the city only depends on the private investment. Now the city authority thinks to push forward the project by PPP, BOT or BOO method at first, and then the project will be proceeded by means of "construction and operation/ maintenance by public" or "construction by public and operation/maintenance by private" in case that the participation by private investors is not expected.

With regard to the capability of arrangement of national/international finance, it can be said that Kyiv City is the highest among the cities in Ukraine because it is capital city and operated by state administration.

According to the PJSC Kyivenergo, a private company which has continued its operation and maintenance of the Energia Incineration Plant, which was constructed in the 1980s, almost all expenses are covered by the revenue from sale of heat and tariff for waste processing (see Table 3.62). Expense required for specified scale of renovation works is budgeted by the city authority.

Therefore, as for the constructing new waste-to-energy facilities, city authority and its communal enterprise "Kyivteploenergo" are fully capable to manage its O&M cost by themselves because the existing Energia Incineration Plant is operating at self-support accounting and there is a high possibility to increase its sales of heat considering the present low operation rate (presently process 700-800 t/day for a gross capacity of 1,080 t/day) and high tariff of heat sale to the grid. Thus, it could be concluded to be "relatively high".

(3) Kharkiv City

The city authority and MKPV also have high ability to prepare necessary finance resource to construct and manage a new waste disposal facility.

Capability to budget operational expenses of waste-to-energy facility is also good because there is an existing system for subventions from the city government to MKPV as gap finance between processing tariff and actual cost. If the unit price of heat selling is high same like Kyiv City, there is also a higher potential to cover such cost. Processing tariff to be allocated from removal tariff of citizens and private companies shall be well considered and fixed when the city plans the facility. Thus, it could be concluded to be "relatively high".

(4) Dnipro City

The Eco Dnipro, the communal enterprise, is pushing forward a construction project of waste disposal site and a waste sorting facility with available private investors, but financial resource from the private side may not be enough for waste-to-energy facility construction, so some support from national/international organizations would be needed.

Capability to budget operational expenses of waste-to-energy facility is also good because there is an existing system for subventions from city government to Eco Dnipro as gap finance between processing tariff and actual cost. As well as Kharkiv City, if the unit price of heat selling is expected to be high to cover such cost. Thus, it could be concluded to be "relatively high".

5.6.2 Tipping Fee

Evaluation Index：It is possible to set the tipping fee at a stable price over a long period by contract.

This index is mostly common throughout the three cities.

Tipping fee is fundamentally determined by the National Regulatory Commission for Energy and Utilities of Ukraine and can be revised the local authorities who are responsible to implement the waste management as is necessary. Waste collection and disposal services are provided stable for a long time. Tariff for such waste management services as well as other utility charges are kept on a low level and careful posture of the city authorities can be seen against the large raise of its rate. Thus, it could be concluded to be "relatively high".

5.6.3 Revenue by Selling Electricity

Evaluation Index：It is reasonable to assume selling price and the amount of electricity and recyclable waste.

This index is common throughout the three cities.

It is rather difficult to directly evaluate at this moment because there is no actual construction project of a waste-to-energy plant to produce the electricity in three cities. The system to sell heat energy, however, is established in Kyiv City. For the heat produced in the Energia Waste Incineration Plant, price of UAH 480/Gcal is set. This case of such example is taken into account. FIT system for the waste-to-energy system is not established in Ukraine but examination on FIT system is now being pushed forward. Thus, it could be concluded to be "relatively high".

5.6.4 Project Scheme

Evaluation Index：Project schemes (DB, DBO, BTO, etc.) are being discussed among stakeholders.

(1) Kyiv City

The Energia Waste Incineration Plant was built through public scheme (DB scheme) and currently operated by the private sector under the "long-term comprehensive management contract" scheme. The City State Administration thinks to proceed with a new project by PPP, BOT or BOO, first, and then apply the same scheme with Energia Incineration Plant or DBO scheme in case any investors, who are interested in a project, are not expected. Thus, the City Authority wisely recognizes the difference of the project scheme.

On the other hand, risk allocation of Energia Incineration Plant seems a bit heavy to the private side, considering fact that PJSC Kyivenergo should bear the risk of change of waste quality and bear the financial responsibility on certain level of facility improvement. So, setting up a fair balance evaluation

is needed when planning the introduction of a new waste-to-energy facility. Thus, it could be concluded to be "relatively high".

(2) Kharkiv City

The City Council is pushing forward the project to construct new waste disposal facilities including a landfill site, sorting facility, and landfill gas used power generation system, getting financial assistance by the WB, and does not expect private financing now. Since most of the municipal solid waste management is going to be done under the city's leadership with communal enterprises, it is evaluated that the project schemes for providing public service are carefully examined by the city government. Thus, it could be concluded to be "high".

(3) Dnipro City

Different than Kharkiv City, through PPP scheme, the City Council is pushing forward the project in which a new waste disposal facility and a sorting facility are incorporated with bio-gas generation system. Although the City Council developed PPP documents based on the "Law on PPP", very general but important conditions of PPP in waste management field, such as quantity and quality of waste, are not detailed in the Request for Proposal. Moreover, risk allocation and risk analysis of the same document often said the termination of the PPP agreement is a risk management measure in case of failure of fulfillment in public/private obligation. Considering the waste management situation in Dnipro City, termination of the PPP activity is the unhappiest result and was never considered as "risk management". Thus, the City Council shall specify how the city is going to manage its waste and which part they are going to outsource to the private fund with specific conditions. Thus, it could be concluded to be "medium".

5.6.5 Project Risks

Evaluation Index : Major project risks are recognized and the difference of responsibility boundary points according to project schemes is understood.

(1) Kyiv City

The Energia Waste Incineration Plant is managed by "long-term comprehensive management contract" scheme. In which, responsibility boundary point, new investment fund provider, and maintenance repair fund provider, are clarified, so, reasonable risk allocation is expected. The risk allocation in future projects needs further examination needed case by case. Thus, it could be concluded to be "high".

(2) Kharkiv City

As mentioned above, Kharkiv City is introducing the new waste processing facilities (new landfills, sorting lines, and landfill-gas to electricity plant) through public initiative using the loan from the WB.

It can be evaluated that Kharkiv City recognizes the importance of the waste management as communal service and it does not rely on private investment so far. Thus, it could be concluded to be "high".

(3) Dnipro City

The City Council is pushing forward the projects considering PPP scheme including the project risk itself in the proposals according to the open documents with regard to PPP procurement. Such attitude to depend the project risk to the private sector might mean that the City Council does not correctly understand the major project risks and how to allocate these risks to public and private partners at this moment. Thus, it could be concluded to be "medium".

5.7 Technical Aspect

5.7.1 Collecting Basic Data Concerning Waste

Evaluation Index : Basic data and information concerning waste (quantity and composition of waste, waste treatment process, etc.) have been clarified.

This index is common throughout the three cities.

Weighing machines are installed at waste disposal sites and waste management flows are clear, although a part of waste, which is collected by private companies, is unknown enough. As for the composition of waste, periodical waste composition analyses are not being carried out, but it could be possible to estimate from the existing physical and chemical compositions obtained through the past surveys, considering the changes of the lifestyle and economic situations, referring the experiences of other countries. Thus, it could be concluded to be "high".

5.7.2 Technical Capacity of Manufacturers

Evaluation Index : Reliable manufacturers (especially of stoker-type incinerators) are expected to participate in the project.

This index is common throughout the three cities.

There is the fact that the European branch office of a Japanese manufacturer had proposed to Kyiv City to construct a waste-to-energy plant in the past, by using the Green Investment Scheme. This project was not realized unfortunately because the fund was not allocated. Considering this, it could be possible to expect the participation of a reliable manufacturer, if reasonable conditions are prepared. In addition, four waste incineration plants, of which furnaces were Czech-based stoker grate type, were constructed and had operated for a long time in Ukraine. Thus, it could be concluded to be "relatively high".

5.7.3 Proper Disposal of Incineration Residue (Incineration Ash)

Evaluation Index : Proper disposal of incineration residue (incineration ash) is possible. (For example, measures for preventing the outflow of leachate have been taken care of at the final disposal site.)

(1) Kyiv City

Landfill No. 5 is equipped with necessary devices such as impermeable bottom layers, leachate collection and treatment system, as well as indication panels and fence which identifies the border of the site. These are essential devices to satisfy the requirements as an engineered final disposal site. Residual ashes generated in the Energia Incineration Plant has been carrying into Landfill No. 5 for long time. On the other hand, however, Landfill No. 5 will be closed soon in a few years and Kyiv City should develop the same types of the final disposal site to accept the residual ashes. Thus, it could be concluded to be "relatively high".

(2) Kharkiv City

The current waste disposal site in Dergachi is also equipped with impermeable bottom layers and leachate reservoir. Countermeasures for rainwater not to go into the landfill site are also taken. Leachate kept in a reservoir is transported to a sewage treatment plant by tank lorry. As for the new landfill under developing by the financial assistance of the WB, leachate treatment facility will be constructed within the Dergachi site. There is no plan to accept the residual incineration ash at this moment but usually this type of a sanitary landfill has enough engineering capability to accumulate such ash. Thus, it could be concluded to be "relatively high".

(3) Dnipro City

Current landfill in the Right Bank waste treatment complex accepts both municipal waste and industrial waste dividing the landfill area. The site is equipped with impermeable bottom layers and leachate collection and storage facilities. It is supposed that the site had accepted incineration residue during the time when the waste incineration plant had been operated until the year 2012. There is the development plan of the new landfill area within the complex with the same engineering works but leachate will be still carried out to the sewerage treatment facility. Thus, it could be concluded to be "relatively high".

5.7.4 Environmental Monitoring System

Evaluation Index : Laboratories for analysis of exhaust gas, leachate before and after treatment, underground and surface water in surrounding area, noise, vibration, odor, etc., are exist and enable to perform appropriate monitoring.

This index is common throughout the three cities.

Legally specified environmental monitoring procedures are established in Ukraine and a lot of laboratories for analysis exist, too.

In the waste disposal sites of the three cities, leachate and atmospheric situation are monitored and analyzed, and a part of analyzed data is disclosed to the public.

As for the monitoring on the waste incineration, necessary instruments are installed in the Energia Incineration Plant to check if the concerned environmental qualities are satisfy the Ukrainian local emission standards or not. This monitoring system can be introduced to other cities. Thus, it could be concluded to be "high".

5.7.5 Practical Experiences of Similar Facilities

Evaluation Index : Similar facilities, such as thermal power plants, exist and are managed appropriately.

This index is common throughout the three cities.

Waste incineration plant itself had existed all of three cities. The operation of the plant was stopped in both Kharkiv City and Dnipro City, but the plant in Kyiv City, which has been operated for more than 30 years, is still under operation making full use of high level maintenance skills.

As for similar facilities, in addition, nuclear power plants are constructed and operated in Ukraine. Cogeneration facilities, so called CHP, are also operated in these three cities. CHP is an important facility to support civic life by providing life-line utilities such as electricity and heat. Thus, it could be concluded to be "high".

5.7.6 Securing of Engineers

Evaluation Index : It is possible to secure engineers (personnel with skills equivalent to technical high school graduates).

This index is common throughout the three cities.

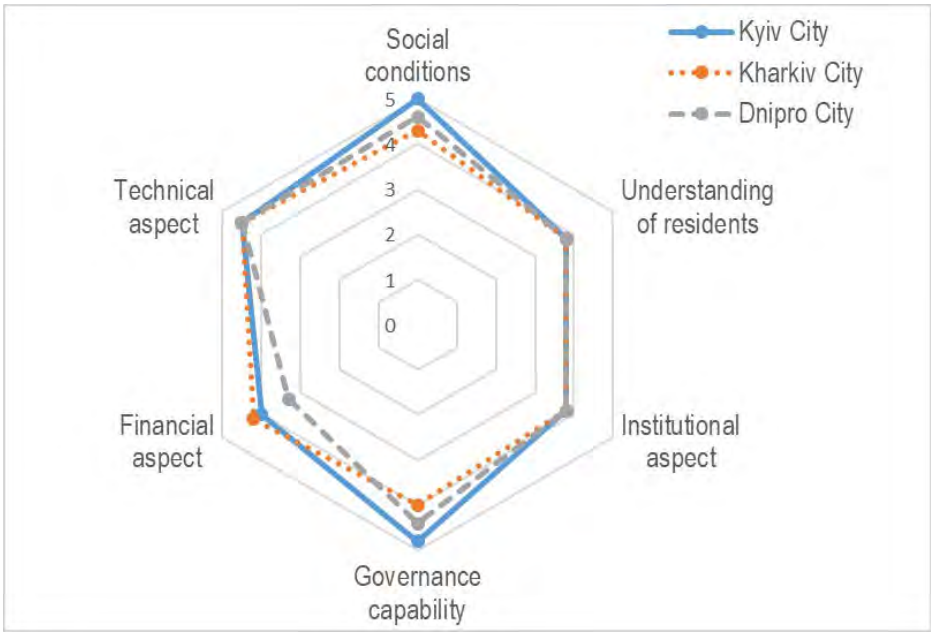
Since Ukraine took charge of heavy industrial sectors such as iron and steel, shipbuilding, and aerospace industries in the Soviet Union era, Ukraine has become a country having a high technique in these fields. There are a lot of engineers and technicians who work in nuclear power plants and CHP, and staff of 150 or more are now working in the Energia Waste Incineration Plant. Many universities in the country accept the students to learn the engineering and science technologies. Therefore, there is no uneasiness in securing the engineers and it could be concluded to be "high".

5.8 Tentative Evaluations for the Introduction of WTE System

(1) Tentative Evaluation Result

As mentioned at the beginning of this chapter, the possibility of introduction of waste-to-energy system in the three target cities is evaluated by using JICA's pre-checklist. Each evaluation items under six categorized aspects were scored with five different levels and valued from 0 to 4, and integrated by each category, considering the importance level of evaluation items.

The evaluation result is tentatively illustrated with the radar chart as shown in Figure 5.1.



Source: JICA Survey Team

Figure 5.1 Tentative Evaluation Result

(2) Summarized Evaluation Result of Each Category

1) Social Conditions

All of the three target cities are large cities in which their population is around or more than one million and have highly installed urban infrastructures including sewage treatment plants and central heat providing system. Environmental laws and regulations have been developed and enforced, while public awareness on waste management including city cleaning and operation of waste treatment facilities is relatively high.

Thus, it could be evaluated that the category of social conditions is highly satisfied. Comparing with Kharkiv City and Dnipro City who have secured a certain size of area for their landfill, Kyiv City is facing problems in finding alternative area for the new landfill after closure of the existing Landfill Nos. 5 and 6.

2) Understanding of Residents

Inhabitants have strong environmental awareness. Although the segregated collection of municipal waste has not been settled, hazardous items such as electric cells and batteries are separately collected at the special bins set at the government buildings and other public spaces.

One waste incineration plant built in 1986 is still under operation in Kyiv City and two other waste incineration plants had been operated before but closed in both Kharkiv City and Dnipro City. The staff concerned in these cities council generally have confidence to proceed the construction project of waste-to-energy plant with public consensus if it is equipped with appropriate pollution control devices.

Thus, it could be evaluated that the category of the understanding of residents is relatively satisfied.

3) Institutional Aspect

Ukraine has prepared laws and regulation related to waste management, such as “Law on Waste”, “Law on Local Government”, and “Law on Housing and Communal Services”. Such current legal framework will be upgraded energetically along with the similar but advanced framework of EU directives. The administrative organization of the target cities is generally in stable state. Actual operation of waste incineration plant is undergoing in Kyiv City, but there is very limited area for future construction within the city. On the other hand, Kharkiv City and Dnipro City had stopped the operation of waste

incineration plants, secure enough area for future construction of the plant within their designated waste processing complexes.

Thus, it could be evaluated that the category of the institutional aspect is relatively satisfied.

4) Governance Capability

There are not so much obvious contradictions between the current waste management plans of central and local administrations, and it is expected to become a more unified relationship in consistent with the policy of the national strategy, through the development of national and local waste management plans. Reflecting the attitude of decision makers who are enthusiastic to improve the waste management system, the administrative staff concerned have high morality in proceeding their works in cooperation with external resources such as communal or private institutes. Green tariff is not applied for electric power generated by waste incineration plant at this moment under the current regulations, but the possibility of recognition as a renewable energy is also under discussions among concerned stakeholders.

Thus, it could be evaluated that the category of the governance capability is relatively satisfied, although it is observed that the mayor at each target city has a different attitude to the introduction of waste incineration facility.

5) Financial Aspect

Although the regulating system to revise the waste removal tariff existed, utility charges as a whole have remained at a very low level for a long time. Local governments also have difficulties to secure appropriate financial resources for the initial investment to construct the waste treatment and disposal facilities. On the other hand, for example at the Energia Incineration Plant in Kyiv City, a certain portion of its operation and maintenance cost is covered by the sales revenue of heat generated from the plant to the local heat grid. As for the private sector involvement, it could be said that many of the local governments have a kind of cruel tendency to depend on the proposals of private sector easily such as PPP project without careful considerations, notwithstanding that the accumulation of experiences and know-how on PPP are not enough as well as their understanding on the business risks.

Thus, it should be evaluated that the category of the financial aspect is not relatively satisfied in total. However, with the condition that the initial investment will be covered by some external financial resources, this category could be evaluated as satisfied.

6) Technical Aspect

As for the technical aspect, social infrastructures such nuclear power plants, water and sewage treatment and distribution facilities, and combined heat and power plant (CHP) in the urban area, are widely constructed and wisely operated in Ukraine. Besides, there are irreplaceable experiences on the operation of waste incineration plants for a long time, more than 30 years. Therefore, technical skills and work attitude of operators at the Energia Incineration Plant could be said to be very professional. As for the environmental consideration, environmental monitoring of waste itself, water, air, and soil at surrounding the waste treatment and disposal facility is regularly done, including the radiation check of the waste.

Thus, it could be evaluated that the category of the technical aspect is highly satisfied.

7) Tentative Conclusion

Although it is necessary to evaluate every item in the financial aspect of the individual projects, the results of evaluation indexes are satisfactory at all three target cities.

In Kyiv City, stringency of the waste disposal site is acute and renovation works of the Energia Waste Incineration Plant are planned and being implemented. However, the deterioration of the plant is remarkable, while the construction of a new facility is an urgent task.

In Kharkiv City, serious stringency of the waste disposal site is not observed. So, it could be said that considerable effort to achieve the understanding of the stakeholders on the introduction and significance of waste-to-energy system is required.

In Dnipro City, the introduction of waste processing system in the Right Bank Waste Processing Complex is planned and being pushed forward. However, the method to process waste is not determined yet. Some efforts to achieve the understanding of stakeholders about the introduction and significance of waste-to-energy system is required.

Chapter 6 Possible Assistance and Pre-Conditions

6.1 JICA's Assistance Schemes

The Japan International Cooperation Agency (JICA) uses an array of development assistance schemes to meet the diverse needs of developing countries around the world as shown in Table 6.1. In which, technical cooperation and official development assistance (ODA) loans are most likely applicable to Ukraine because Ukraine is not a target country to provide ODA grants.

Table 6.1 JICA's Assistance Schemes

Schemes	Sub-Schemes
Technical Cooperation	- **Dispatch of Experts** - **Acceptance of Training Participants** - **Technical Cooperation Projects** - **Technical Cooperation for Development Planning**
Official Development Assistance (ODA) Loans	
Official Development Assistance (ODA) Grants	
Citizen Participation	- Volunteers - JICA Partnership Program
Public-Private Partnerships	
Emergency Disaster Relief	

Source: https://www.jica.go.jp/english/our_work/types_of_assistance/index.html (As of 31 May 2018)

6.2 Technical Cooperation

The JICA's Technical Cooperation supports human resource development, research and development, technology dissemination, and the development of institutional frameworks essential for the development of economies and societies in recipient countries by dispatching experts, accepting training participants, and/or providing equipment as shown in Table 6.2.

Table 6.2 Types of JICA's Technical Cooperation

Type of Technical Cooperation	Description
Dispatch of Experts	Japanese experts are dispatched to disseminate necessary technologies and knowledge to partner country government officials and engineers (counterparts).
Acceptance of Training Participants	JICA invites competent personnel, who have significant responsibility in social and economic development, to Japan as training participants.
Technical Cooperation Projects	Technical Cooperation projects, which optimally combine the "Dispatch of Experts," "Acceptance of Training Participants" and/or provision of equipment.
Technical Cooperation for Development Planning	Technical Cooperation for Development Planning, which supports counterparts in the partner country to formulate policies and master plans through conducting master plan studies and/or feasibility studies.

Source: https://www.jica.go.jp/english/our_work/types_of_assistance/tech/projects/index.html (As of 31 May 2018)

As for the results of this survey, the following ideas could be considered for assistance with technical cooperation schemes with conditions for implementation.

Table 6.3 Tentative Ideas for JICA's Technical Cooperation

Types of Technical Cooperation	Ideas for Assistance	Possible Target Counterpart
Dispatch of Experts	・ Assist to develop the regional solid waste management plan and its implementation as a coordinator to local government	MoRDCHCS, MoENR
Acceptance of Training Participants	・ Provide comprehensive training courses in Japan to learn the solid waste management system in Japan	All concerned ministries, oblasts, and cities

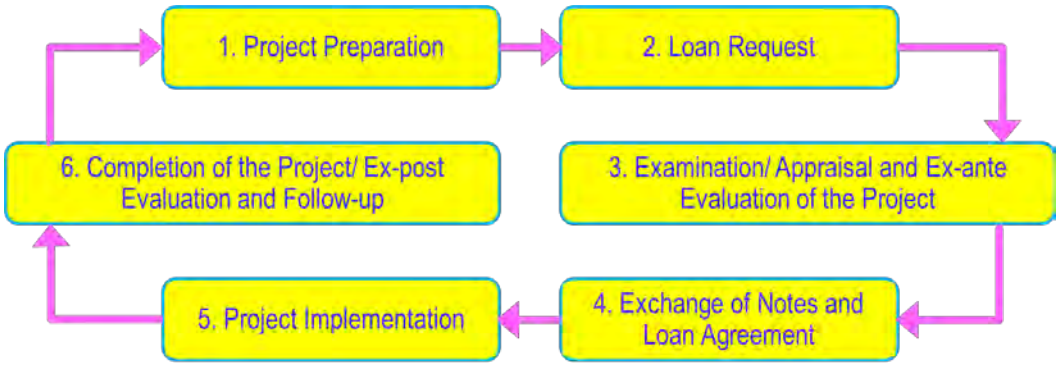
Types of Technical Cooperation	Ideas for Assistance	Possible Target Counterpart
Technical Cooperation Projects	・ Support the counterparts to develop the waste management master plan and to introduce the segregated waste collection system through the implementation of pilot project(s) with public awareness raising, and so on.	Three target cities
Technical Cooperation for Development Planning	・ Conduct the master plan study or feasibility study to support the counterparts to implement the project(s)	Three target cities

Source: JICA Survey Team

6.3 Financial Assistance

As a financial assistance, ODA loans support partner countries by providing low-interest, long-term, and concessional funds to finance their efforts for the development of economic and social infrastructure, following the "JICA Guidelines for Environmental and Social Considerations". However, it should be noted that, only in case the internal and external conditions for JICA to provide such ODA Loan Project is satisfied, development of waste treatment facilities such as the waste to energy plant will be financially supported.

ODA loans follow six steps as shown in Figure 6.1.



Source: JICA Survey Team

Figure 6.1 Project Cycle of ODA Loans

6.4 Effectiveness of Comprehensive Scenarios

After the development and approval of the National Waste Management Strategy, as previously described, a new legal framework on the waste management is now desperately restructured by the concerned central government such as the Ministry of Ecology and Natural Resources in Ukraine with the support from European donors, as well as the development of the National Waste Management Plan.

Upon such circumstances in Ukraine, it could be said that the technical and financial assistances focusing to the implementation stage of the new waste management system over the country is very crucial and effective.

The National Waste Management Strategy proposes the implementation of soft components such as the "development of municipal solid waste master plan", "pilot scale activity for segregated collection or recycling promotion", "training of municipal staffs", and "public awareness raising", in addition to the hard component which is the development of municipal waste treatment and disposal facilities. Such comprehensive approach with soft and hard components exactly match JICA's assistance policy in the field of solid waste management or so called "comprehensive assistance model".

Therefore, it will be very effective to formulate the JICA's future assistance in the comprehensive way as a holistic program.

6.5 Tentative Implementation Schedule of Possible Assistance

Table 6.4 shows a tentative implementation schedule, in short-, mid- and long term, of the measures by using JICA's assistance which is theoretically applicable to the needs identified through the survey.

Table 6.4 Tentative Implementation Schedule of Possible Assistance for Identified Needs

Identified Needs	Short-term	Mid-term	Long-term
Central Government			
1) Training for capacity development of central executing body on waste management	x	x	x
2) Support for networking among central and local administrations	x	x	
3) Support for the preparation of related technical guidelines and standards	x	x	
4) Support for monitoring and data management		x	x
Kyiv City			
1) Expansion and closure of Landfill No. 5	x	x	
2) Closure of Landfill No. 6	x	x	
3) Construction of new municipal landfill	x	x	
4) Construction of waste processing plant		x	
5) Improvement of Energia Incineration Plant (gas treatment system, power generation system)	x	x	
6) Renewal of Energia Incineration Plant			x
7) Introduction of segregated waste collection and related public awareness raising		x	x
8) Support for review and re-develop related existing scheme and plans	x		
9) Training for capacity development of local executing body on waste management	x	x	x
Kharkiv City			
1) Support for an efficient operation of the new waste sorting plant constructed by IBRD project	x	x	
2) Introduction of segregated waste collection and related public awareness raising	x	x	
3) Support for planning and implementation for 2nd phase of waste treatment complex in Dergachi			x
4) Support for waste reduction plan to be directly landfilled under the policy of national strategy			x
5) Support for review and re-develop related existing scheme and plans	x		
5) Training for capacity development of local executing body on waste management	x	x	x
Dnipro City			
1) Support for alternative facility planning by public investment instead of the public-private partnership (PPP) projects	x		
2) Support for efficient operation of the new waste sorting plant constructed by PPP project or by Eco Dnipro		x	
3) Introduction of segregated waste collection and related public awareness raising		x	
4) Support for review and re-develop the related existing scheme and plans	x		
5) Training for capacity development of local executing body on waste management	x	x	x
Short-term: Measures shall be commenced within one to two years, 2019 – 2020, with possible scheme which could be a technical cooperation. Mid-term: Measures shall be commenced within three to five years, 2021 – 2023, with possible scheme which could be a technical cooperation. Long-term: Measures shall be commenced within six to ten years, 2024 - 2028 with possible scheme which could be a ODA loan and/or technical cooperation.			

Source: JICA Survey Team

Based on the matrix shown in above Table 6.4, possible assistances to the needs can be summarized by different terms as described in Table 6.5.

Table 6.5 Summarized Possible Assistance for Identified Needs in Different Terms

Term	Possible JICA's Scheme	Tentative Assistance
Short-term 2019-2020	Technical cooperation	・ Provision of technical trainings to concerned staff of both national and local government level. ・ Support for inter-administrative networking. ・ Support for development of relevant guidelines or others. ・ Support for review and re-develop the related existing scheme and plans ・ Support for planning on urgent facility development and its operation
Mid-term 2021-2023	Technical cooperation	・ Continuous provision of technical trainings to concerned staff of both national and local government level. ・ Support for monitoring and data management. ・ Support for introduction of segregated waste collection and related public awareness raising. ・ Support for technical detail inspection for Energia Incineration Plant. ・ Support for preparatory planning on long-term facility development
Long-Term 2024-2028	ODA loan and/or Technical cooperation	・ Continuous Provision of technical trainings to concerned staff of both national and local government level. ・ Support for implementing of long-term facility development and its soft component

Source: JICA Survey Team

It should be noted that these are tentative ideas for implementation schedules with possible assistance scheme and not yet committed for implementation. Decision whether such assistances will be adopted or not is completely entrusted to the JICA HQs and other concerned organizations, only after careful examination on the applications submitted from the Ukrainian side, considering the actual circumstances for assistance such as budget and timing.

6.6 Pre-conditions for JICA's Assistance

As previously mentioned, the implementation of JICA's assistance will only be determined through a very careful examination and justification on applications submitted by Ukrainian side by considering the comprehensive scenario formulation, based on various conditions such as budget limitation, available human resources, political, and economic circumstances, in order for the assistance to be effective and sustainable once it is commenced.

On the other hand, JICA also verifies if the recipient side is well prepared to have the assistance or not, through the observations on the situations for the pre-conditions to the implementation.

The pre-conditions identified as the result of this survey are listed in Table 6.6 together with the timing to be cleared.

Table 6.6 Pre-Conditions for JICA's Assistance

Identified Needs		Short-term	Mid-term	Long-term
(1) General Pre-Conditions				
1) Legal Framework				
a)	The completion of development of related laws such as "Law on Waste" and its disclosure to the public	x		
b)	The completion of development of National Waste Management Plan and its disclosure to the public	x		
c)	The completion of establishment of the central executive body on waste management and its disclosure to the public	x		

Identified Needs		Short-term	Mid-term	Long-term
2) Stakeholder Communication				
a)	Strengthening of the cooperation among the central and local government, including the mechanism of knowledge sharing from central government to local government through regular or occasional meetings or other opportunities between the ministries and oblast, or oblast and municipalities.	x	x	
b)	Preparation of the list of private companies who deal with the waste management including recycling		x	x
c)	Preparation of the list of private companies, CBOs or NGOs who deal with the public awareness related to waste management including recycling		x	x
d)	Preparation of the list of academicians who deal with the research of waste management including recycling		x	x
e)	Continuation of cooperation and information exchange with the international organizations and private sector	x	x	x
3) Governance Sustainability				
a)	Sustainable continuation of waste management policy beyond political change	x	x	x
b)	Preparation of energy balance statement at each target city to understand local demands and supply amount of heat and electricity	x	x	
4) Financial Sustainability				
a)	Continuation of discussions and considerations on regulating the appropriate waste removal tariff	x	x	x
b)	Preparation of the financial statement of waste management such as revenue, expenditures, and their breakdown separately from the general statement, and its disclosure to the public	x	x	x
c)	Continuation of discussions for the possibility of application of green tariff for power recovered by incinerating of waste		x	
5) Public Awareness				
a)	Development and continuation of public awareness promotion for understanding the waste management implemented by the government		x	x
6) Capacity Development				
b)	Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills	x	x	x
(2) Specified Pre-conditions at Each Target City				
1) Kyiv City				
a)	Compilation of requested assistances	x		
b)	Conclusion of business scheme to handle the municipal waste after the closure of Landfill No. 5	x		
c)	Discussions and cooperation with Kyiv Oblast State Administration about the location of waste treatment and disposal facilities constructed outside of the city in the future	x	x	
d)	Technical evaluation of Energia Incineration Plant		x	
e)	Financial evaluation of Energia Incineration Plant	x	x	
2) Kharkiv City				
a)	Compilation of requested assistances	x		
b)	Preparation of operational plan of the new waste sorting plant and landfill	x		
c)	Provision of trainings to the operators of the new waste sorting plant and landfill	x	x	
d)	Monitoring the operation of the new waste sorting plant and landfill		x	x
3) Dnipro City				
a)	Conclusion of business scheme to handle municipal waste	x		
b)	Determination of introduction of PPP Project or not	x		

Identified Needs		Short-term	Mid-term	Long-term
c)	Discussions and agreement with Dnipropetrovsk Oblast State Administration about the waste allocation among Dnipro City and other municipalities in the future	x		
d)	Preparation of waste management concept for the waste generated on the left bank		x	
e)	Technical evaluation of Zhilservis or other enterprises who will be in-charge of waste collection		x	
f)	Training for capacity development of local executing body on waste management	x	x	x
Short-term: Pre-conditions shell be cleared within one to two years, 2019 – 2020. Mid-term: Pre-conditions shell be cleared within three to five years, 2021 – 2023. Long-term: Pre-conditions shell be cleared within six to ten years, 2024 - 2028.				

Source: JICA Study Team

6.7 Conclusion of Possible Assistance Scenario

Combing the possible assistance summarized in Table 6.5 and its pre-conditions described in Table 6.6, possible assistance scenario can be concluded as shown in Table 6.7.

Table 6.7 Summarized Possible Assistance and Its Pre-Conditions

Term	Possible JICA's Scheme	Tentative Assistance	Target	Pre-Conditions
Short-term 2019-2020	Technical cooperation	Provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ The completion of development of related laws such as "Law on Waste" and its disclosure to the public ✓ Strengthening of the cooperation among the central and local government, including the mechanism of knowledge sharing from central government to local government ✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills ✓ Compilation of requested assistances
		Support for inter-administrative networking.	Ministries Oblasts Cities	✓ The completion of establishment of the central executive body on waste management and its disclosure to the public
		Support for development of regional waste management plan	Ministries Oblasts Cities	✓ The completion of development of National Waste Management Plan and its disclosure to the public
		Support for review and re-develop the related existing scheme and plans	Cities	✓ Preparation of energy balance statement at each target city to understand local demands and supply amount of heat and electricity ✓ Continuation of discussions and considerations on regulating the appropriate waste removal tariff ✓ Preparation of the financial statement of waste management
		Support for planning on urgent facility development and its operation	Kyiv	✓ Conclusion of business scheme to handle the municipal waste after the closure of Landfill No. 5 ✓ Discussions and cooperation with Kyiv Oblast State Administration about the location of waste treatment and disposal facilities constructed outside of the city in the future ✓ Financial evaluation of Energia Incineration Plant

Term	Possible JICA's Scheme	Tentative Assistance	Target	Pre-Conditions
			Kharkiv	✓ Preparation of operational plan of the new waste sorting plant and landfill ✓ Provision of trainings to the operators of the new waste sorting plant and landfill
Short-term 2019-2020	Technical cooperation		Dnipro	✓ Determination of introduction of PPP Project or not ✓ Discussions and agreement with Dnipropetrovsk Oblast State Administration about the waste allocation among Dnipro City and other municipalities in the future
Mid-term 2021-2023	Technical cooperation	Continuous provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ Continuation of cooperation and information exchange with the international organizations and private sector ✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills
		Support for monitoring and data management.	Ministries Oblasts Cities	✓ Preparation of the list of academicians who deal with the research of waste management including recycling
		Support for introduction of segregated waste collection and related public awareness raising.	Ministries Oblasts Cities	✓ Preparation of the list of private companies who deal with the waste management including recycling ✓ Preparation of the list of private companies, CBOs or NGOs who deal with the public awareness related to waste management including recycling ✓ Development and continuation of public awareness promotion for understanding the waste management implemented by the government
		Support for technical detail inspection for Energia Incineration Plant.	Kyiv	✓ Continuation of discussions for the possibility of application of green tariff for power recovered by incinerating of waste
		Support for preparatory planning on long-term facility development	Kyiv	✓ Technical evaluation of Energia Incineration Plant
			Kharkiv	✓ Monitoring the operation of the new waste sorting plant and landfill
			Dnipro	✓ Preparation of waste management concept for the waste generated on the left bank ✓ Technical evaluation of Zhilservis or other enterprises who will be in-charge of waste collection
Long-Term 2024-2028	ODA loan and/or Technical cooperation	Continuous Provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills
		Support for implementing of long-term facility development and its soft component	Kyiv Kharkiv Dnipro	✓ Completion of clearing pre-conditions during the short and mid term

Source: JICA Survey Team

Chapter 7 Environmental Scoping

Although the types and capacity of solid waste management facilities are not determined in this survey, the followings in Table 7.1 are tentatively assumed as conditions for the scoping of environmental and social impacts in the implementation of project. Based on the results of scoping, the terms of reference (ToR) of environmental and social consideration survey will be determined. In case the conditions will be changed, the scoping has to be conducted again.

Table 7.1 Tentative Facility Plan as Conditions for Scoping

Items	Conditions		
	Kyiv City	**Kharkiv City**	**Dnipro City**
Sorting Plant: Considering the introduction of segregated collection, 50% of generated waste could be the capacity of the sorting plant.			
Project site (Candidate site)	Not yet determined	Within the Dergachi MSWM Complex as an additional plant to IBRD Project	Within the right bank MSWM complex
Treatment capacity	2,000 tons/day (1st phase: 1,000 tons/day, 2nd phase: 1,000 tons/day)	220 ton/day	480 ton/day
Incineration Plant: Considering the introduction of segregated collection and waste reduction before incinerating, 25% to 50% of generated waste could be the capacity of the waste-to-energy plant.			
Project site (Candidate site)	Within the premises of Energia Incineration Plant	Not considered at this moment due to implementation of IBRD Project	Within the right bank MSWM complex
Treatment capacity	2,000 tons/day (1st phase: 1,000 tons/day, 2nd phase: 1,000 tons/day)	-	480 tons/day
Final Disposal Site: Considering the intensive waste reduction to be directly landfilled, 50% of generated waste could be the daily volume of waste accepted at the landfill. Necessary capacity and area of landfill are calculated with the assumption of 20 years operation, 20 m height, 30% of cover soil use, and 70% of land use efficiency.			
Project site (Candidate site)	Not yet determined	Within the Dergachi MSWM Complex	Within the right bank MSWM complex
Treatment capacity	2,000 tons/day	550 tons/day	480 tons/day
Site area	136 ha	17 ha	33 ha

Source: JICA Survey Team

According to the above design capacities, environmental impact assessment (EIA) for all the proposed facilities have to be conducted as their daily capacities are over 100 tons per day, which is the criteria for implementation of EIA in Ukraine.

The results of scoping are shown in Table 7.2, Table 7.3, and Table 7.4.

Environmental and social impacts were evaluated using the following criteria:

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. A further examination is needed to clarify the impact.

D : No impact is expected.

Items evaluated as C have to be clarified in the F/S stage. Regarding items evaluated as A- and B-, mitigation measures and monitoring programs for the items have to be considered.

Table 7.2 Result of Scoping: Cases of Construction of Sorting Plants in Kyiv and Dnipro Cities

Category	Item		Evaluation		Reasons for Evaluation
			Before/ During Construction	After Start of Operation	
Pollution control	1	Air	B-	B-	**During Construction:** Emission gases by heavy machinery operated in-site and trucks to access to the site will affect the air temporarily. **After start of Operation:** Emission gases from trucks transporting waste and treatment residues to/from the site will affect the air.
	2	Water	B-	B-	**During Construction:** Wastewater from construction work and workers' lodging house will affect the surface water temporarily. **After Start of Operation:** Wastewater from the disposal site will affect surface water and groundwater.
	3	Waste	B-	B-	**During Construction:** Construction waste such as soil and wood will be generated. **After Start of Operation:** Waste including hazardous substances will be taken care of.
	4	Soil	B-	B-	**During Construction:** Oils from heavy machinery may pollute the soil. **After Start of Operation:** Wastewater from the plant may pollute the soil.
	5	Noise/ Vibration	B-	B-	**During Construction:** Noise and vibration generated by heavy machinery operated in-site and trucks to access to the site will affect the surrounding area temporarily. **After Start of Operation:** Noise and vibration generated by the plant, heavy machinery operated in-site and trucks transporting waste and treatment residues to/from the site will affect the surrounding area.
	6	Odor	D	B-	**During Construction:** Odor materials will not be used and generated. **After Start of Operation:** Odor coming from treated waste may affect people living and working in the surrounding area.
Natural environ-ment	7	Protective zone	C/D	C/D	Kyiv City: The project may affect national nature reserves or protective zone depending on the location of the project site (C) Dnipro City: There are neither national nature reserves nor protective zone near the sites. (D)
	8	Ecosystem	C/B-	C/B-	Kyiv City: The project may affect natural vegetation near the site and it may be removed by the project depending on the location of the project site. (C) Dnipro City: Some natural vegetation will be removed by the project (B-)
	9	Land use after closure of facility	D	B-	When land will be used for another purpose after closure of the plant, remaining hazardous substances may affect human health

Category	Item		Evaluation		Reasons for Evaluation
			Before/ During Construction	After Start of Operation	
Social environ-ment	10	Resettle-ment	C/D	C/D	**Before Construction:** Kyiv City: Resettlement may be necessary depending on the location. (C) Dnipro City: Resettlement will not be required as there are no people living at the site. (D)
	11	Livelihood	D	B+	**After Start of Operation:** The project can provide a job to some waste pickers who earn livelihood by collecting and selling recyclables kept at the landfill sites.
	12	Cultural assets	C/D	C/D	Kyiv City: The project may affect cultural assets depending on the location. (C) Dnipro City: There is no cultural asset near the sites. (D)
	13	Landscape	D	D	**After Start of Operation:** It will not affect the landscape as the plant is not big. (D)
	14	Minority/ indigenous people	C/D	C/D	Kyiv City: The project may affect the minority and indigenous people depending on the location. (C) Dnipro City: There are no minority and indigenous people near the site. (D)
	15	Work environ-ment	B-	B-	**During Construction:** Work environment of labors will be taken care of. **After start of Operation:** Work environment of operators will be taken care of.
	16	Land acquisi-tion	C/D	C/D	Kyiv City: Land acquisition will be necessary as location of project site has not been determined yet. (C) Dnipro City: Land acquisition is not necessary as lands are ready for the project. (D)
Legend:	A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is unknown. A further examination is needed to clarify the impact. D: No impact is expected.				

Source: JICA Survey Team

Table 7.3 Result of Scoping: Cases of Construction of Incineration Plants in Kyiv and Dnipro Cities

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	After Start of Operation	
Pollution control	1	Air	B-	B+/B-	**During Construction:** Emission gases by heavy machinery operated in-site and trucks to access to the site will affect the air temporarily. **After Start of Operation:** Emission gases from the plant, heavy machinery operated in-site and trucks transporting waste and ash to/from the site will affect the air.
	2	Water	B-	B-	**During Construction:** Wastewater from construction work and workers' lodging house will affect the surface water temporarily. **After Start of Operation:** Wastewater from the plant will affect surface water and groundwater.

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	After Start of Operation	
	3	Waste	B-	B-	**During Construction:** Construction waste such as soil and wood will be generated. **After Start of Operation:** Incineration ash will be generated.
	4	Soil	B-	B-	**During Construction:** Oils from heavy machinery may pollute the soil. **After Start of Operation:** Incineration ash and wastewater may pollute the soil.
	5	Noise/ Vibration	B-	B-	**During Construction:** Noise and vibration generated by heavy machinery operated in-site and trucks to access to the site will affect the surrounding area temporarily. **After Start of Operation:** Noise and vibration generated by the plant, heavy machinery operated in-site and trucks transporting waste and ash to/from the site will affect the surrounding area.
	6	Odor	D	C	**During Construction:** Odor materials will not be used and generated. **After Start of Operation:** Odor of waste treated and emission gas from the plant will affect people living and working in the surrounding area.
Natural environment	7	Protective zone	D	D	There are no national nature reserve and protective zones near the site.
	8	Ecosystem	D/C-	D/C-	Kyiv City: There are no natural vegetation near the site. (D) Dnipro City: There may be natural vegetation near the site and it will be removed by the project. (C)
	9	Land use after closure of facility	D	B-	When land will be used for another purpose after closure of the plant, remaining hazardous substances will affect human health.
Social environment	10	Resettlement	D	D	**Before Construction:** Resettlement will not be required as there is no people living at the site.
	11	Livelihood	D	C	**After Start of Operation:** Waste pickers who earn livelihood by collecting and selling recyclables to keep at the landfill site will lose the livelihood method as all or a part of waste will be treated at the plant and thus, will not come to the landfill site any more.
	12	Cultural assets	D	D	There are not cultural assets near the site.
	13	Landscape	D	B-	**After Start of Operation:** The plant especially its stack will affect the landscape.
	14	Minority/ indigenous people	D	D	There are no minority and indigenous people near the site.

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	After Start of Operation	
	15	Work environment	B-	B-	**During Construction:** Work environment of labors will be taken care of. **After Start of Operation:** Work environment of operators will be taken care of.
	16	Land acquisition	D	D	Land acquisition is not necessary as lands are ready for the project.
Legend:	A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is unknown. A further examination is needed to clarify the impact. D: No impact is expected.				

Source: JICA Study Team

Table 7.4 Result of Scoping: Cases of Construction of Final Disposal Sites in Kyiv, Kharkiv and Dnipro Cities

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	After Start of Operation	
Pollution control	1	Air	B-	B-	**During Construction:** Emission gases by heavy machinery operated in-site and trucks to access to the site will affect the air temporarily. **After Start of Operation:** Methane gas from the disposal site and emission gases from heavy machinery operated in-site and trucks transporting waste and ash to/from the site will affect the air.
	2	Water	B-	B-	**During Construction:** Wastewater from construction work and workers' lodging house will affect the surface water temporary. **After Start of Operation:** Wastewater from the disposal site will affect surface water and groundwater.
	3	Waste	B-	B-	**During Construction:** Construction waste such as soil and wood will be generated. **After Start of Operation:** Waste including hazardous substances will be taken care of.
	4	Soil	B-	B-	**During Construction:** Oils from heavy machinery may pollute the soil. **After Start of Operation:** Leachate may pollute the soil.
	5	Noise/ Vibration	B-	B-	**During Construction:** Noise and vibration generated by heavy machinery operated in-site and trucks to access to the site will affect the surrounding area temporary. **After Start of Operation:** Noise and vibration generated by the plant, heavy machinery operated in-site and trucks transporting waste and ash to the site will affect the surrounding area.

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	After Start of Operation	
	6	Odor	D	B-	**During Construction:** Odor materials will not be used and generated. **After Start of Operation:** Odor coming from disposed waste and the leachate treatment plant may affect people living and working in the surrounding area.
Natural environment	7	Protective zone	C/D	C/D	Kyiv City: The project may affect national nature reserves and protective zone depending on location of the project site. (C) Kharkiv City/Dnipro City: There are no national nature reserves and protective zones near the sites. (D)
	8	Ecosystem	C/D/B-	C/D/B-	Kyiv City: Natural vegetation may be removed by the project depending on the location of the project site. (C) Kharkiv City: Ecosystem will not be affected as there is no natural vegetation near the sites. (D) Dnipro City: Some natural vegetation will be removed by the project (B-)
	9	Land use after closure of facility	D	B-	When land will be used for another purpose after closure of the disposal site, impact of remaining hazardous substances to human health, fire due to generated methane gas and ground subsidence may occur.
Social environment	10	Resettlement	C/D	D	**Before Construction:** Kyiv City: Resettlement may be necessary depending on the location. (C) Kharkiv City/Dnipro City: Resettlement will not be required as there are no people living at the site. (D)
	11	Livelihood	D	C	**After Start of Operation:** Waste pickers who earn their livelihood by collecting and selling recyclables to keep at the landfill site may lose the livelihood as depending on the rule of operation of the landfill sites.
	12	Cultural assets	C/D	C/D	Kyiv City: The project may affect cultural assets depending on the location of project site. (C) Kharkiv City/Dnipro City: There is no cultural asset near the sites. (D)
	13	Landscape	D	C/D	**After Start of Operation:** The landfill site where waste is accumulated as a small hill will affect the landscape. (C) Kharkiv City/Dnipro City: the new landfill site will not affect the landscape as the existing landfill site is already located within the MSWM complexes. (D)
	14	Minority/ indigenous people	C/D	C/D	Kyiv City: the project may affect the minority and indigenous people depending on the location of the project site. (C) Kharkiv City/Dnipro City: There are no minority and indigenous people near the site. (D)

Category	Item		Evaluation		Reasons for Evaluation
			Before/During Construction	**After Start of Operation**	
	15	Work environment	B-	B-	**During Construction:** Work environment of labors will be taken care of. **After Start of Operation:** Work environment of operators will be taken care of.
	16	Land acquisition	C/D	C/D	Kyiv City: Land acquisition will be necessary as the location of the project site has not been determined yet. (C) Kharkiv City/Dnipro City: Land acquisition is not necessary as lands are ready for the project.
Legend:	A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is unknown. A further examination is needed to clarify the impact. D: No impact is expected.				

Source: JICA Study Team

List of Appendices

Appendix 1

Calendar of Field Survey

Appendix 1. Calendar of Field Survey

First Field Survey Schedule (22 February - 15 April)

Date		First Field Survey Schedule	Place of Stay
22-Feb	Thu	12:00 - 13:00 Meeting with JICA Ukraine office 14:00 - 15:30 Meeting with Ministry of Ecology and Natural Resources (MENR) 16:10 - 17:00 Meeting with Ministry of Regional Development, Construction, Housing, and Communal Services (MRDCHCS) (with Deputy Minister)	Kyiv
23-Feb	Fri	9:40 - 11:00 Meeting with GIZ 12:00 - 13:10 Meeting with Kyiv Oblast State Administration 14:30 - 15:30 Meeting with Kyiv City State Administration (with Deputy Mayor) 16:30 - 17:30 Courtesy Call to Embassy of Japan	Kyiv
24-Feb	Sat		Kyiv
25-Feb	Sun		Kyiv
26-Feb	Mon	9:40 - 11:30 Meeting with EBRD 12:00 - 13:30 Meeting with Ministry of Economic Development and Trades (MEDT)	Kyiv
27-Feb	Tue	10:00 - 11:30 Meeting with Dnipropetrovsk Oblast State Administration 14:00 - 15:30 Meeting with Dnipro City Council 16:00 - 16:30 Field-visit (Pravoberezhny)	Dnipro
28-Feb	Wed	10:00 - 11:30 Field-visit (Zhovti Vody City)	Dnipro
1-Mar	Thu	11:15 - 12:00 Meeting with Kharkiv City Council	Kharkiv
2-Mar	Fri	10:30 - 12:00 Meeting with Kharkiv Oblast State Administration 13:00 - 17:00 Field-visit (Bohodukhiv City)	Kharkiv
3-Mar	Sat	9:40 - 10:30 Field-visit (Dergachi)	Kharkiv
4-Mar	Sun		Kyiv
5-Mar	Mon	Working at Hotel	Kyiv
6-Mar	Tue	Working at Hotel	Kyiv
7-Mar	Wed	Working at Hotel	Kyiv
8-Mar	Thu	10:00 - 13:00 Field-visit (Landfill No.5+6)	Kyiv
9-Mar	Fri		Kyiv
10-Mar	Sat		Kyiv
11-Mar	Sun		Kyiv
12-Mar	Mon	11:45 - 13:00 Meeting with Kyivspetstrans 15:00 - 16:00 Meeting with Otava	Kyiv
13-Mar	Tue	10:00 - 13:00 Field-visit (Energia Plant) 14:00 - 16:00 Meeting with Energia Plant director	Kyiv
14-Mar	Wed	9:00 - 10:00 Meeting with Kyivkomunservis	Kyiv
15-Mar	Thu	Working at Hotel	Kyiv
16-Mar	Fri	Working at Hotel	Kyiv
17-Mar	Sat		Kyiv
18-Mar	Sun		Kyiv
19-Mar	Mon	14:00 - 18:00 Meeting with Dnipro City Council (Questionnaire confirmation)	Dnipro
20-Mar	Tue	8:20 - 11:00 Field Visit (Pravoberezhny landfill) 11:00 - 18:00 Meeting with Eco Dnipro (Landfill engineering and others)	Dnipro

Appendix 1

Date		First Field Survey Schedule	Place of Stay
21-Mar	Wed	AM: Working at Hotel 15:00 - 18:30 Meeting with Eco Dnipro (Landfill engineering and others)	Dnipro
22-Mar	Thu	9:00 - 12:30 Meeting with Dnipro City Council (PPP, Financial matters and future development) 14:00 - 17:00 Meeting with Dnipropetrovsk Oblast State Administration (Confirmation of Questionnaire)	Dnipro
23-Mar	Fri	9:00 - 15:00 Waste Composition Survey at Pravoberezhny landfill 15:00 - 18:30 Meeting with Dnipro City (Deputy Mayor, Wrap-up)	Dnipro
24-Mar	Sat		Dnipro
25-Mar	Sun		Kharkiv
26-Mar	Mon	14:00 - 17:00 Meeting with Kharkiv City Council (Questionnaire confirmation)	Kharkiv
27-Mar	Tue	9:30 - 11:00 Field Visit (Munichipal waste removal complex) 11:00 - 12:00 Field Visit (Waste collection) 13:30 - 15:30 Field Visit (Dergachi landfill)	Kharkiv
28-Mar	Wed	9:00 - 11:00 Meeting with Kharkiv City Council (Municipal Waste Disposal Complex) 14:00 - 16:30 Meeting with Kharkiv Oblast State Administration (Questionnaire confirmation)	Kharkiv
29-Mar	Thu	9:00 - 15:00 Waste Composition Survey at Dergachi landfill	Kharkiv
30-Mar	Fri	9:00 - 12:00 Meeting with Kharkiv City Council (Wrap-up, requesting) 14:00 - 16:30 Meeting with Kharkiv Oblast State Administration (Wrap-up: requesting)	Kharkiv
31-Mar	Sat		Kharkiv
1-Apr	Sun		Kyiv
2-Apr	Mon	10:00 - 11:00 Meeting with Kyiv City State Administration (Questionnaire confirmation) 12:00 - 13:00 Meeting with State Agency for energy efficiency and saving (SAEE)	Kyiv
3-Apr	Tue	Working at Hotel	Kyiv
4-Apr	Wed	10:00 - 11:00 Meeting with Kyiv Oblast State Administration (Questionnaire confirmation) 12:00 - 14:00 Meeting with JICA Ukraine office	Kyiv
5-Apr	Thu	Working at Hotel	Kyiv
6-Apr	Fri	Working at Hotel	Kyiv
7-Apr	Sat		Kyiv
8-Apr	Sun		Kyiv
9-Apr	Mon		Kyiv
10-Apr	Tue	13:00 - 14:00 Meeting with Eurofins (Contract) 16:00 - 17:00 Meeting with Bilfinger	Kyiv
11-Apr	Wed	14:00 - 16:00 Meeting with Kyivspetstrans (Waste Composition Survey)	Kyiv
12-Apr	Thu	10:00 - 11:00 Field-Visit (Kompania Eko Stok)	Kyiv
13-Apr	Fri	Working at Hotel	Kyiv
14-Apr	Sat		Kyiv
15-Apr	Sun		Kyiv

Second Field Survey Schedule (9 May – 6 June)

Date		Second Field Survey Schedule	Place of Stay
9-May	Wed		Kyiv
10-May	Thu	15:00 - 16:00 Meeting with Kyiv City State Administration 17:30 - 20:00 Meeting with JICA Ukraine office	Kyiv
11-May	Fri	11:00 - 13:00 Meeting with MRDCHCS	Kyiv
12-May	Sat		Kyiv
13-May	Sun		Kyiv
14-May	Mon	Working at Hotel	Kyiv
15-May	Tue	11:00 - 12:30 Meeting with Kyiv Oblast State Administration 8:00 - 15:00 Waste Composition Survey at Landfill No.5	Kyiv
16-May	Wed	9:30 - 11:00 Meeting with MENR	Kyiv
17-May	Thu	Working at Hotel	Kyiv
18-May	Fri	15:00 - 16:15 Meeting with SAEE	Kyiv
19-May	Sat		Kyiv
20-May	Sun		Kharkiv
21-May	Mon	10:30 - 12:00 Meeting with Kharkiv City Council	Kharkiv
22-May	Tue	10:00 - 11:30 Field-visit (Dergachi landfill)	Dnipro
23-May	Wed	15:00 - 17:00 Meeting with Dnipro City Council	Dnipro
24-May	Thu	10:00 - 14:00 Meeting with Eco Dnipro	Dnipro
25-May	Fri	12:00 - 13:15 Meeting with Dnipro City Council (with Mayor)	Kyiv
26-May	Sat		Kyiv
27-May	Sun		Kyiv
28-May	Mon		Kyiv
29-May	Tue	11:00 - 12:15 Meeting with MEDT	Kyiv
30-May	Wed	11:00 - 12:00 Meeting with MRDCHCS	Kyiv
31-May	Thu	9:00 - 14:00 Field-visit (Energia Plant)	Kyiv
1-Jun	Fri	10:00 - 13:40 MSWM Seminar	Kyiv
2-Jun	Sat		Kyiv
3-Jun	Sun		Kyiv
4-Jun	Mon	Working at Hotel	Kyiv
5-Jun	Tue	10:00 - 18:20 Conference hosted by MENR 15:00 - 16:00 Report to Ambassador 17:00 - 17:30 Meeting with Kyiv City State Administration	Kyiv
6-Jun	Wed	10:00 - 13:30 Conference hosted by MENR	

Third Field Survey Schedule (15 July – 1 August)

Date		Third Field Survey Schedule	Place of Stay
15-Jul	Sun		Kyiv
16-Jul	Mon	10:30 - 14:00 Field-visit (Energia Plant) 15:00 - 16:00 Meeting with Kyiv City State Administration (Application Form)	Kyiv
17-Jul	Tue	11:00 - 12:30 Meeting with MRDCHCS 14:00 - 15:00 Meeting with MENR	Kyiv
18-Jul	Wed	11:00 - 12:20 Meeting with Kyiv Oblast State Administration 15:00 - 16:30 Meeting with MEDT	Dnipro
19-Jul	Thu	10:00 - 12:10 Meeting with Dnipro City Council 14:00 - 15:30 Meeting with Dnipropetrovsk Oblast State Administration	Dnipro
20-Jul	Fri	9:00 - 10:00 Field-visit (Right Bank Waste Treatment Complex) 11:00 - 12:00 Meeting with Dnipro Mayor 14:00 - 15:00 Field-visit (Damping site)	Dnipro
21-Jul			Kharkiv
22-Jul			Kharkiv
23-Jul	Mon	17:00 - 18:00 Meeting with Kharkiv City Council 13:00 - 14:00 Field-visit (Dergachi Landfill)	Kharkiv
24-Jul	Tue	9:00 - 10:00 Meeting with Kharkiv Oblast State Administration	Kyiv
25-Jul	Wed	11:00 - 12:00 Meeting with World Bank (WB) 15:30 - 18:00 Field-visit (Obukhivmiskvtorresursy)	Kyiv
26-Jul	Thu	9:00 - 10:00 Meeting with MRDCHCS 15:00 - 16:00 Meeting with Swiss-Ukrainian Decentralization Support Project (DESPRO) 17:30 - 18:30 Meeting with Kyiv City State Administration	Kyiv
27-Jul	Fri	11:00 - 12:00 Meeting with GIZ 15:00 - 16:00 Report to Ambassador	Kyiv
28-Jul	Sat		Kyiv
29-Jul	Sun		Kyiv
30-Jul	Mon	Working at Hotel	Kyiv

Appendix 2

List of Participants

Appendix 2. List of Participants

Name	Position
Ministry	
Ministry of Ecology and Natural Resources (MENR)	
Mr. Anatolii Kutsevol	Director-Reform Support Team
Mr. Oleksandr Semenets	Deputy Head of Environmental Safety & licensing Activity Department/ Head of Waste Management & Environmental Safety Division
Ms. Natafia Shorobura	Division Head/Deputy Head of Waste Management Unit
Ms. Natalia Korzhunova	Project manager, waste management reform
Ministry of Regional Development, Construction, Housing and Communal Services (MRDCHC)	
Mr. Eduard Kruglyak	Deputy Minister of MRDCHCS
Ms. Poltorachenko Liudmyla	Deputy Director of Department/ Head of handling household waste Division
Ms. Diane Lovikova	Expert
Ministry of Economic Development and Trade (MEDT)	
Mr. Cherny Oleksandr	Director of department of Industrial Policy
Ms. Korznenko Irina	Department of governmental investment project and development support
Ms. Zobova Lilia	
Ms. Minitska Olena	
State Agency on Energy Efficiency and Energy Saving (SAEE)	
Mr. Eugene Magliovanniy	Director of Technical Regulation Department in Energy Efficiency
Mr. Victor Bilko	Deputy Head of Technical Regulation Department in Energy Efficiency
Kyiv	
Kyiv Oblast State Administration	
Ms. Viktoriya Kireeva	Director of Department
Ms. Anna Tkalieh	Department of ecology and natural resources of Kyiv Oblast state administration. Deputy Director of the Department. Head of (Managing) Office for waste management.
Mr. Sergei Movchou	Head of division for waste management
Ms. Galina Kogob	
Kyiv City State Administration	
Mr. Petro Panteleyev	Deputy Head of Kyiv City State Administration
Mr. Olekgandr Malykhin	Deputy Head of Department of Municipal Infrastructure
Ms. Zhylka Marina	Head of Division for Sanitary Cleaning and Engineering Protection of the Territory
Mr. Dmytro Naumenko	Director of Department of Housing and Communal Infrastructure
Mr. Mryga Serug	Deputy director of Housing and Communal Infrastructure

Name	Position
Ms. Liudmyla Viktorivma Kyrii	Chief Specialist
Ms. Vira Radchenko	Housing and Communal Infrastructure
Kyivspetstrans	
Mr. Andrii Grushchynskyi	Deputation
Kyivenergo	
Mr. Sergey Stepanovich Krikun	Branch Director
Mr. Alexander Vladimirovich Galchenko	Chief Engineer
Kyivkomunservis (KKS)	
Mr. Maksym Volodymyrovych	Director
Mr. Viacheslav Veadyslavovych	Deputy Director
Mr. Koval Sergei Vasyljovych	Head of Department of Solid Waste Management
Ms. Victoria	Head of Department of Public Relations
Obukhivmiskvtorresursy (OMBP)	
Mr. Polatyan Armen Olegovich	General Director

Kharkiv

Kharkiv Oblast State Administration	
Ms. Nadiia Kryvytska	First Deputy Head of Improvement of Reginal Competitiveness Department/ Head of Design Analytical Division
Mr. Andrii Kolos	Head of Economics and International Relations Department
Mr. Sergii Magdysiuk	Head of housing and communal services Department
Mr. Andrii Tymchuk	Head of Economics and International Relations Department
Mr. Andrii Paramonov	Head of fuel and energy complex Division
Ms. Tetiana PASHKOVA	Deputy of Economical & International Cooperation
Mr. Allex	Head of SWM, Dept. of Ecology
Mr. Oleksandr	Head of Dept. of Fuel Energy Complex and Power Recovery
Mr. Eduard YAROVI	Deputy Director of the Department of Housing and Infrastructure
Mr. Leonid ANANCO	Deputy head of construction, road sector and improvement in the housing sector - Department of Housing and Infrastructure
Mr. Roman LAURO	Department of Housing and Infrastructure
Ms. Hanna Bykova	
Kharkiv City Council	
Mr. Ihor Terekhov	First deputy mayor

Name	Position
Mr. Fedir Luchenko	Mayor's Councilor
Mr. Aleksei BOGACH	Director Department for municipal services
Ms. Olga Demianenko	Head of International Project Support Development
Mr. Victor Rud	Director of International Cooperation Development
Municipal enterprise of complex on municipal waste removal (KVBO）	
Mr. Abbasov Fazil Sevindikovich	Director
Municipal Company for Solid Waste Management (MKPV)	
Mr. Skljarov Nikolai Mikhailovich	Director
Mr. Suyarko Jurii Mykhailovych	Chief Engineer
Mr. Kozar Yuriy Volodymyrovych	Financial Expert

Dnipro

Dnipropetrovsk Oblast State Administration	
Mr. Strilets Ruslan	Director of the Department of Ecology and Natural Resources
Ms. Skyba Dania	Deputy Head of Department
Mr. Oleksii Psarov	Deputy Director of Economic Department
Mr. Plieshakov Andrey	Deputy Director of the Department of Ecology and Natural Resources
Mr. Nagniy Alexander	Senior Specialist
Mr. Vitaliy Lytvyn	Advisor to the Head of Administration
Mr. Auma Dima Hanis Chiste Misto	CLEAN CITY
Dnipro City Council	
Mr. Borys Filatov	Mayer
Mr. Mykhailo Lysenko	Deputy Mayor for Housing and Utility Issues/ Director of the Dept. of Municipal Improvement and Infrastructure
Ms. Chernyshova.N	Head of Department
Mr. Molovakha Pavlo	Director
Ms. Kozlova Irene	Deputy Director of Economic Department (to be a Director from 1 June)
Ms. Fomenko Helen	Adviser
Ms. Viktoria Pashchenko	Head of SWM Division
Ms. Levachova Tetjana	Head of Ecology Control Division
Mr. Plieshakov Andrey	
Eco Dnipro	
Mr. Edward Myeshkovskyy	Director

Name	Position
Institute Dneprokomunproekt	
Mr. Zhelezko Ihor Platonovych	Director
Mr. Madjak Oleksandr Petrovych	Chief engineer

Donor

European Bank for Reconstruction and Development (EBRD)	
Ms. Olena Borysova	Principal, Policy and Climate Finance Energy Efficiency and Climate Change
German Society for International Cooperation (GIZ)	
Mr. Benjamin Klinger	Program Director, Promotion of Supportive Framework for Trade in Ukraine
Ms. Tatjana Anischuk	Deputy Project Director
World Bank (WB)	
Ms. Ludmilla Butenko	Program leader for infrastructure and sustainable development in Ukraine, Belarus and Moldova
Ms. Klavdiya Maksymenko	Senior country officer for Ukraine
Swiss-Ukrainian Decentralization Support Project (DESPRO)	
Mr.Viacheslav Sorokovskyi	Public Services and Monitoring Expert
Ms. Oksana Garnets	Senior Project Coordinator

Appendix 3

Presentation Materials

- ☐ ***Introduction of Survey Outline***
- ☐ ***Tentative Result of First Field Survey***
- ☐ ***Summary of Draft Final Report***

Introduction of Survey Outline

Information Collection and Verification
Survey for
Municipal Solid Waste Management
in
Ukraine

Introduction of Survey Outline

Japan International Cooperation Agency

NIPPON KOEI

Contents

Background

1. In Ukraine, volumes of Municipal Solid Waste (MSW) generation is estimated to be 49 million cubic meters, or approximately 11 million tons, in 2016. Approximately 94% of these are directly disposed of at the landfills or open dumps which are not always authorized.
2. National Waste Management Strategy was developed and approved in November 2017, which aims to establish an integrated waste management system in the nation.
3. Based on this strategy, plans necessary to reduce the amount of MSW to be landfilled, by recovering recyclable materials and energy will be developed and implemented.
4. It is expected that Japan's various long-years experiences in this field may also contribute to the improvement of MSW management in Ukraine.

Outline of survey

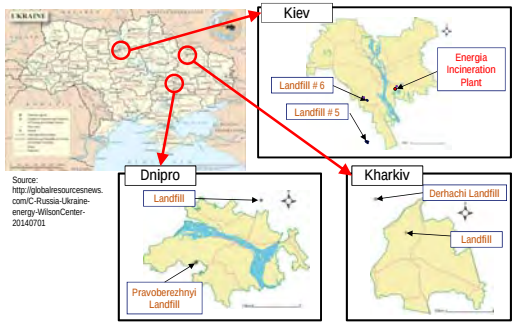
Stage of this Survey

- This "Information Collection and Verification Survey" is the most preliminary survey for finding the needs for JICA's assistance in future, and preconditions for its implementation.

Objectives

1. To collect basic information about current solid waste management (SWM) systems, focusing MSW for its generation, collection, transportation, intermediate treatment/recycling, final disposal as well as financial systems for SWM, general situation in Ukraine and specific situation at three target cities; and
2. Based on the results above, 1) to analyze current plans of the national, state and municipal government; 2) to identify specific needs; 3) to study necessity and validity of introduction of waste treatment facility such as waste to energy plant; 4) to select priority project(s); and 5) to clarify the preconditions to be satisfied to proceed to conduct the further studies of selected priority project(s).

Target Areas of the Survey



Source: http://globalresourcesnews.com/C-Russia-Ukraine-energy-WilsonCenter-20140701

Concerned Organizations

National government:

- Ministry of Regional Development, Construction, Housing and Communal Services;
- Ministry of Ecology and Natural Resources;
- Ministry of Economic Development and Trade.

Local government :

- State of Kiev, City of Kiev
- State of Kharkiv, City of Kharkiv
- State of Dnipropetrovsk, City of Dnipro

Foreign Donors :

- European Bank for Reconstruction and Development (EBRD)
- German International Cooperation Agency (GIZ)

Survey Schedule

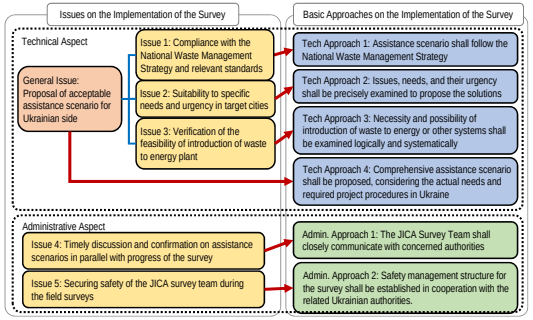
	2018							
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Preparation of study								
1st field survey (data collection)								
Domestic work in Japan (interim reporting)								
2nd field survey (scenario studies)								
Domestic work in Japan (draft reporting)								
3rd field survey (output explanation)								
Domestic work in Japan (final reporting)								

Member of JICA survey team

Name	Responsibility
Shungo SOEDA	Team Leader / Waste Management Plan (1)
Tomoyuki HOSONO	Deputy Team Leader/ Waste Management Plan (2) / Waste Collection and Transportation System Analysis / Waste Characteristics Analysis (1)
Shoichi HAYAMI	Waste Incineration with Energy Recovery
Makoto KOSAKA	Financial and Economic Analysis
Keita SAITO	Legal System and Organizational Structure Analysis / Environmental and Social Consideration Survey
Kyoko KIMURA	Waste Characteristics Analysis (2) / Administrative Coordinator

Approaches for the Survey

Approaches corresponded to MSW issues



Background of Technical Approach 1

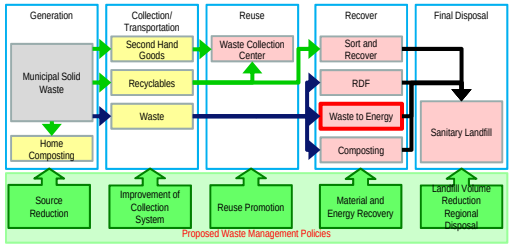
- Ukraine approved “National Waste Management Strategy” on November 2017 with the support of EU (EBRD and GIZ), which aims to establish a circular economy in Ukraine.
- Target indicators of implementation of the strategy are set for the short- (2017-2018), medium- (2019-2023), and long-term (2024-

Source: http://eco.ck.ua/docs/Prezentazja_Strategia.pdf

- Any future development plan related MSWM should be comply with the fundamental policy of this strategy

Technical Approach 1

- JICA survey team will deeply understand the contents of the national waste management strategy for proposing assistance scenario which will follow the strategy.



Background of Technical Approach 2

- Some of MSWM Situations in target three cities are similar, but some are different.
- All cities are making their efforts to improve the MSWM system, but also facing technical, financial and social difficulties to do so.

Data Items	Kiev	Kharkiv	Dnipro
Annual Generation Quantity	1,089,000 tons	443,000 tons	307,000 tons
Daily Generation Quantity	2,984 tons	1,214 tons	841 tons
Population	2,893,822	1,430,885	999,250
Unit Generation Rate per Capita	1.03 kg /day-capita	0.85 kg /day-capita	0.84 kg /day-capita

Source: Information collection and verification Survey for Ukraine energy sector (JICA, May 2018)

- Any future development plan related MSWM should contribute to improve the situations effectively and efficiently.

Technical Approach 2

- JICA survey team will firmly grasp the current MSWM situations in target three cities by questionnaire, interview, and field visit surveys, as well as reviewing the existing related documents provided.

Questionnaire survey
- General information (environment, population, economy)
- Laws, regulation and plan related to MSWM
- Implementation structures on MSWM
- Current situations of MSWM (from generation to final disposal, and financial matters)
- Waste Treatment and Energy Recovery
- Project implementation method such as PPP (public private partnership)
- Environmental and Social Consideration

Interview survey
- With concerned authorities

Field visit
- Storage, collection, transportation, recycling, incinerating, final disposal and other related fields

Background of Technical Approach 3

- National Waste Management Strategy also sets the target indicator for the introduction of thermal treatment facilities which use waste as secondary energy resources.
- Common thermal treatment technologies are waste to energy (incineration), mechanical and biological treatment (MBT), and etc.

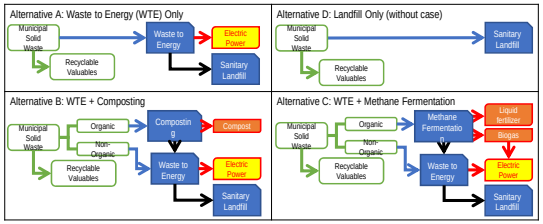
Indicator	Unit	2016	2017-18	2019-23	2024-30
Construction of facilities	Units(s)	1	3	15	20
Thermal treatment volume	Tons	1,000,000	1,500,000	2,000,000	3,000,000
Thermal treatment rate	%	2.37	5.00	5.00	10.00

Source: National Waste Management Strategy of Ukraine until 2030, November 2017

- It is necessary to understand the outline of thermal treatment technologies with their advantages and disadvantages.

Technical Approach 3

- JICA survey team will carefully examine the necessity and possibility of Introduction of waste to energy or other systems.
- For example, the following comparison will be done from the environmental, financial, and social point of view.



Technical Approach 3 (continued)

- JICA survey team will also study the project implementation schemes as shown below, comparing the important factors such as financial resource, tipping fees, power sales, or risks, together with the consideration of the implementation structures.

Schemes	Capital Expenditure	Operational Ecpenditure
Constructed and operated by public	Public investment	Relatively high due to the direct management by the public sector.
Constructed by public and operated by private (Design-Build-Operate: DBO)	Public investment	Relatively low due to the efficient cost savings by the private sector.
Constructed and operated by private (Build-Operate-Transfer: BOT), Build-Own-Operate: BOO)	Private investment	Extremely high due to the inclusion of the initial investment. There is no risk for the public sector on unexpected cost fluctuation.

Source: JICA Survey Team

Background of Technical Approach 4

- The National Waste Management Strategy also proposes the implementation of soft components such as “detail planning”, “pilot scale recycling activities”, and “public awareness raising”, in addition to the hard component which is the development of facilities.
- JICA sets “comprehensive assistance model” in the field of solid waste management which exactly match the above mentioned

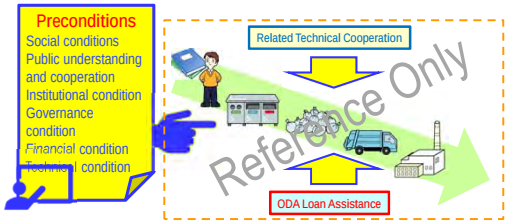
Category	Technical cooperation	Financial Assistance
Scheme	Technical cooperation projects, Technical coopetition for development planning, Training, dispatch of experts, JICA partnership programs (grassroots activities)	ODA loan

Source: JICA Strategy Paper on Solid Waste Management, 2015

- It is better to consider the appropriate comprehensive model to support the facility development in more effective ways.

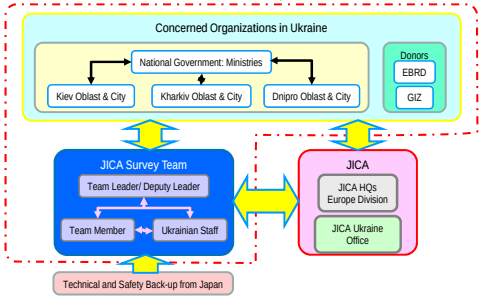
Technical Approach 4

- JICA survey team will clarify the preconditions to be satisfied for the further studies for the possible and effective combination of the assistance components, in comply with the related rules and procedures in Ukraine.



Administrative Approaches

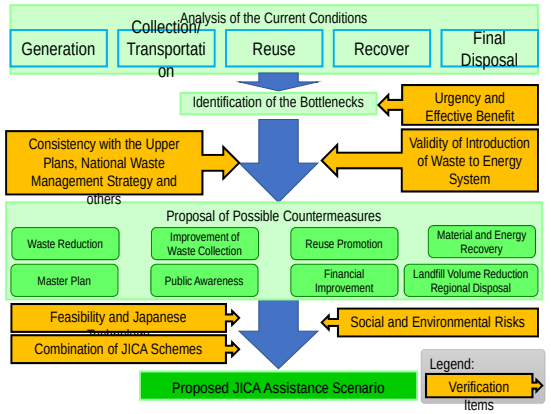
- To make mutual communication closer, under safe circumstances



Plan of Operation

Outline of each survey

	2018							
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.
Preparation of study	Analysis of the documents collected or provided, Preparation for the 1st field survey.							
1st field survey (data collection)	Kick-off meeting, information & data collection and its preliminary analysis through questionnaires,							
Domestic work in Japan (interim reporting)	Analysis of the current situations and issues of MSWM,							
2nd field survey (scenario studies)	Explanation of the contents of interim report, additional information collection surveys, exchange							
Domestic work in Japan (draft reporting)	Creation and comparison of the ideas for the future assistance scenarios, preparation of the draft final							
3rd field survey (output explanation)	Explanation of the contents of interim report. Exchange of opinions for the future assistance scenarios.							
Domestic work in Japan (final reporting)	Preparation and submission of the final report (F/R) to JICA							



Summary of 1st Field Survey

Duration: February 22 to April 15

- Kick-off meetings to explain the outline and schedule of the survey to concerned Ukrainian authorities and international donors.
- Implementation of questionnaire and interview surveys with above each authority, distributing a questionnaire sheet.

→ Please prepare the answers to the questionnaire.

- Implementation of site visits to the places and facilities related to MSWM in each target area, together with on-site interviews.

→ Please make arrangements for site visits with necessary supports.

- Supplemental waste composition survey in each target city.

→ Please cooperate to implement the survey.

Main Items to be Surveyed

1. General Information
2. Laws, Regulation and Plan related to MSWM
3. Implementation Structures on MSWM
4. Municipal Solid Waste Matters
5. Waste Treatment and Energy Recovery
6. Project implementation method
7. Environmental and Social Consideration
8. Others

1. General Information

Natural Conditions of Ukraine and each target in general

- Climate conditions such as temperature and precipitation, by annually and by monthly, High, Low, and Averaged in the past
- Brief explanation of topographical and geological characteristics.

Population of Ukraine and each target city and state

- Changes in past 10 years and projection for next 10 to 20 years, total, by gender, and by age group, if available.

Economic Situations on Ukraine and each target city and state

- GDP or regional GDP, employment No. and its ratio, average income, industrial structure, economic growth ratio, literacy ratio, etc.

Service Utility Status

- Electric power, water, and sewer (demand, supply, coverage ratio)

2. Laws, Regulation and Plan related to MSWM

- Existing laws, regulations, guidelines, standards, and other legal and technical documents related to MSWM.
- National Waste Management Strategy until 2030 approved on 8 November, 2017 (Ukrainian Original and English)
- Any other documents connected to above national strategy (either draft or approved one, related EU directives).
- National or regional development plans, in general and especially related to MSWM
- Update plan for these laws and regulations

3. Implementation Structures on MSWM

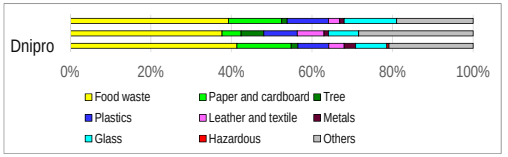
Organization chart of concerned authorities (Ministries, State government, and municipal government).

- Roles, structure, number of staffs of each department,
- For the responsible department for MSWM, amount and breakdown of annual budget, expense, income source, etc.
- Inter-ministerial or inter-provincial/ municipal cooperation to share the experiences or to support each other, if any.
- Relationships, demarcation and task allocation of national, state and municipal governments related to MSWM

4. Municipal Solid Waste Matters

1. Generation quantity and quality of Municipal Solid Waste
2. Service providers on MSWM in each city
3. Collection and transportation
4. Intermediate treatment and recycling
5. Energia Incineration facility
6. Final Disposal
7. Waste management fee
8. Social needs for improvement of the current MSWM system
9. 3R, environmental education and public awareness
10. Financial matters

Supplemental Waste Composition Survey



Source: City of Kiev, City of Kharkiv, and City of Dnipro, February 2018

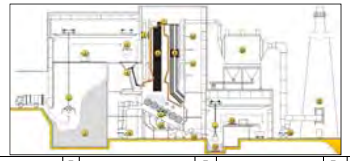
In order to understand the waste composition data provided, very simplified waste composition survey will be conducted.

- 2 samples only in each target city
- Bulk density, physical composition, three components (moisture, ash, combustible), chemical components (C, H, O, N, S, Cl), and calorific value)

5. Waste Treatment and Energy Recovery

- Any regulations, guidelines, procedures or other documents related to energy policy including the renewable energy (RE)
- Any regulations, guidelines to promote RE including "energy recovery from waste" and "biomass energy." (e.g. Feed-in Tariff for RE, purchase obligation for grid operators, incentives for RE project, etc.)
- Improvement or Development plan of MSW incinerator and other plant.
- Intentions of the decision maker for the development of waste treatment facility and energy recovery.

Energia Incineration Plant in Kiev



①	Waste feeding crane	⑥	Air supply fan	⑪	Administration area	⑯	Induced draft fan
②	Waste pit (18,000m2)	⑦	Boiler	⑫	Slope conveyer	⑰	Vent stack
③	Crane control system	⑧	Heat remove screen	⑬	Ash banker		
④	Waste hopper	⑨	Rotary grate stoker furnace	⑭	Metal recovery line		
⑤	Air supply piping	⑩	Ash remover	⑮	Electric precipitator		

Source: Kievenergo pamphlet

- It is very important for JICA survey team to grasp the actual situation of Energia plant because it is only the incineration experience in Ukraine
- Project Brief of Kiev Energia Incineration Plant (history, capital cost, concessionaries list, contents of concession, problems, future aspect, etc.)

6. Project implementation method

- Any existing laws and regulations related to PPP (public private partnership) such as the Law of Ukraine "on public private partnership“
- Outline of some existing projects operated under PPP in the City of Kiev.
- Any regulations, standards, guidelines in Ukraine which are related to procedures for the development of waste treatment plant or other infrastructures

7. Environmental and Social Consideration

Regulations, standards and policies related to environmental impact assessment, information disclosure, resettlement of residents and land acquisition

- Categories of projects and criteria of size of the project requiring environmental impacts assessment such as SEA, EIA and IEE based on Ukrainian Regulations
- Detailed processes of EIA such as an approval process, required time, survey items, report formats and necessity of stakeholder meetings
- Relevant certifications required in implementing projects

Number and activities of waste pickers at existing landfills and dump sites, or in and around the city area

8. Others

1. Assistance by other international donors,
2. Interest field in Japan's MSWM experiences such as;
   a. History,
   b. Legal system,
   c. Statics data such as waste generation quantity,
   d. 3R,
   e. Waste collection and transportation system,
   f. Waste incineration and energy recovery,
   g. Other intermediate treatment technology,
   h. Final disposal technology,
   i. Procedures and schemes of facility construction and operation,
   j. Subsidy system,
   k. Public awareness and participation,
   l. Hazardous waste management,
   m. Others

MSWM Seminar

Proposal for MSWM Seminar

Purpose: To share common understanding on the objective of the survey with the ideas for the assistance scenario with the related authorities and organizations in Ukraine,

Proposed date and time: half day in late May or early June 2018

Proposed venue: at the meeting room of the national or local government in Kiev.

Tentative Agenda of Solid Waste Management Seminar

Time	Content	Presenter
9:00-9:10	Opening	Ukrainian Authorities, JICA
9:10-9:40	Outline of the JICA Survey	JICA Survey Team
9:40-10:00	Outline of National Waste Management Strategy	Ministry of Ecology and Natural Resources
10:00-10:30	Current Situation of Waste Management in Kiev	City of Kiev
10:30-10:50	Tea Break	
10:50-11:20	Japanese Experiences and Waste to Energy Technology	JICA Survey Team
11:20-11:40	Introduction of JICA Assistance Schemes	JICA Survey Team
11:40-12:20	Questions and Answers	All Participants
12:20-12:30	Closing	Same as Opening

Undertakings

Expected Undertakings by the Ukrainian side

The JICA Survey Team expects the following matters to be undertaken by the Ukrainian side which are requested through JICA as previously mentioned:

- Provision of data, information, and documents requested by the JICA Survey Team
- Provision of answers to the questionnaires prepared by the JICA Survey Team
- Arrangement of the meetings with the JICA Survey Team
- Coordination with the concerned organizations and facilities for the field survey
- Provision of security for the JICA Survey Team

End of Explanation

Thank you very much for your attention!

Tentative Result of First Field Survey

Information Collection and Verification
Survey for
Municipal Solid Waste Management
in
Ukraine

Interim Report
(Tentative Result of First Field Survey)
May 2018

Japan International Cooperation Agency

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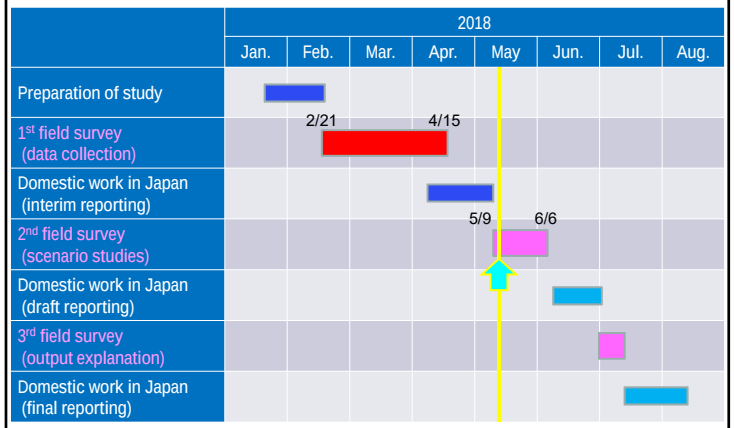
Contents

Outline of First Field Survey

Current status of survey



Target cities visited during the first field survey

Kiev
Kick-Off
2/21 – 2/26
Survey
3/4 – 3/17
4/1 – 4/15

Kharkiv
Kick-Off
3/1 – 3/3
Survey
3/25 – 3/31

Dnipro
Kick-Off
2/27 – 2/28
Survey
3/18 – 3/24

Meetings and surveys conducted

Classification	Concerned organization and activities
Ministry	• Ministry of Ecology and Natural Resources (MENR) • Ministry of Regional Development, Construction, Housing, and Communal Services (MRDCHCS) • Ministry of Economic Development and Trades (MEDT) • State Agency on Energy Efficiency and Energy Savings
Kyiv	• Kyiv Oblast State Administration • Kyiv City State Administration, *Kyiv Communal Service (KKS), Energia Incineration Plant, Kyivspetstrans, Kompania Eko Stok*
Kharkiv	• Kharkiv Oblast State Administration • Kharkiv City State Administration, *Municipal Enterprise of Complex on Municipal Waste Removal (KVBO), Municipal Company for Solid Waste Management (MKPV)*
Dnipro	• Dnipropetrovsk Oblast State Administration • Dnipro City State Administration, *EcoDnipro*
Donner	• EBRD, GIZ

Survey methods conducted

Questionnaire survey

- The questionnaire sheets, which covers all the survey items for the different governmental levels, ministry level, oblast level, and city level, were prepared and distributed to obtain the answers.

Interview survey

- Specific meetings for interview survey with the organizations and the persons in-charge of solid waste management were conducted based on the questionnaire.

Field visit

- Field visits were conducted at the waste collection including the garage, sorting facility, incineration facility, and final disposal site.

Waste composition survey

- Waste sampling and classification was done at Kharkiv and Dnipro.

Tentative Result of First Field Survey

General in Ukraine

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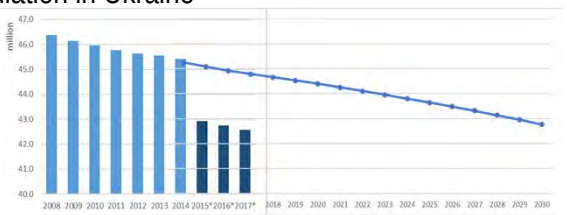
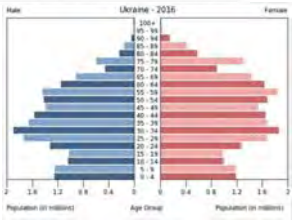
Population in Ukraine



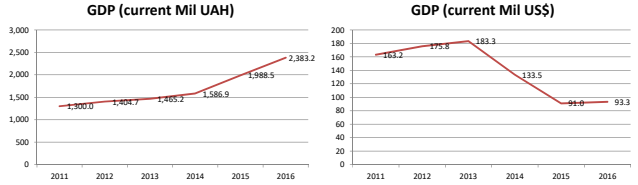
Source: JICA Survey Team referring the following data sources.
https://ukrstat.org/en/operativ/operativ2007/ds/nas_rik/nas_e/nas_rik_e.html
http://www.idss.org.ua/forecasts/nation_pop_proj_en.html

- Total population of Ukraine is about 42.4 million people and is expected to decrease slightly year by year.
- Next national census will be planed to conduct in 2020.

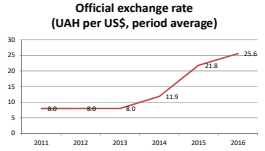


Source: https://www.cia.gov/library/publications/the-world-factbook/geos/up.html (as of 07 April 2018)

GDP in Ukraine



- It seems that the Ukrainian economy is growing year by year; however, in USD, it is shrinking from 2013 to 2015 and remains low in 2016 as well, because of the sharp depreciation of UAH caused by economic crises in 2013-2014



Source: JICA Survey Team based on the data from World Bank (https://data.worldbank.org/country/Ukraine)

Municipal Solid Waste Management in Ukraine

Category	Situations
Generation	• Approximately 49 million m3 ,or 11 million tons of municipal waste was generated in 2016, means about 0.03 m3 or 685 gram generated per day • Waste generation increases, though population decreased
Collection	• Over 78% of the population is covered by the municipal waste collection services • 822 settlement implement the segregated waste collection
Recycling	• Only 3.09% of waste is recycled • There are more than 25 waste sorting lines
Incineration	• 2.71 % of waste is incinerated at the facility • Only one incinerator is still been operating in Kyiv
Final Disposal	• There are more than 5.5 thousand landfills and dumping sites
Tariff	• The average tariff for the municipal waste management in the country is about UAH 65.3 / m3, including for dumping - UAH 19.45 / m3.

Source: JICA Survey Team based on Questionnaire Survey

Related Existing Laws and Regulations

Category	Major Law and Regulation
Waste Management	• Law “on waste”, *defines legal, organizational, and economic principles of activity related to SWM* • Law “on local government”, *defines the system and guarantees the local government in Ukraine, including the responsibility of the* executive bodies for SWM • Law “on housing and communal services”, *defines basic principles of organizational and economic relations that arise in the sphere of provision and consumption of housing and communal services*
Environment	• Law “on environmental impact assessment” • Law “on strategic environmental assessment”
PPP	• Law “on public-private partnership”
Energy	• Law “on alternative energy sources” • Law “on alternative fuels”
EU directives	Still under survey

Source: JICA Survey Team based on Questionnaire Survey

Target of National Solid Waste Management Strategy

Indicator	Unit	2016	2017-18	2019-23	2024-30
Segregated collection	settlement	575	800	2,500	5,000
Waste collection center	unit	-	25	100	250
Reuse rate target	%	5	7	8	10
Waste sorting facility	unit	65	100	250	800
Composting facility	unit	20	70	150	500
Recycling rate target	%	3.04	5	15	50
Thermal Treatment facility	unit	1	3	15	20
Thermal treatment rate	%	2.37	5.00	7.00	10.00
Dumping sites	unit	6,000	5,000	1,000	300
Direct landfill rate target	%	95	80	50	30
Regional landfill	unit	-	5	25	50

Source: National Waste Management Strategy

Action Plan under Strategy

Category	Title	Target
Laws	On waste	01.03.2018
	On electronic and electrical equipment waste	01.04.2018
	On cells and batteries	
	On packaging waste	
	On domestic waste	01.06.2018
	On waste landfill	01.08.2018
	On waste incineration	
	On spent petroleum products	01.09.2018
	On decommissioned motor vehicles	
	On the management of extractive industry waste	31.12.2018
Plan	Draft of National Waste Management Action Plan	April 2018
	Agreement on National Waste Management Action Plan	June 2018

Source: Action Plan for National Waste Management Strategy

Action Plan under Strategy

Power plant	Capacity of the power plant and other factors influencing the size of the 'green' tariff	Tariff for objects put into operation, €ct/kW·h		
		01.01.2017 - 31.12.2019	01.01.2020 - 31.12.2024	01.01.2025 - 31.12.2029
Wind power plant	Capacity up to 600 kW	5,82	5,17	4,52*
	Capacity from 600 kW to 2 MW	6,79	6,03	5,28*
	Capacity from 2 MW	10,18	9,05	7,92*
Solar power plant	Power stations on the surface	15,02	13,52	12,01*
	Power stations on roofs and / or facades of buildings, buildings and structures	16,37	14,75	13,09*
Bioenergy power plants	Biomass is a non-biologically biodegradable substance of organic origin, in the form of products, waste and residues. Biogas is a gas from biomass.	12,39	11,15	9,91*
Geothermal power plants	Geothermal energy	15,02	13,52	12,01*
Hydroelectric stations	Micro HPS (up to 200 kW inclusively)	17,45	15,72	13,95*
	Mini HPS (capacity from 200 kW to 1 MW)	13,94	12,55	11,15*
	Small HPS (capacity up to 10 MW inclusive)	10,45	9,42	8,35*
Power plants of private households	Solar power stations up to 30 kW	18,09	16,26	14,49*
	Wind power stations up to 30 kW	11,63	10,45	9,32*

** Before December 31, 2024, the green tariff is set in the national currency at the official exchange rate of the National Bank of Ukraine and is recalculated quarterly.*
** After December 31, 2024, the 'green' tariff will be calculated at the beginning of 2025, and remains unchanged until December 31, 2029.*

Source: JICA Survey Team based on Questionnaire Survey to SAEE

Tentative Result of First Field Survey

Kyiv

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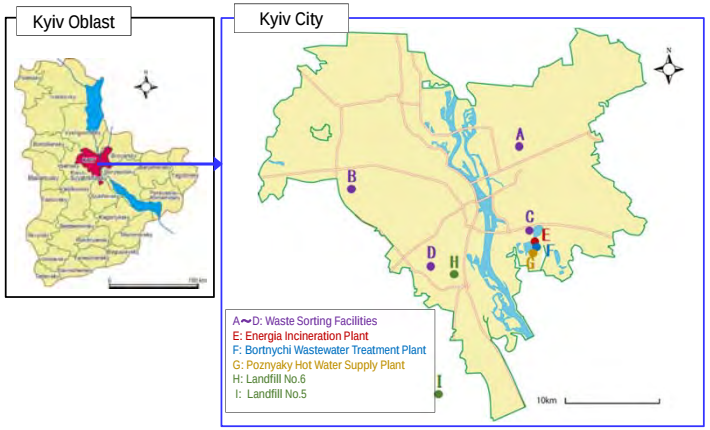
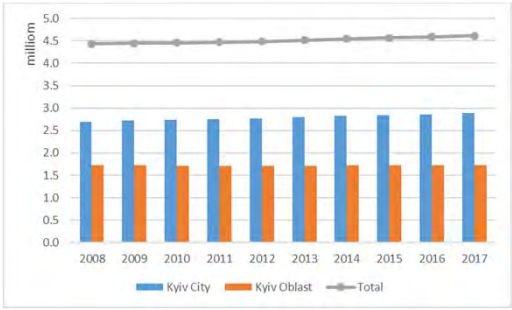
Map of major facilities in Kyiv City



Population of Kyiv Oblast and Kyiv City

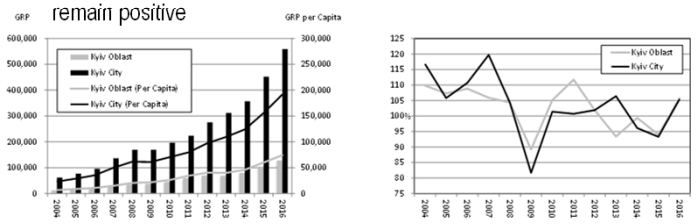
- Population in the past ten years of both Kyiv City and Kyiv Oblast has been almost stable, about 2.9 million and 1.7 million respectively.



Source: JICA Survey Team referring the following data sources.
Kyiv Oblast State Administration for the Questionnaire of JICA Survey Team
http://kyivobl.ukrstat.gov.ua/content/p.php3?c=114&lang=1

GRP in Kyiv

- The GRP of Kyiv City State Administration and Kyiv Oblast Administration in 2016 were UAH 599,140 million and UAH 128,638 million, respectively. The capital city of Kyiv produces 23.4 % of the total national GDP.
- Growth rates of GRP of Kyiv City and Kyiv Oblast went negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty. In 2016, it became positive and is expected to remain positive



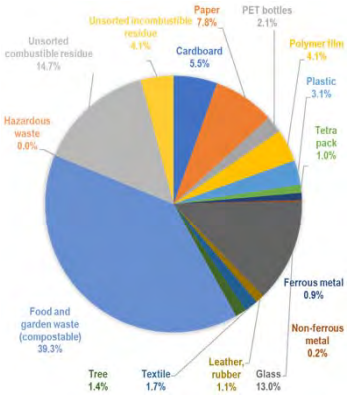
Source; State Statistic Service of Ukraine website (http://www.ukrstat.gov.ua/)

Municipal Solid Waste Generation in Kyiv City

Estimated Quantity in 2018 (per year)		
Waste Type	Volume (1000 m3)	Weight (1000 t)
Household waste	6,153	1,188
Administrative waste	787	107
Commercial waste	765	122
Total per year	7,955	1,457
	Volume (m3)	*Weight (t)*
Total per day	*21,800*	*4,000*

Source: State Enterprise; Scientific Research Design Technology Institute of Urban Management (2011) "Sanitary Cleaning Scheme of Kyiv City"

Surveyed Quality in 2011



Municipal Solid Waste Collection in Kyiv City

- Management for municipal waste collection and transportation is entrusted to a communal enterprise, “Kyivkomunservis (KKS)”, mainly for waste generated from multi-residential apartment. KKS contracts with the seven service providers to implement the waste collection.
- The other municipal solid wastes generated from individual houses, commercial, and administrative sectors are mostly not managed by KKS but through private service providers.
- Municipal waste collection service is performed six days a week excluding Sunday and collective segregated waste collection system is not yet fully introduced in the city. The amount of municipal waste collected by KKS is about 1.2 million t/year and the collection rate of municipal waste is 100%, according to Kyiv City State Administration.

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Municipal Solid Waste Collection in Kyiv City (Photos)

Typical waste containers in the city

Waste collection work by service provider

Segregated waste containers

Hazardous waste container

Underground waste container

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Recycling in Kyiv City

- At this moment, there are some waste sorting facilities operated by private companies which sort and recover recyclable materials from municipal solid waste.

Recyclables collection point

Waste transported to sorting plant

Bundled PET bottes after sorting

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Energia Incineration Plant of Kyiv City

- It was constructed in 1986 and started its operation in December 1987, means it has been operated more than 30 years.
- Total facility area is 8.3 ha including 1.2 ha of heat providing building
- Design capacity is 1,440 tons/day (360 tons/furnace/day x 4 unit), means about 432,000 tons/year in case 300 days operation.
- But, in reality, it is accepting 200,000 tons to 260,000 tons/year at the maximum these days. → Operating efficiency ≒ 50%
- Approximately 200,000 Gcal of heat is generated and sold to the local heat supply network of Kyiv City. The sales revenue of heat accounts for 67% of the whole revenue and it is used for the maintenance and repair of equipment.
- There is the plan to improve the gas treatment system to satisfy the EU’s emission gas standard.

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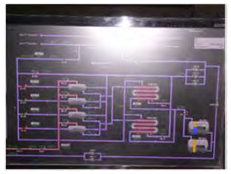
Municipal Solid Waste Collection in Kyiv City (Photos)


Weighing bridges


Unloading platform


Waste pit and crane


Rotary stoker type furnace


Heat distribution system


Ash remover

Final Disposal in Kyiv City

- In 2016, 790,400 tons of municipal solid waste was transported to landfills and dumping sites
- Landfill No.5 and Landfill No.6 received 519,800 tons, the remaining 270,600 tons were taken to the landfills in Kyiv Oblast.
- Landfill No.5, now operated by the PJSC Kyivspetstrans, is located near the village of Pidhirtsi, Obukhiv District, Kyiv Oblast, 15 km to the south of the Kyiv City limits. It was constructed in 1986. The total area of the landfill is 63.7 ha. Due to the shortage of the remaining landfill capacity, renovative construction plan is now under preparation, but the closure of the landfill has been also planed.
- Landfill No.6 is accepting approximately 100,000 tons to 150,000 tons of the construction waste and bulk waste. It started its operation in 1999 with the area of 11 ha, but it has been almost full beyond its capacity.

Final Disposal in Kyiv City (Photos)


Entrance of Landfill No. 5


Distant view of landfill area


Leachate purifying facility


Entrance of Landfill No. 6


Distant view of landfill area No. 6

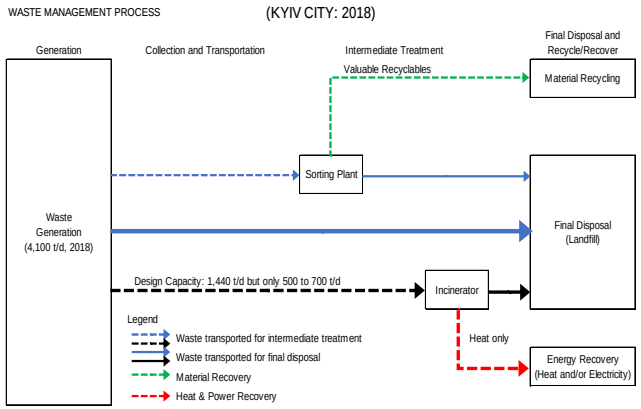
Waste Removal/Disposal Tariff in Kyiv City

Category of Waste Generator	Tariff for KKS (UAH/m3)
Residents	74.45
Public institutions	79.84
Other waste generators	92.78

Source: Kyiv City State Administration (2017) "Resolution No. 666 to change tariff for the services of solid municipal waste removal including activities of municipal waste management provided by public utility company 'Kyivkomunservis' as a service provider

- The tariff includes the fee for waste collection and treatment service as well as the fee for waste treatment at Energia Incineration Plant and disposal fee at Landfills No. 5 and No. 6.
- The waste generation rate of households is set at 2.1 m3/person/year; therefore, it is calculated that residents in Kyiv City pay UAH 156/year (= 2.1 x 74.45). As the bulk density of municipal solid waste is 5 m3/t, it is also calculated to be UAH 372/t (= 74.45 x 5).

Current Waste Flow of Kyiv City



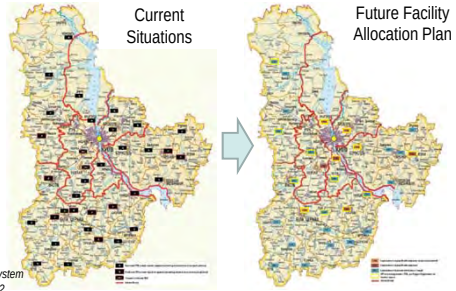
Current Waste Management Plan of Kyiv City

- "On Approval of Sanitary Cleaning Scheme (10 February 2014)".
- "On Approval of Complex Target Program of Energy Efficiency and Development of Housing and Communal Infrastructure of Kyiv in 2016 - 2020 and Measures for its Implementation (17 March 2016)."
- Action plan on solid waste management in Kyiv City for 2017-2025.
  - ➢ *Reconstruction and reclamation of Landfill No.5 (2017 – 2021)*
  - ➢ *Reconstruction and reclamation of Landfill No.6 (by 2019)*
  - ➢ *Improvement of gas treatment system at Energia plant (2017 – 2019)*
  - ➢ *Installation of power generation system at Energia plant (2018 – 2021)*
  - ➢ *Development of waste processing complex, if necessary (2018 – 2025)*
  - ➢ *Additional installation of heat/power recovery facility (2020 – 2025)*
  - ➢ *Installing and review the waste collection/disposal tariffs (constantly)*
  - ➢ *Improved development of segregated waste collection (constantly)*

Concerned Waste Management Plan of Kyiv Oblast

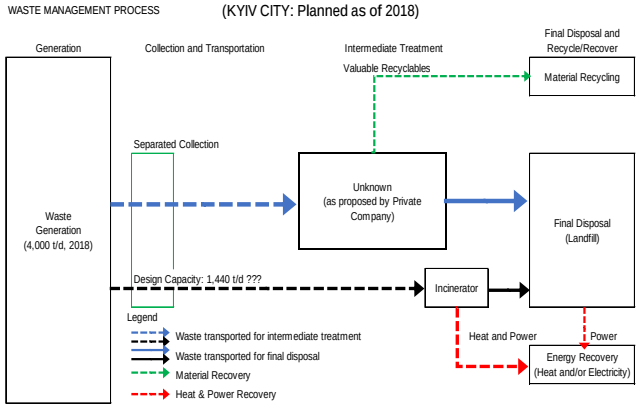
- Modern solid waste management system implementation in Kyiv Region for 2017-2022
- Municipal solid waste management program in Kyiv Region for 2017-2020

→ *Kyiv Region is divided into seven blocks, and each block has its own appropriate waste facility development plan based on each characteristics of the block, such as population, area, geological condition and road network.*



Source: Modern solid waste management system implementation in Kyiv Region for 2017-2022

Planned Waste Flow of Kyiv City as of 2018



Appendix 3

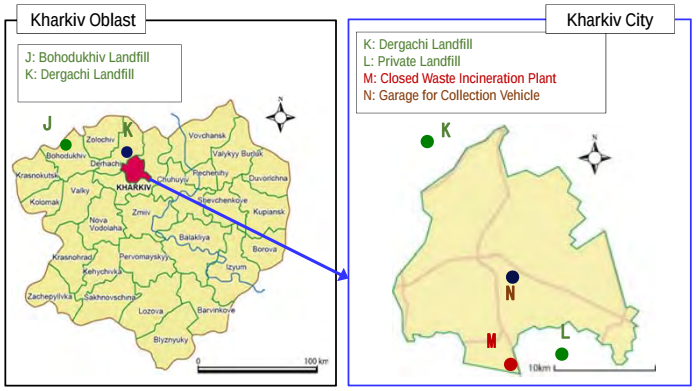
Current Issues of Waste Management of Kyiv City

1. Uncertainty of Future Landfill Plan
2. Existing Illegal Dump
3. Aging of Energia Incineration Plant
4. Uncertainty of private investment
5. Difficulty on introduction of segregated waste collection

Tentative Result of First Field Survey

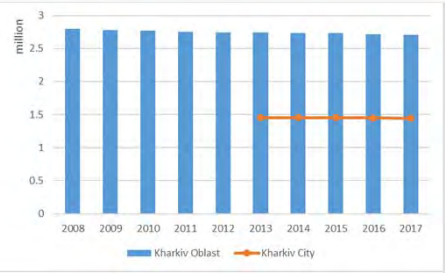
Kharkiv

Map of major facilities in Kharkiv Region



Population of Kharkiv Oblast and Kharkiv City

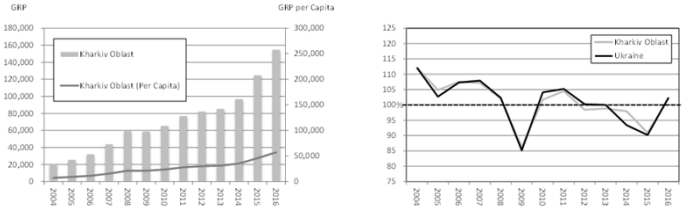
- Population in the past ten years of both Kharkiv Oblast and Kharkiv City has been almost stable, about 2.7 million and 1.4 million respectively.
- It is unofficially observed that its population might have increased, due to the recent rapid population inflow from Donetsk and Luhansk.



Source: JICA Survey Team referring the following data sources.
Kharkiv City State Administration for the Questionnaire of the JICA Survey Team
http://kh.ukrstat.gov.ua/index.php/naselennia-1995-2012rr

GRP in Kharkiv

- The GRP of Kharkiv Oblast Administration in 2016 were UAH 154,871 million, which compromise 6.5 % of the total national GDP.
- The GRP growth rates of Kharkiv Oblast have similar fluctuations like with the GDP growth rate of the whole Ukraine, falling negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty, etc. In 2016, it became positive.



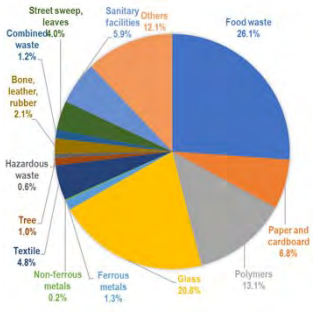
Source; State Statistic Service of Ukraine website (http://www.ukrstat.gov.ua/)

Municipal Solid Waste Generation in Kharkiv City

Estimated Quantity

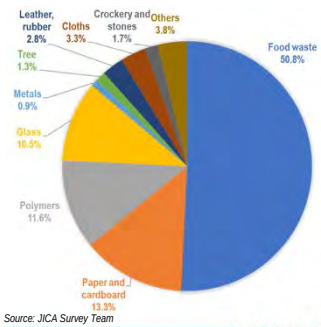
There is no statistic data on the amount of municipal solid waste generated but it could be estimated to be 400,000 t/year, or 1,100 t/day

Surveyed Quality in 2012



Source: Kharkiv City State Administration

Surveyed Quality in 2018 (only 1 sample)



Source: JICA Survey Team

Municipal Solid Waste Collection in Kharkiv City

- Management for municipal waste collection and transportation is entrusted to a communal enterprise, “Municipal enterprise of complex on municipal waste removal (KVBO)” and two private companies. KVBO collects about 80% of waste generated in the city, about 300,000 t/year (820 t/day). Collection rate is 100%.
- KVBO’s municipal waste collection service is performed seven days a week, although the private service providers are assumed to be operational 2~3 days a week based on the contracts with waste generators.
- A collective segregated waste collection system is not yet introduced in the city but the Kharkiv City State Administration has a clear intention to introduce segregated waste collection in the city in the near future.

Municipal Solid Waste Collection in Kharkiv City (Photos)

Typical waste containers in the city

Old type containers

Recyclable collection containers

Waste collection work by KVBO

New collection trucks in garage

Truck tracking system

Final Disposal in Kharkiv City

- The City of Kharkiv uses the following two landfill sites respectively located in the northern and southern parts of the city.

Landfill of municipal enterprise "Municipal company of waste management (MKPV)"

- It is located inside the neighboring municipality Dergachi City.
- The area size is 13 hectares and it started its operation from 2006 as the second stage, accepting about 250,000 tons of waste annually.
- First stage had been operated from 1976 to 2005, for 40 years.
- New landfill is under construction by the World Bank project

Landfill of private enterprise LLC "Recycling Plant"

- It is located in the southern part of the city.
- Area size is 19 hectares and it started its operation from 2002, accepting about 150,000 tons of waste annually. This landfill is planned to be used for about two more years until 2019.

Municipal Landfill of Kharkiv City (Photos)

Distant view of landfill area

Operating area

Track scale and waste collection trucks

Leachate storage pond

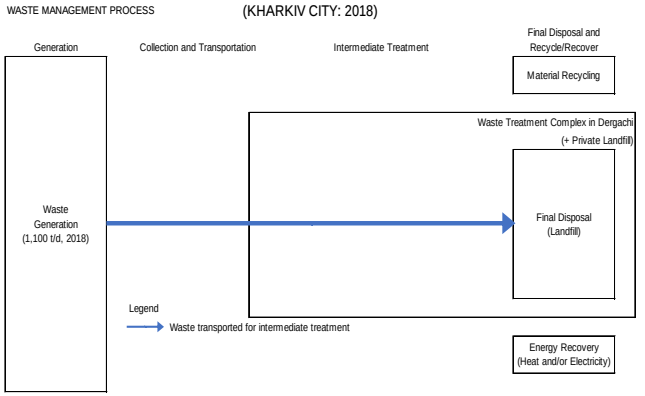
Waste Removal/Disposal Tariff in Kharkiv City

Category of Waste Generator	Tariff for KVBO (UAH/m3)
Residents	55.56
Public institutions	60.84
Other waste generators	79.32

Source: Kharkiv City State Administration (2014 and 2016) "Decision of the Executive Committee of Kharkiv City Council dated 19 July 2016 No.472", "Decision of the Executive Committee of Kharkiv City Council dated 5 November 2014 No.646", "Decision of the Executive Committee of Kharkiv City Council dated 23 February 2016 No.110"

- The tariff includes the fee for waste collection and treatment service and disposal fee.
- Unlike the cases of Kyiv City and Dnipro City, the operational cost of municipal waste collection and disposal service is not fully covered by the waste management tariff paid by the waste generators.
- The Kharkiv City State Administration gives a budget to KVBO annually amounting to about UAH 100 million for both capital investment operational cost, in order to avoid increasing the tariffs.

Current Waste Flow of Kharkiv City



Current Waste Management Plan of Kharkiv City

- The Scheme of Sanitary Cleaning of Kharkiv for 2004-2020 (24 December 2003)".
- The Program of Development of the Solid Waste Management System in Kharkiv for 2015 – 2026 (24 December 2003)."
- Rules for Landscaping City of Kharkiv (16 November 2011)
- "Urban Infrastructure Project 2 (UIF2)" funded by the World Bank

➢ *One of the component of UIF2 is the phase one of the construction of a solid waste treatment facility for Kharkiv City beside the current municipal landfill in Dergachi City*

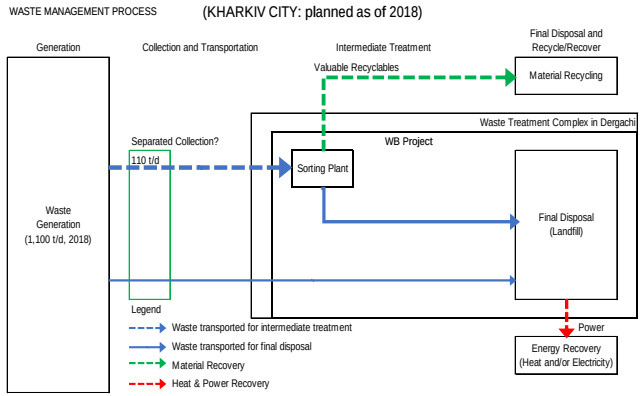
➢ *Project cost is USD 44 million for 1) New landfill, 2) waste sorting plant, 3) power plant with landfill gas and gas collection network, and 4) land preparation, within the area of 17 ha.*

➢ *Project cost is not included for the construction of the phase two in another 17 ha. It shall be invested by Kharkiv City's initiative.*

Concerned Waste Management Plan of Kharkiv Oblast

- The Kharkiv region has been implementing a complex Environmental Protection Program in Kharkiv Region for 2009-2013 and up to 2020 , approved by the decision of the Kharkiv Region Council as of 29.10.2009, No. 1413-V (including amendments). The Program has a section "Rational Usage, Storage and Utilization of Industrial and Household Wastes".
- The regional strategy "Kharkiv Region Ecology" for 2016-2020, approved by the decision of the Kharkiv Region Council as of 14.04.2016 No. 107-VII (with amendments).
- Kharkiv Oblast State Administration plans to construct 22 waste treatment complexes in the region. Two landfills are now under construction and other three are under preparation. Contents of this plan is subject to be revised based on the national waste management plan which is now under developing by the central government.

Planned Waste Flow of Kharkiv City as of 2018



Current Issues of Waste Management of Kharkiv City

1. Efficiency of Operation of Sorting Plant

➢ *Introduction of segregated waste collection system may increase the recovering efficiency of recyclables at the facility*

➢ *Careful training for the operators at the facility will be required because there is no experiences of the operation of such sorting facility*

2. Necessity of further waste reduction at the landfill

➢ *Considering the principles of the National Waste Management Strategy which is to reduce the amount of waste to be directly disposed of at the landfill, some additional treatment might be necessary in the future*

3. Existing illegal dumping sites and inappropriate private landfill

➢ *There is still unauthorized dumping and inappropriate operation of private landfill*

Tentative Result of First Field Survey

Dnipro

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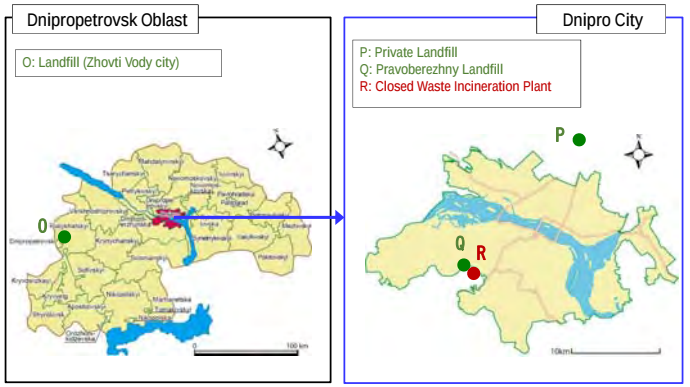
Map of major facilities in Dnipropetrovsk Region



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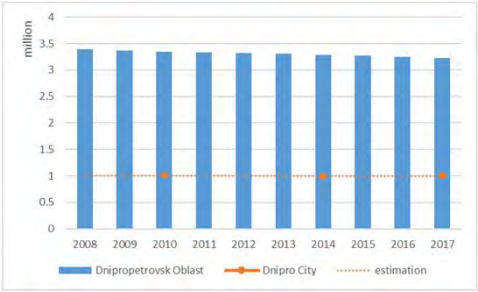
Population of Dnipropetrovsk Oblast and Dnipro City

- Population in the past ten years of both Dnipro Oblast and Dnipro City has been almost stable, about 3.2 million and 1.0 million respectively.
- it could be said that the population will be stable or slightly decrease in near future.



Source: JICA Survey Team referring the following data sources.
Dnipro City State Administration for the Questionnaire of the JICA Survey Team
http://kh.ukrstat.gov.ua/index.php/naselennia-1995-2012rr

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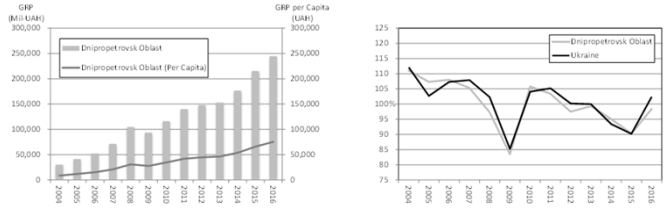
GRP in Dnipropetrovsk

- The GRP of Dnipropetrovsk Oblast Administration in 2016 were UAH 244,478 million, which compromise 10.2 % of the total national GDP.
- The GRP growth rates of Dnipropetrovsk Oblast have similar fluctuations like with the GDP growth rate of the whole Ukraine, falling negative in 2009 and in 2014-15 due to the global economic crisis and domestic political uncertainty, etc. In 2016, it became positive.



Source; State Statistic Service of Ukraine website (http://www.ukrstat.gov.ua/)

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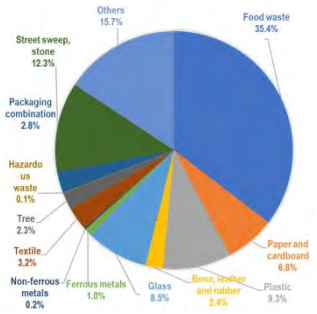
Municipal Solid Waste Generation in Dnipro City

Estimated Quantity

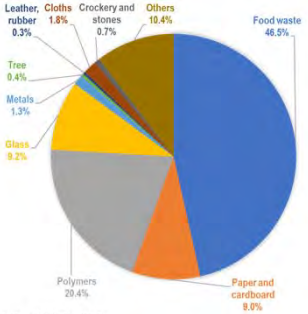
There is no statistic data on the amount of municipal solid waste generated but it could be estimated to be 350,000 t/year, or 960 t/day

Surveyed Quality in 2017



Source: Kharkiv City State Administration

Surveyed Quality in 2018 (only 1 sample)



Source: JICA Survey Team

Municipal Solid Waste Collection in Dnipro City

- Municipal waste collection and transportation is entrusted to a private enterprise, “Dniprokomuntrans”.
- There is no information on the amount of collected waste but the collection rate of municipal waste is considered to be 70%. Assuming that 920 t/day~1,000 t/day of municipal waste is currently generated in the city, it is calculated that the amount of collected municipal waste is about 640~700 t/day.
- The collection service is provided daily and collective segregated waste collection system is not yet introduced in the city.
- Due to the recent unsatisfied performance on the waste collection, Dnipro City State Administration is going to change its collection service provider from “Dniprokomuntrans” to the communal enterprise named “Ecopolis”, which was established in September 2017.

Municipal Solid Waste Collection in Dnipro City (Photos)

Typical waste containers in the city

Waste collection work by Dniprokomuntrans

Final Disposal in Dnipro City

- Final disposal of the waste generated from Dnipro City is mostly done by the waste treatment complex called "Right Bank” (Pravoberezhny) facility, located in the Ptashyna Valley, on the territory of the Novo-Aleksandrovsky Village Council.
- Landfill management is done by the communal enterprise “Eco-Dnipro” of the Dnipro City Council.
- Total area for the complex is 131.5 ha. Design capacity of the municipal solid waste landfill is 5,322 million m3 or 4.25 million tons, while 1,001 million m3 or 1.3 million tons for the industrial waste landfill.
- Component 1 of landfill was already full and component 2 is under operation. Component 4 will be constructed next.

Municipal Landfill of Dnipro City (Photos)

Truck scale

Signboard for Driving Route in the Site

Landfill Operation Area

Waste Pickers

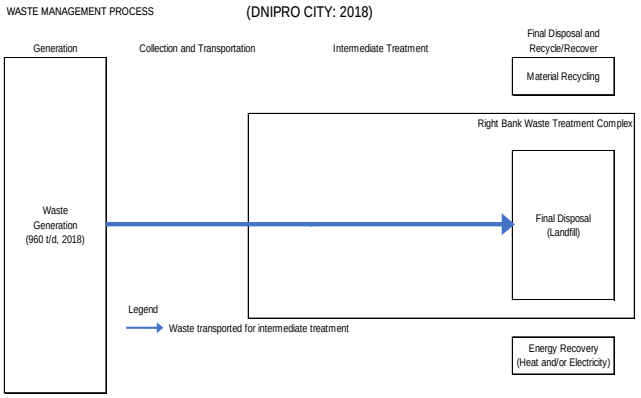
Waste Removal/Disposal Tariff in Dnipro City

Category of Waste Generator	Tariff for MSW (UAH/m3)
Residents	35.00
Public institutions	47.25
Other waste generators	70.00

Source: Dnipro City State Administration (2011) "Decision of the Executive Committee of Dnipro City Council dated 31 August 2011 No.1147"

- The tariff includes the fee for waste collection and treatment service and disposal fee.
- The operational cost of municipal waste collection and disposal service is fully covered by the waste management tariff paid by the waste generators. However, the Dnipro City State Administration acknowledged the necessity to increase the tariff as it has not been revised from 2011 up to now.
- The residents pay waste management fee directly to Dniprokomuntrans according to the bill issued by the Unified Calculation Center, which manages the billing of public utility service, at this moment.

Current Waste Flow of Dnipro City



Current Waste Management Plan of Dnipro City

- The fundamental plan for the solid waste management of Dnipro can be stated on "the Scheme of Sanitary Cleaning of Dnipropetrovsk (No. 31/32)" approved on 27 February 2013 which was developed based on "the Waste Management Rules in the City of Dnipropetrovsk (No. 403)" approved on 24 April 2012.
- According to the plan, EcoDnipro which is the authorized operator of the "Right Bank" Waste Treatment Complex is proceeding to construct the waste sorting facility firstly with the capacity of 100,000 tons/y, then extended its capacity up to 350,000 tons/y in future.
- On the other hand, Dnipro City also conducted another feasibility study for the development of waste processing facility under the PPP scheme. Component of this PPP project is a combination of waste sorting plant and digestion plant that produces biogas for its energy recovery.
- Based on the feasibility study, Dnipro City conducted the international tender to select a private investor who will implement the project. As a result of the tender, a British company named "Stopford Project Limited" was selected.

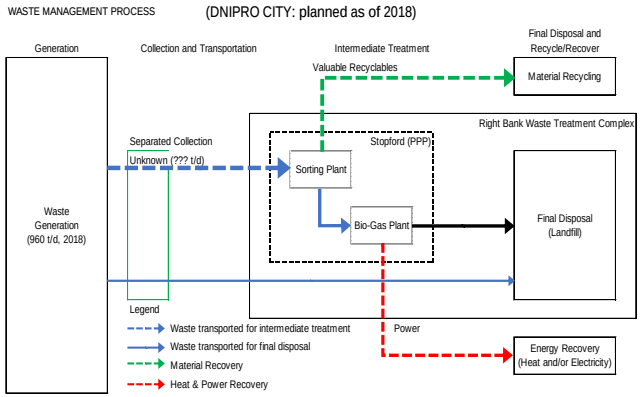
Concerned Waste Management Plan of Dnipropetrovsk Oblast

- Development strategy of Dnipropetrovsk region for the period till 2020 approved by the Decision of Dnipropetrovsk Regional Council dated 26.09.2014 № 561-27/VI
- Dnipropetrovsk Regional Integrated Environmental Safety Strategy for 2016 – 2025 approved by the Decision of the Regional Council dated 21.10.2015 № 680-34/VI (as amended).
- Dnipropetrovsk Regional Strategy for Solid Municipal Waste Management approved by the Decision of the Regional Council dated 29.07.016 № 80-5/VII.

➢ In this strategy, the region will be divided into six blocks and each block will develop its regional landfill and other related waste processing facilities. After waste processing, 50 % of collected waste will be disposed of at the landfill.

- A PPP project with waste incineration plant by Austrian company is also undergoing.

Planned Waste Flow of Dnipro City as of 2018



Current Issues of Waste Management of Dnipro City

1. Uncertainty of private investment

➢ *As for the PPP project by British company, details of the facility plan have not been disclosed, including the treatment capacity of the plant.*

➢ *As for another PPP project by Austrian company, details of facility plan and waste collection plan are not clear.*

2. Existence of illegal dump and uncollected waste

➢ *waste collection rate is still considered to be 70% while the remaining 30% of waste is sometimes not collected regularly and disposed of at unauthorized dumping sites, mostly on the left bank*

3. Hesitation in the introduction of segregated waste collection

➢ *Even though it is proposed to introduce the segregated waste collection by the operating enterprise, Dnipro city is very careful on its introduction.*

Schedules of Second Field Survey

Proposed Schedule for Second Field Survey

Date	Location	Survey Activity
9 May	Kyiv	Arrival in Kyiv
10–15 May	Kyiv	Meetings and supplemental surveys with the ministries, international donors including the World Bank, Kyiv City State Administration, Kyiv Oblast State Administration, and other concerned organizations Preparation and implementation of waste composition survey Preparation of solid waste management seminar Interim report to JICA Ukraine Office and Embassy of Japan
16–20 May	Kharkiv	Meetings and supplemental surveys with Dnipro City State Administration, Dnipropetrovsk Oblast Administration and other concerned organizations.
21–24 May	Dnipro	Meetings and supplemental surveys with Kharkiv City State Administration, Kharkiv Oblast Administration and other concerned organizations.
25 May –5 June	Kyiv	Meetings and supplemental surveys with the ministries, Kyiv City State Administration, Kyiv Oblast State Administration, and other concerned organizations Holding of solid waste management seminar (01 June, half day)
June 6th	Kyiv	Departure from Kyiv

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Proposal for MSWM Seminar

Proposed date and time: half day on June 1st or May 31st

Proposed venue: at the meeting room of Kyiv Oblast State Administration.

Tentative Agenda of Solid Waste Management Seminar

Time	Content	Presenter
9:00-9:10	Opening	Ukrainian Authorities, JICA
9:10-9:20	Outline of the JICA Survey	JICA Survey Team
9:20-9:40	Outline of the National Waste Management Strategy, National Waste Management Plan and status of revision of concerned laws.	Ministry of Ecology and Natural Resources
9:40-10:20	Current Situation of Waste Management in Kyiv, Kharkiv, and Dnipro	JICA Survey Team
10:20-10:30	Tea Break	
10:30-11:20	Japanese Experiences and Waste to Energy Technology	JICA Survey Team
11:20-11:40	Introduction of JICA Assistance Schemes	JICA Survey Team
11:40-12:20	Questions and Answers, Discussions	All Participants
12:20-12:30	Closing	Same as Opening

Source: JICA Survey Team

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End of Interim Report

Thank you very much for your attention!

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Summary of Draft Final Report

Information Collection and Verification Survey for Municipal Solid Waste Management in Ukraine

Summary of Draft Final Report

16 July 2018

JICA Survey Team

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Contents

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1. Status of Survey

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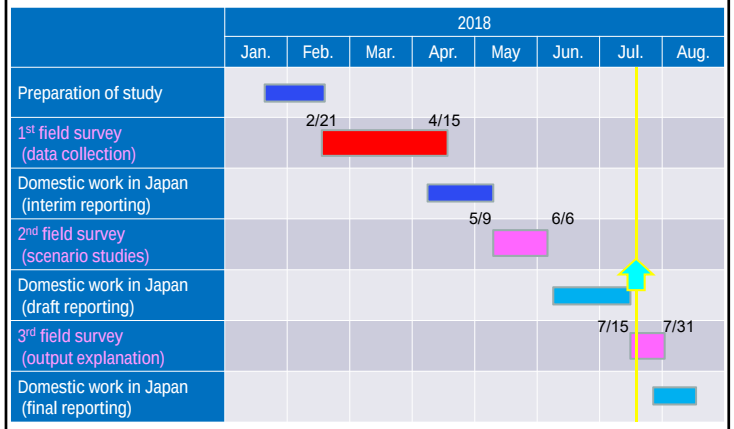
1. Status of survey



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2. Contents of Draft Final Report

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2. Contents of Draft Final Report

Chapter 1	Outline of the Survey • Background, Objectives, Target area, Concerned organizations
Chapter 2	Outline of the Field Survey • Survey schedule, Methods, Seminar
Chapter 3	Results of the Field Survey • Current Status of Ukraine, Kyiv City, Kharkiv City, Dnipro City • International donor's assistance
Chapter 4	Identified Assistance Needs • Overall needs in Ukraine • Specific needs of central governments and target cities
Chapter 5	Tentative Evaluation for the Introduction of Waste-to-Energy System • Evaluation Method • Tentative evaluation result
Chapter 6	Possible Assistance and Pre-Conditions • Possible assistance and its schedule • Pre-conditions
Chapter 7	Environmental Scoping

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3. Identified Needs for Assistance

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Identified Overall Needs in Ukraine

Needs for implementation of solid waste management, following the new national legal framework and national waste management plan

1. Urgent and Appropriate Review and Renewal of the Existing Plans
2. Collection of Reliable Data
3. Research and Creation of Recycling Market
4. Introduction of Segregated Waste Collection
5. Public Awareness Raising and Environmental Education
6. Adoption of Appropriate Technology and Business Scheme
7. Appropriate Waste Removal Tariff Setting
8. Private Sector Involvement and Evaluation of PPP Project
9. Globalization of Existing Engineering Standards
10. Provision of Training and Education Opportunity
11. Coordination among Ministries, Oblasts, and Municipalities

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Specific Needs at the Central Government

- Training and education for the enhancement of the "central executing body on waste management" which will be newly established;
- Establishment of network among concerned ministries, oblasts, and municipalities for strengthening their cooperation, together with the creation of regular opportunities for sharing the experiences and information;
- Development of technical guidelines and standards for the preparation and implementation of the local waste management plan; and
- Establishment of monitoring structure on waste management with the data management system.

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Specific Needs in Kyiv City

1. Life-expansion or closure of Landfill No. 5;
2. Closure of Landfill No. 6;
3. Development of new landfill(s) after the closure of No. 5 and 6;
4. Development of waste processing facilities to reduce the waste to be directly landfilled;
5. Fundamental improvement of Energia Incineration Plant (chemical and physical gas treatment, power generators);
6. New construction of substitute plant of Energia Incineration Plant by around 2030;
7. Introduction and expansions of segregated waste collection, including public awareness raising;
8. Renew the conceptual and master plan of solid waste management including facility development plan and its implementation.

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Specific Needs in Kharkiv City

1. Efficient operation of sorting plant being constructed by the World Bank project;
2. Introduction of segregated waste collection, including public awareness raising;
3. Future facility development plan for the second phase of landfill and waste processing plant (17 ha) after the World Bank project;
4. Consideration of further waste reduction at the landfill, following the National Waste Management Strategy; and
5. Renew the conceptual and master plan of solid waste management including facility development plan and its implementation plan as the city's solid waste management plan, updating related schemes of sanitation and cleaning or other project documents.

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Specific Needs in Dnipro City

1. Preparation of alternative facility development plan against the PPP project plans, which are currently being done by both city and oblast;
2. Efficient operation of sorting plant in case Eco Dnipro will be constructed;
3. Introduction of segregated waste collection, including public awareness raising;
4. Renewal of the conceptual and master plan of the solid waste management including facility development plan and its implementation plan as the city's solid waste management plan, updating related scheme of sanitation and cleaning or other project documents

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4. JICA's Assistance Schemes

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Types of Assistance Schemes of JICA

Technical Cooperation ① Dispatch of Experts ② Acceptance of Training Participants ③ Technical Cooperation Projects ✓ Combination of above ① and ② with participatory methods ④ Technical Cooperation for Development Planning ✓ Support to prepare master plans and feasibility studies	Mostly applicable to Ukraine, individually, or comprehensively as a comprehensive assistance model
Official Development Assistance Loans ✓ Support to develop economic and social infrastructure	
Official Development Assistance Grants	
Citizen Participation *- Volunteers* *- JICA Partnership Program*	
Public-Private Partnerships	
Emergency Disaster Relief	

JICA Survey Team based on JICA's web site

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5. Pre-Conditions for Possible Assistances

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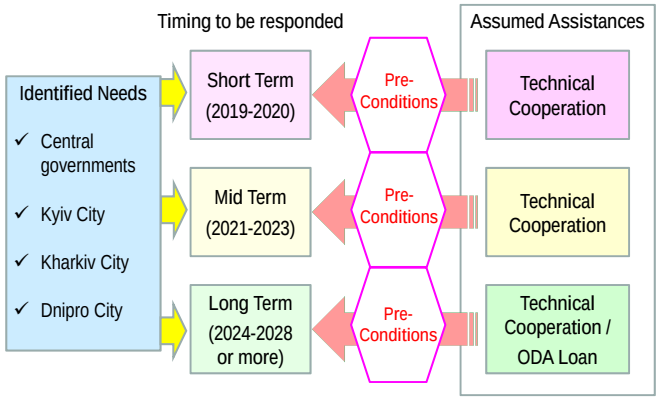
Phased Assistance and Pre-Conditions



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Assumed Assistances

Term	Assumed Scheme	Tentative Assistance
Short-term 2019-2020	Technical cooperation	・ Provision of technical trainings to concerned staff of both national and local government level. ・ Support for inter-administrative networking. ・ Support for development of relevant guidelines or others. ・ Support for review and re-develop the related existing scheme and plans ・ Support for planning on urgent facility development and its operation
Mid-term 2021-2023	Technical cooperation	・ Continuous provision of technical trainings to concerned staff of both national and local government level. ・ Support for monitoring and data management. ・ Support for introduction of segregated waste collection and related public awareness raising. ・ Support for technical detail inspection for Energia Incineration Plant. ・ Support for preparatory planning on long-term facility development
Long-Term 2024-2028	ODA loan and/or Technical cooperation	・ Continuous Provision of technical trainings to concerned staff of both national and local government level. ・ Support for implementing of long-term facility development and its soft component

Short-term Assistances and Pre-Conditions (1)

Tentative Assistance	Target	Pre-Conditions
・ Provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ The completion of development of related laws such as "Law on Waste" and its disclosure to the public ✓ Strengthening of the cooperation among the central and local government, including the mechanism of knowledge sharing from central government to local government ✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills ✓ Compilation of requested assistances
・ Support for inter-administrative networking	Ministries Oblasts Cities	✓ The completion of establishment of the central executive body on waste management and its disclosure to the public
・ Support for development of relevant guidelines or others	Ministries	✓ The completion of development of National Waste Management Plan and its disclosure to the public

Short-term Assistances and Pre-Conditions (2)

Tentative Assistance	Target	Pre-Conditions
・ Support for review and re-develop the related existing scheme and plans	Cities	✓ Preparation of energy balance statement at each target city to understand local demands and supply amount of heat and electricity ✓ Continuation of discussions and considerations on regulating the appropriate waste removal tariff ✓ Preparation of the financial statement of waste management
・ Support for planning on urgent facility development and its operation	Kyiv	✓ Conclusion of business scheme to handle the municipal waste after the closure of Landfill No. 5 ✓ Discussions and cooperation with Kyiv Oblast State Administration about the location of waste treatment and disposal facilities constructed outside of the city in the future ✓ Financial evaluation of Energia Incineration Plant
	Kharkiv	✓ Preparation of operational plan of the new waste sorting plant and landfill ✓ Provision of trainings to the operators of the new waste sorting plant and landfill
	Dnipro	✓ Determination of introduction of PPP Project or not ✓ Discussions and agreement with Dnipropetrovsk Oblast State Administration about the waste allocation among Dnipro City and other municipalities in the future

Mid-term Assistances and Pre-Conditions (1)

Tentative Assistance	Target	Pre-Conditions
・ Continuous provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ Continuation of cooperation and information exchange with the international organizations and private sector ✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills
・ Support for monitoring and data management.	Ministries Oblasts Cities	✓ Preparation of the list of academicians who deal with the research of waste management including recycling
・ Support for introduction of segregated waste collection and related public awareness raising.	Ministries Oblasts Cities	✓ Preparation of the list of private companies who deal with the waste management including recycling ✓ Preparation of the list of private companies, CBOs or NGOs who deal with the public awareness related to waste management including recycling ✓ Development and continuation of public awareness promotion for understanding the waste management implemented by the government

Mid-, Long-term Assistances and Pre-Conditions

Tentative Assistance	Target	Pre-Conditions
・ Support for technical detail inspection for Energia Incineration Plant.	Kyiv	✓ Continuation of discussions for the possibility of application of green tariff for power recovered by incinerating of waste
・ Support for preparatory planning on long-term facility development	Kyiv	✓ Technical evaluation of Energia Incineration Plant
	Kharkiv	✓ Monitoring the operation of the new waste sorting plant and landfill
	Dnipro	✓ Preparation of waste management concept for the waste generated on the left bank ✓ Technical evaluation of Zhilservis or other enterprises who will be in-charge of waste collection
・ Continuous Provision of technical trainings to concerned staff of both national and local government level.	Ministries Oblasts Cities	✓ Sustainable continuation of waste management policy beyond political change ✓ Continuation in participating domestic and international trainings or seminars to improve the waste management knowledge and skills
・ Support for implementing of long-term facility development and its soft component	Kyiv Kharkiv Dnipro	✓ Completion of clearing pre-conditions during the short and mid term

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6. Possibility of Introduction of Waste to Energy Plant

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JICA's Tentative Guideline for Introduction of WTE

- JICA has been developing a tentative guideline for the introduction of waste-to-energy (WTE) system, including the draft of pre-checklist.
- In Draft Pre-checklist, evaluation items are set by six different categories, which are 1) social conditions, 2) understanding by residence, 3) institutional aspect, 4) governance capability of government, 5) financial aspect, 6) technical aspect.
- Each evaluation items under six categories were scored with five different levels from "low" to "high" and valued from "0" to "4", and integrated by each category, considering the importance level of evaluation items.
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JICA's Pre-Checklist for Introduction of WTE

Classification	Evaluation Item	Importance
1) Social conditions	(1) Target city population	Most important
	(2) Social needs	Inportant
	(3) Development status of social infrastructure pertaining to environmental sanitation	Recommended
	(4) Integration of environmental and social considerations	Recommended
2) Understanding of residents	(1) Cooperation of residents in waste sorting	Most important
	(2) Understanding of residents about WtE	Most important
3) Institutional aspect	(1) Development of laws, enforcement orders and rules	Most important
	(2) Stability of administrative organization	Important
	(3) Adequacy of construction site	Important
4) Governance capability of the government	(1) Positioning of WtE in upper level plan	Most important
	(2) Stance of the head of local government	Most important
	(3) Performance capability of the government	Important
	(4) Technical standards and operation pertaining to selling electricity	Important
5) Financial aspect	(1) Securing of financial resources	Most important
	(2) Tipping fee	Important
	(3) Revenue by selling electricity	Important
	(4) Project scheme	Recommended
	(5) Project risks	Recommended
6) Technical aspect	(1) Collecting basic data concerning waste	Most important
	(2) Technical capacity of manufacturers	Important
	(3) Proper disposal of incineration residue (incineration ash)	Important
	(4) Environmental monitoring system	Recommended
	(5) Track record of similar facilities	Recommended
	(6) Securing of engineers	Recommended

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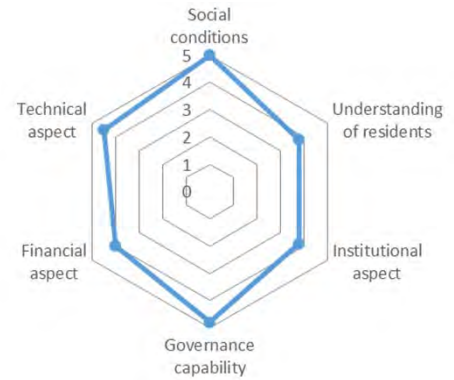
Tentative Result of Evaluation (Kyiv)



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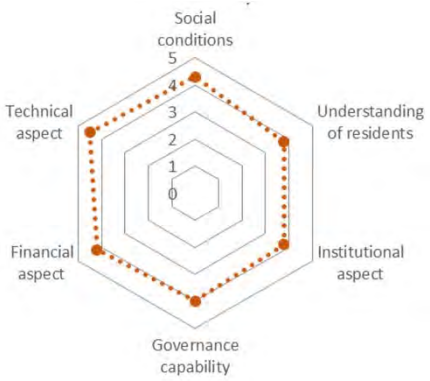
Tentative Result of Evaluation (Kharkiv)



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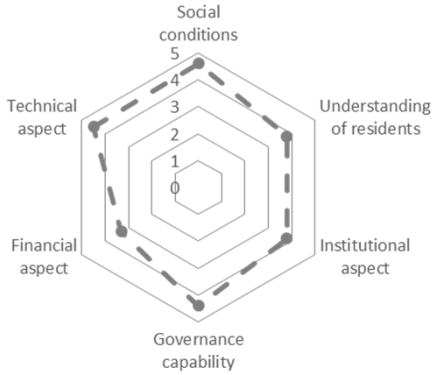
Tentative Result of Evaluation (Dnipro)



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7. Preparation of Final Report

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Preparation of Final Report

- Draft Final Report is shared with concerned organization in Ukraine in the middle of July, 2018, with brief explanation by JICA Survey Team.
- JICA Survey Team will return to Japan at the end of July.

→Please review Draft Final Report and give your comments back to the Survey Team by August 3rd.

- Based on the comments, JICA Survey Team will prepare the Final Report through discussion with JICA HQs.
- Final Report, English, Ukrainian and Japanese, will be finalized and submitted to JICA HQs in August.

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End of Report

Thank you very much for your attention!

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Appendix 4

Questionnaire

Appendix 4. Questionnaire

Question Item for Ministry	
0. General Description of the Ministry	
0-1	Organization chart of the ministries in Ukraine, with the annual budget for each ministry in the past several years.
0-2	Indication of the ministries which are related to MSWM with their general roles.
0-3	General description of your ministry with internal organization chart.
1. General Information of Ukraine	
1-1	General climate and natural conditions in Ukraine such as temperature, precipitation, geological condition, and others.
1-2	Trend of population change in the past 10 years and projection for the next 10 to 20 years in Ukraine, by gender and age group, and by region.
1-3	Trend of GDP or other economic indicators, employment no. and ratio, average income, industrial structure, economic growth ratio, literacy ratio, average life expectancy, etc., at the national level.
2. Laws, Regulation and Plan Related to MSWM	
2-1	Laws, regulation, plan, guideline, standards, or goals related to MSWM.
2-2	International laws and regulations which Ukraine will refer to, such as EU directives.
2-3	Development plan or strategy.
2-4	Regulations and directives under EU related to MSWM that Ukraine will have to comply with as a condition for becoming a member of EU in the future.
3. Implementation Structures on MSWM	
3-1	Organization chart of Ukraine, oblast, city.
3-2	Relationships, demarcation and task allocation of national, state, and municipal governments related to MSWM.
3-3	Inter-municipal relationship to share the experiences or to support each other, if any.
4. Municipal Solid Waste Matters	
4-1	Generation quantity and quality.
4-1-1	Amount of waste generation per day in Ukraine. (by type of waste such as municipal waste, industrial waste)
4-1-2	Physical composition and chemical property of municipal waste.
4-2	Nationwide public awareness on MSWM.
4-3	Overview of the financial requirement for MSW management in Ukraine and sufficiency of financial resources.
5. Waste Treatment and Energy Recovery	
5-1	Any regulations, guidelines, procedures or other documents related to energy policy including renewable energy (RE)
5-2	Regulations on energy (heat and electricity) recovery and heat supply
5-2-1	Any regulations, guidelines to promote RE including "energy recovery from waste" and "biomass energy." (e.g., Feed-in Tariff for RE, purchase obligation for grid operators, incentives for RE project, etc.)
5-2-2	Any regulations, guidelines, procedures or other documents related to ordinary heat supply by boiler facility.
6. Project Implementation Method	
6-1	Any existing laws and regulations related to public private partnership (PPP) such as the Law of Ukraine "on public private partnership".
6-2	Outline of some existing projects operated under PPP in Ukraine.
6-3	Please explain about project implementation procedure in Ukraine and provide relevant documents. We understand that a project must obtain Stage P and Stage R approvals before commencement of the construction.
7. Environmental and Social Consideration	
7-1	Regulations, standards, and policies related to environmental impact assessment, information

Question Item for Ministry	
	disclosure, resettlement of residents, and land acquisition.
7-2	Number of waste pickers.
8. Assistance by Other Donors	
8-1	Any experiences in the past and ongoing plans related to solid waste management assisted by foreign donors or private sectors including NGOs.
9. Interested Field in Japan's MSWM Experiences	
9-1	Please choose five fields you are interested in about Japan's experiences from the following:

Question Item for Oblast	
1. General Information	
1-1	General climate and natural conditions in Ukraine such as temperature, precipitation, geological condition, and others.
1-2	Trend of population change in past the 10 years and projection for the next 10 to 20 years in Ukraine, by gender and age group, and by region.
1-3	Trend of GDP or other economic indicators, employment no. and ratio, average income, industrial structure, economic growth ratio, literacy ratio, average life expectancy, etc., at the national level.
2. Laws, Regulation, and Plan Related to MSWM	
2-1	Laws, regulation, plan, guideline, standards, or goals related to MSWM.
2-2	Municipal development plan or strategy of the oblast.
3. Implementation Structures on MSWM	
3-1	Organization chart of Ukraine, oblast, city.
3-2	Relationships, demarcation, and task allocation of national, state, and municipal governments related to MSWM.
3-3	Inter-municipal relationship to share the experiences or to support each other, if any.
4. Waste Treatment and Energy Recovery	
4-1	Any regulations, guidelines, procedures or other documents related to energy policy including renewable energy (RE).
4-2	Regulations on energy (heat and electricity) recovery and heat supply.
4-2-1	Any regulations, guidelines to promote RE including "energy recovery from waste" and "biomass energy." (e.g. Feed-in Tariff for RE, purchase obligation for grid operators, incentives for RE project, etc.)
4-2-2	Any regulations, guidelines, procedures or other documents related to ordinary heat supply by boiler facility.
5. Project Implementation Method	
5-1	Any existing laws and regulations related to public private partnership (PPP) such as the Law of Ukraine "on public private partnership".
5-2	Outline of some existing projects operated under PPP in the State of Kyiv.
6. Assistance by Other Donors	
6-1	Any experiences in the past and ongoing plans related to solid waste management assisted by foreign donors or private sectors including NGOs.
7. Interested Field in Japan's MSWM Experiences	
7-1	Please choose five fields you are interested in about Japan's experiences from the following:

Question Item for City	
1. General Information	
1-1	General climate and natural conditions in Ukraine such as temperature, precipitation, geological condition, and others.
1-2	Trend of population change in the past 10 years and projection for the next 10 to 20 years in Ukraine, by gender and age group, and by region.
1-3	Trend of GDP or other economic indicators, employment no. and ratio, average income, industrial structure, economic growth ratio, literacy ratio, average life expectancy, etc., at the national level.
1-4	Status of power supply; status of water supply; status of sewer collection/treatment
2. Laws, Regulation and Plan related to MSWM	
2-1	Laws, regulation, plan, guideline, standards, or goals related to MSWM.
2-2	Municipal development plan or strategy of the city.
3. Implementation Structures on MSWM	
3-1	Organization chart of Ukraine, oblast, city.
3-2	Relationships, demarcation and task allocation of national, state, and municipal governments related to MSWM.
3-3	Inter-municipal relationship to share the experiences or to support each other, if any.
4. Municipal Solid Waste Matters	
4-1	Generation quantity and quality.
4-1-1	Latest data for the daily amount of waste generated, record of annual amount of waste in the past 10 years, and monthly amount in each month. (by type of waste: municipal waste, industrial waste, other waste)
4-1-2	Physical composition and chemical property of municipal waste.
4-1-3	Current rules of waste segregation such as target items and coverage area. In addition, what is the current situation at household and business levels, good or bad?
4-2	The list of service provider for MSWM: name of provider, kind of service such as collection and transportation, intermediate treatment, recycling, and final disposal.
4-3	Collection and transportation.
4-3-1	The collection of municipal waste is done by: municipality, private sector, or others?
4-3-2	Frequency (times/week) and working time of municipal waste collection.
4-3-3	Frequency (times/week) and working time of road sweeping.
4-3-4	Collection rate of municipal waste (%).
4-3-5	Type of vehicle(s) and other equipment used to collect the waste: compactor truck, dump truck, container loader, etc.
4-3-6	Capacity and location of waste transfer station (if any).
4-3-7	Cost information.
4-4	Intermediate treatment and recycling
4-4-1	Existing municipal waste recycling activity: composting, valuables recovery, or others with the recent data of the recycled amount.
4-4-2	Recyclable items collected by municipality, private sector, and waste pickers.
4-4-3	Recycling companies in the surroundings of the city.
4-5	"Energia" Incineration Facility
4-5-1	Project Brief of Kyiv Energia Incineration Plant (history, capital cost, concessionaries list, contents of concession, problems, future aspect, etc.)
4-5-2	Concession agreement (agreed duration, T/F, quantity and quality of intake waste, role allocation between city and concessionaire, etc.)
4-5-3	Financial statements such as profit and loss statement (P/L), balance sheet (B/S) and cash flow (C/F) of concession companies of "Kyiv Energo (for 20xx-2018)", and other concessionaires if any.
4-5-4	Technical Information: design capacity and actual treatment capacity, adopted technologies for combustion and gas treatment, material and heat balance, environmental and technical standards

Question Item for City	
	complied, current operational problem, and so on.
4-6	Final disposal.
4-6-1	Cost information.
4-6-2	Name, location, disposal methods, area of landfill, operation years and remaining years, daily waste quantity accepted, operation structure, environmental monitoring data, and so on.
4-7	Waste management fee.
4-7-1	Existence of waste collection fee for the generators such as citizens and business establishments
4-7-2	Mechanism of waste collection fee (governing rule, unit price, target generation sources, collectors, collection way, etc.), if any.
4-8	Any indicators related to the social needs for the introduction of waste to energy system such as public complaint on the overflow of the existing landfill or shortage of heat or electricity in the region. Public's understanding of waste to energy plant:
4-9	3R, environmental education, and public awareness
4-9-1	Outline of current environmental education and awareness raising activity.
4-9-2	NGOs and other actors conducting 3R-related campaigns.
4-9-3	Other actors involved in municipal SWM (other than collection, transportation, recycling, and environmental education and awareness raising)
4-10	In addition to Q 4-8, any other information related to public opinions against MSWM such as the records of public hearing meetings, if any.
4-11	Financial matters.
4-11-1	Please share financial statements such as P/L, B/S and C/F of the city of Kyiv in the past five years.
4-11-2	Waste related budget (such as collection, transportation, energy recovery, and final disposal).
5. Waste Treatment and Energy Recovery	
5-1	Any regulations, guidelines, procedures, or other documents related to energy policy including renewable energy (RE).
5-2	Regulations on energy (heat and electricity) recovery and heat supply.
5-2-1	Any regulations, guidelines to promote RE including "energy recovery from waste" and "biomass energy." (e.g. Feed-in Tariff for RE, purchase obligation for grid operators, incentives for RE project, etc.)
5-2-2	Any regulations, guidelines, procedures or other documents related to ordinary heat supply by boiler facility.
5-3	Development plan of MSW incinerator and other plant.
5-3-1	New or renew construction plan of waste to energy plants, results of feasibility study for the plan, progress of approval process.
5-3-2	Existing development plan: any development plan to introduce waste to energy system by public investment or private investment.
5-3-3	Any development plans for facilities related to SWM: kind of facilities, daily capacity, schedule.
5-4	Term of municipal chief (mayor) Intention of municipal chief on introduction of waste to energy system.
6. Project Implementation Method	
6-1	Any existing laws and regulations related to public private partnership (PPP) such as the Law of Ukraine "on public private partnership"
6-2	Outline of some existing projects operated under PPP in Ukraine.
7. Environmental and Social Consideration	
7-1	Regulations, standards, and policies related to environmental impact assessment, information disclosure, resettlement of residents, and land acquisition
7-2	Number of waste pickers.
7-3	For the candidate site for future development of MSWM facility such as a new landfill.
8. Assistance by Other Donors	
8-1	Any experiences in the past and ongoing plans related to solid waste management assisted by

Question Item for City	
	foreign donors or private sectors including NGOs.
9. Interested Field in Japan's MSWM Experiences	
9-1	Please choose five fields you are interested in about Japan's experiences from the following:

Appendix 5

Waste Composition Survey

Appendix 5. Waste Composition Survey

1. Introduction

Analysis of composition and characteristics of municipal waste are necessary to examine waste treatment options. Sampling, field analysis and laboratory analysis were conducted in Kyiv City, Kharkiv City and Dnipro City.

2. Survey Method

2.1 Specification of Waste Composition and Quality Analysis

Item	Specification
Survey duration	Field measurement: March 2018 (Kharkiv and Dnipro), May 2018 (Kyiv) Laboratory analysis: March to April 2018 (Kharkiv and Dnipro), May to June 2018 (Kyiv)
Target waste	Municipal solid waste of 1 day during the weekday
Sampling location	Municipal waste landfill sites
Analysis location	Field measurement at landfill sites by the JICA Survey Team ・ Preparation of sample, weight per unit volume, waste composition Laboratory analysis by Eurofins Ukraine (sent to laboratory in Germany) ・ three components (moisture, ash, combustible), gross calorific value, six elements (C, H, O, N, S, Cl)

Source: JICA Survey Team

2.2 Sampling for Analysis

Sampling	Contraction	Weight per Unit Volume	Waste Composition	Waste Quality Analysis
JICA Team	JICA Team	JICA Team	JICA Team	Sub-contract
200 kg	200 kg → over 30 kg	Over 30 kg	Over 30 kg	5 kg
Waste sample was collected directly from municipal waste collection vehicles at the landfill sites.	Waste sample was contracted by conical quartering at the sites.	Measurement of weight per unit at the sites	Measurement of waste composition at the sites	3 components, gross calorific value and element composition was analyzed at laboratory.

Source: JICA Survey Team

Methodology of Sampling: 200KG in total for each sample

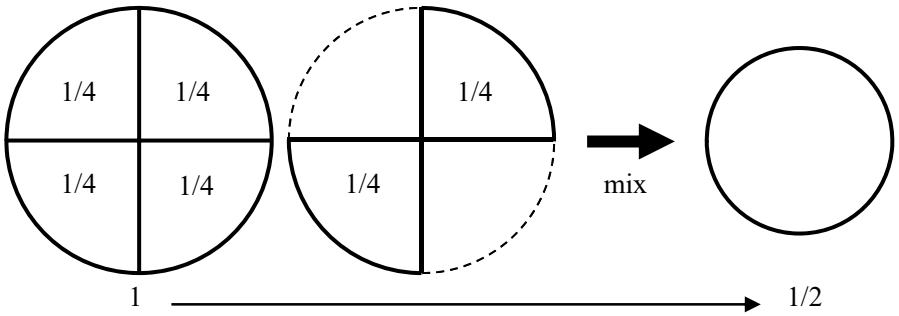
① Find and identify a vehicle carrying target waste, with assistance by a landfill staff.
② To direct a vehicle to working space at landfill.
③ To collect about 200 kg of typical waste sample from waste cargo on truck bed.

Preparation of sample: Conical quartering

① 200 kg of collected waste sample was cut into approx. 15 cm pieces by shovels and scissors and be agitated by shovels to be uniformized.
② The uniformized waste sample was reduced into above 30 kg by repeating conical quartering more than two times.

< Conical quartering >

1) Form mixed waste into a flat circle.
2) Divide it into four even quarters and separate them from each other.
3) Remove two opposite quarters and mix the two remaining quarters together again.
4) Repeat this process until a sample of the required size is obtained.



2.3 Field analysis

Sampling	Contraction	Weight per Unit Volume	Waste Composition	Waste Quality Analysis
JICA Team	JICA Team	JICA Team	JICA Team	Sub-contract
200 kg	200 kg → over 30 kg	Over 30 kg	Over 30 kg	5 kg
Waste sample was collected directly from municipal waste collection vehicles at the landfill sites.	Waste sample was contracted by conical quartering at the sites.	Measurement of weight per unit at the sites	Measurement of waste composition at the sites	3 components, gross calorific value and element composition was analyzed at laboratory.

Source: JICA Survey Team

Weight Per Unit Volume

① After preparation, lightly put sample waste into a bucket whose volume is already known, but not press it into the bucket.
② Drop the bucket horizontally from 30cm height, then fill up the space made by decreased volume with sample waste. Repeat this process three times.
③ Measure weight of the sample waste.
④ Calculate Weight per Unit Volume using equation below.

Weight per Unit Volume (kg/L = t/m^3)
= { Total Weight (kg) - Bucket Weight (kg) } / {Bucket Volume (kg)}

Determination of the Composition of Waste

① After sample preparation, spread out 30 kg of sample waste on plastic sheet.
② Segregate it into 10 categories as follows.
A) Papers
B) Kitchen wastes (Food residuals, meats, vegetables, eggs and shells)
C) Woods (including straws and leaves)
D) Clothes
E) Plastics
F) Rubbers and leathers
G) Metals
H) Glasses
I) Crockery (Earthen ware) and Stones
J) Others (small and/or unclassifiable materials)
③ Calculate parameters using equations below.

$$\text{Composition (Wet base)}(\%) = \frac{\text{Weight of each category(kg)}}{\text{Total weight (kg)}} \times 100$$

$$\text{Combustible (Wet base)}(\%) = \frac{\text{Total weight of A to F (kg)}}{\text{Total weight (kg)}} \times 100$$

$$\text{Degradable (Wet base)}(\%) = \frac{\text{Total weight of A, B and C (kg)}}{\text{Total weight(kg)}} \times 100$$

2.4 Packing of samples for laboratory analysis

① Sample for laboratory analysis shall be prepared with segregated samples of A to J and weight of each composition sample should be proportionally calculated by composition percentage calculated above to be 5 kg in per total sample.

② The samples packed in plastic will be kept in another thick plastic bag (dark color) and put it a plastic box, then it will be sent to the laboratory by courier service (Nova Poscha).

2.5 Laboratory Analysis

Samples should be prepared for laboratory analysis. The parameters as follows were analyzed at the subcontracted laboratory.

Parameters for Laboratory Analysis and their Analysis Methods

#	Parameters	Unit	Method Based on
01	Total Moisture	%	DIN EN 14346, Method A
02	Ash Content	%	DIN 51719
03	Volatile Mater (Combustible)	%	DIN EN 15169: 2007-05
04	Gross Calorific Value	kcal/kg	DIN CEN/TS 16023, DIN SPEC 19524
05	Total Sulphur	%	DIN 51724-3: 2012-07
06	Carbon	%	DIN EN 15407: 2011-05
07	Nitrogen	%	DIN EN 15407
08	Oxygen	%	analog DIN EN ISO 16993: 2016-11
09	Hydrogen	%	DIN EN 15407
10	Chlorine	%	DIN EN 14582

Source: JICA Survey Team

3. Result of Waste Composition Survey and Chemical Analysis

3.1 Kyiv City

Physical Composition of MSW in Kyiv City (2018)

No.	Category	Composition (%)
1	Papers	13.5
2	Kitchen wastes	44.0
3	Woods	2.3
4	Cloths	3.3
5	Plastics	21.5
6	Rubbers and leathers	1.5
7	Metals	1.4
8	Glasses	9.5
9	Crockery and stones	1.2
10	Others	1.8
	Total	100.0

Source: JICA Survey Team

Chemical Composition of MSW in Kyiv City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	2,844	5,067
2	Moisture content	%	43.9	-
3	Ash content	%	7.8	14
4	Loss on ignition	%	48.4	86.2
5	Carbon	%	27	48
6	Hydrogen	%	3.8	6.7
7	Oxygen	%	17	30
8	Nitrogen	%	0.37	0.65
9	Chlorine	%	0.374	0.666
10	Sulphur	%	0.12	0.21

Source: JICA Survey Team

3.2 Kharkiv City

Physical Composition of MSW in Kharkiv City (2018)

No.	Category	Composition (%)
1	Papers	13.3
2	Kitchen wastes	50.8
3	Woods	1.3
4	Cloths	3.3
5	Plastics	11.6
6	Rubbers and leathers	2.8
7	Metals	0.9
8	Glasses	10.5
9	Crockery and stones	1.7
10	Others	3.8
	Total	100.0

Source: JICA Survey Team

Chemical Composition of MSW in Kharkiv City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	3,872	5,354
2	Moisture content	%	27.8	-
3	Ash content	%	6.8	9.4
4	Loss on ignition	%	65.4	90.6
5	Carbon	%	37	52
6	Hydrogen	%	4.6	6.4
7	Oxygen	%	22	31
8	Nitrogen	%	0.69	0.96
9	Chlorine	%	0.507	0.702
10	Sulphur	%	0.17	0.24

Source: JICA Survey Team

3.3 Dnipro City

Physical Composition of MSW in Dnipro City (2018)

No.	Category	Composition (%)
1	Papers	9.0
2	Kitchen wastes	46.5
3	Woods	0.4
4	Cloths	1.8
5	Plastics	20.4
6	Rubbers and leathers	0.3
7	Metals	1.3
8	Glasses	9.2
9	Crockery and stones	0.7
10	Others	10.4
	Total	100.0

Source: JICA Survey Team

Chemical Composition of MSW in Dnipro City (2018)

No.	Parameter	Unit	Raw	Dry
1	Gross calorific value	kcal/kg	2,486	4,541
2	Moisture content	%	45.2	-
3	Ash content	%	8.6	16
4	Loss on ignition	%	46.2	84.3
5	Carbon	%	27	50
6	Hydrogen	%	3.7	6.8
7	Oxygen	%	15	27
8	Nitrogen	%	0.44	0.80
9	Chlorine	%	0.234	0.427
10	Sulphur	%	0.13	0.24

Source: JICA Survey Team

4. Scenery of Waste Composition Survey

Target waste (over 200 kg of municipal waste was taken from waste collection trucks)

Mixing (waste in plastic bags was taken out and all the waste was mixed well)

Conical quartering (over 30 kg of waste was remained for segregation)

Measurement of bulk density of waste

Segregation (waste was segregated into 10 categories)

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kyiv City (1/3)

Paper

Kitchen waste

Wood and leaves

Cloth and textile

Plastic

Rubber and leather

Metal

Glass

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kyiv City (2/3)

Crockery and stone

Others (diapers, napkins, cigarettes, medical waste)

Measurement of physical composition of waste

Sample preparation for laboratory test

Sample for laboratory test

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kyiv City (3/3)

Target waste (over 200 kg of municipal waste was taken from waste collection trucks)

Mixing (waste in plastic bags was taken out and all the waste was mixed well)

Conical quartering (over 30 kg of waste was remained for segregation)

Measurement of bulk density of waste

Segregation (waste was segregated into 10 categories)

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kharkiv City (1/3)

Paper

Kitchen waste

Wood and leaves

Cloth and textile

Plastic

Rubber and leather

Metal

Glass

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kharkiv City (2/3)

Crockery and stone

Others (diapers, napkins, cigarettes)

Measurement of physical composition of waste

Sample preparation for laboratory test

Sample for laboratory test

Source: JICA Survey Team

Scenery of Waste Composition Survey in Kharkiv City (3/3)

Target waste (over 200 kg of municipal waste was taken from waste collection trucks)

Mixing (waste in plastic bags was taken out and all of it was mixed well)

Conical quartering (over 50 kg of waste remained for segregation)

Measurement of bulk density of waste

Segregation (waste was segregated into 10 categories)

Source: JICA Survey Team

Scenery of Waste Composition Survey in Dnipro City (1/3)

Paper

Kitchen waste

Wood and leaves

Cloth and textile

Plastic

Rubber and leather

Metal

Glass

Source: JICA Survey Team

Scenery of Waste Composition Survey in Dnipro City (2/3)

Crockery and stone

Others (mostly diapers)

Measurement of physical composition of waste

Sample preparation for laboratory test

Sample for laboratory test

Source: JICA Survey Team

Scenery of Waste Composition Survey in Dnipro City (3/3)

Appendix 6

Solid Waste Management Seminar

- ☐ ***Agenda of Solid Waste Management Seminar***
- ☐ ***Attendant list***
- ☐ ***Presentation Materials***
  - ***Tentative Result of JICA Survey***
  - ***Outline of new National Waste Management Strategy and status of development of National Waste Management Plan***
  - ***Historical Footsteps of Solid Waste Management and Experience of Japan***
  - ***Introduction of JICA Assistance Schemes***

Agenda of Solid Waste Management Seminar

As of 31 May

Date	Venue
1 June, 2018	**Aarhus center** at the premises of the Ministry of ecology and natural resources of Ukraine Address: Kyiv City, 35, Vasyl Lypkivskyi str.

Invited Participants (20 to 40 people)

- ✓ Ministry of Ecology and Natural Resources
- ✓ Ministry of Regional Development, Construction, Housing and Communal Services
- ✓ Ministry of Economic Development and Trade
- ✓ State Agency of Energy Efficiency and Energy Saving
- ✓ EBRD
- ✓ GIZ
- ✓ WB
- ✓ Kyiv City State Administration
- ✓ Kyivcomunservise
- ✓ Kyivenego/ Energia Plant
- ✓ Kyivspetstrans
- ✓ Kyiv Oblast State Administration
- ✓ Dnipro City Counsel
- ✓ Kharkiv Oblast
- ✓ JICA Ukraine Office
- ✓ JICA Survey Team

Time	Content	Presenter
10:00-10:10	Opening	Related Ukrainian Authorities, JICA Ukraine Office
10:10-10:20	Self-Introduction	All participants
10:20-11:00	Outline of the JICA Survey Current Situation of Waste Management in Kyiv, Kharkiv and Dnipro	JICA Survey Team (Mr. Soeda)
11:00-11:30	Outline of National Waste Management Strategy, Status of development of National Waste Management Plan and concerned Laws.	Ministry of Ecology and Natural Resources
11:30-11:45	Tea Break	
11:45-12:30	Japanese Experiences and Waste to Energy Technology	JICA Survey Team (Mr. Fujiyoshi)
12:30-13:00	Introduction of JICA Assistance Schemes	JICA Survey Team (Mr. Soeda)
13:00-13:30	Questions and Answers, Discussions	All Participants
13:30-13:40	Closing	Same as Opening

Source: JICA Survey Team

Attendant list/ Список учасників

Date: 1st June 2018
Venue/ Місце проведення: Aarhus center at the premises of the Ministry of ecology and natural resources of Ukraine
Subject/ Тема семінару: JICA Solid Waste Management Seminar

No.	Name/ Ім'я	Organiztion/ Організація	Position/ Посада
1	Mr. Anatolii Kutsevol	MoENR	Director-Reform Support Team
2	Mr. Oleksandr Semenets	MoENR	Deputy Head-Environmental Safety & licensing Activity Dept./Head-Waste Management & Environmental Safety Division
3	Ms. Sierova Galyna	Aarhus Centre/MoENR	Director, galina_serova@ukr.net
4	Ms. Poltorachenko Liudmyla	MoRCHCS	Deputy Director of Management office for development of territory and municipal services, Head of household waste handling Division,
5	Ms. Azarkhina O.K.	RST MoENR	Communication specialist
6	Mr.Globyn V.B.	MoRDCHCS	STATE ENTERPRISE "SCIENTIFIS-RESEARCH AND DESIGN-TECHNOLOGICAL INSTITUTE OF CITY HOUSEHOLD"
7	Ms. Natalia	MoENR	
8	Ms. Diana NOVIKOVA	MoRDCHCS	Chief specialist
9	Olexander Chernykh	MoEDT	Director of Industrial Policy Department
10	Minitska Olena	MoEDT	Head of division for development of processing field of industry
11	Kostiantyn Gura	SAEE	Acting Director
12	Oleksandr MALYKHIN	City of Kyiv	Deputy Director of the Department - Head of Housing and Communal Policy Management Office of DHCI
13	Marina ZHYLKA	City of Kyiv	Head of the Division of Sanitary Cleaning and Engineering Protection of the territory, of Housing and Communal Policy Management Office of DHCI
14	DVORETSKA Tetiana Borysivna	City of Kyiv	Management office of Ecology and Natural Resources of the executive body of the Kyiv City Council (Kyiv City State Administration), Chief Specialist of the Division of Nature Management and Control
15	TKALICH Hanna Ivanivna	Kyiv Oblast	Deputy director of the Department of Ecology and Natural Resourses; Head of Management office for nature use economics and waste management

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16	MOVCHAN Sergii Sergijovych	Kyiv Oblast	Head of division for waste management
17	KORETSKA Ruslana Olehivna	Kyiv Oblast	Head of unit (sector) for information support and public relations
18	Vyacheslav SAVTSKYI	Kyivcomunservise	Deputy director of Communal Enterprise "Kyivkomunservis"
19	Serhii KRYKUN	Kyivenego/ Energia Plant	Director of the branch "Zavod Energia"
20	Kostiantyn VASYLIEV	Kyivenego/ Energia Plant	Leading Specialist from the divisiom of Ecology and Analysis of Equipment Operation of PJSC "Kyivenergo"
21	Fateiev Denis Yuriyevich	Dnipro City	Chief Engineer of Communal Enterprise ` Eko-Dnipro
22	Tatjana Anischuk	GIZ	Deputy Project Director
23	Oleksandr Kislitsyn	GIZ	
24	Hanna BYKOVA	Kharkiv Oblast	Deputy Director of the Department of Housing and Communal Services and Infrastructure Development of the Kharkiv Regional State Administration - Head of the division of Construction, Road Complex and Improvement in the Housing and Communal Services.
25	Ms. Vuhovska G.P.	State Ecology Academy	State Ecology Academy of Postgraduate Education and Management, Head of the Department of Environmental Safety
26	Takaaki KAWANO	JICA Ukraine Office	Resident Representative

Tentative Result of JICA Survey

Information Collection and Verification Survey for Municipal Solid Waste Management in Ukraine

Solid Waste Management Seminar

Tentative Result of JICA Survey

- Current SWM Situations at Target Cities -

1 June 2018

JICA Survey Team

JICA

NIPPON KOEI

Contents

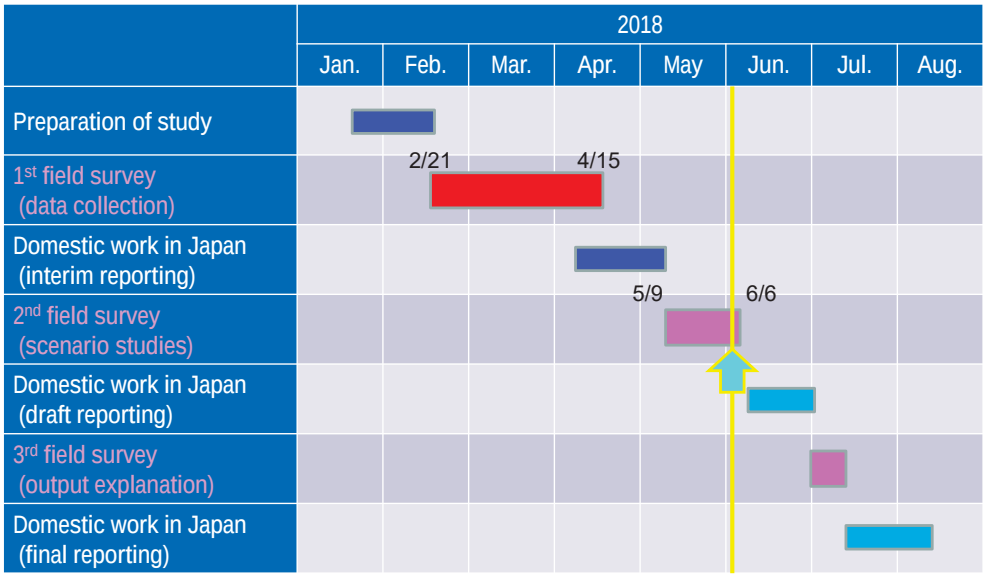
Outline of Survey

Objectives

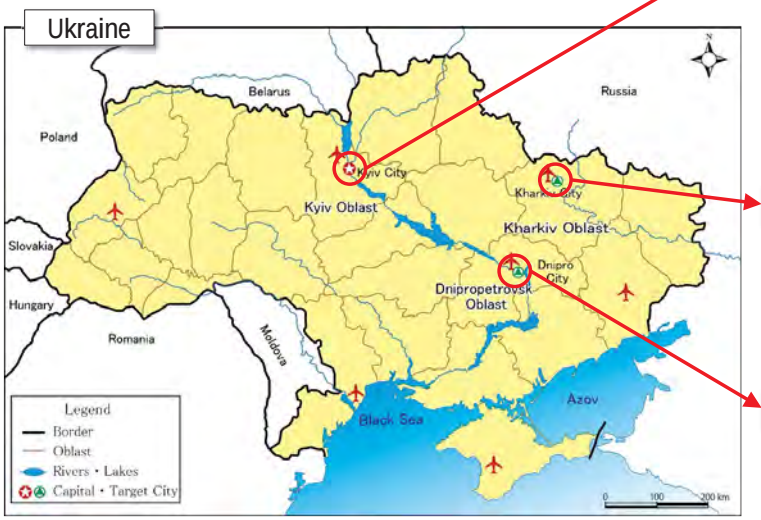
1. To collect basic information about current solid waste management (SWM) systems, focusing MSW for its generation, collection, transportation, intermediate treatment/recycling, final disposal as well as financial systems for SWM, general situation in Ukraine and specific situation at three target cities; and
2. Based on the results above,

1) to analyze current plans of the national, state and municipal government;
2) to identify specific needs;
3) to study necessity and validity of introduction of waste treatment facility such as waste to energy plant;
4) to select priority project(s); and
5) to clarify the preconditions to be satisfied to proceed to conduct the further studies of selected priority project(s).

Current status of survey



Target cities visited during the survey



Kyiv

Kick-Off
2/21 – 2/26
Survey
3/4 – 3/17
4/1 – 4/15
5/10 – 5/18
5/29 – 6/6

Kharkiv

Kick-Off
3/1 – 3/3
Survey
3/25 – 3/31
5/21 – 5/22

Dnipro

Kick-Off
2/27 – 2/28
Survey
3/18 – 3/24
5/23 – 5/25

Meetings and surveys conducted

Classification	Concerned organization and activities
Ministry	• Ministry of Ecology and Natural Resources (MENR) • Ministry of Regional Development, Construction, Housing, and Communal Services (MRDCHCS) • Ministry of Economic Development and Trades (MEDT) • State Agency on Energy Efficiency and Energy Savings
Kyiv	• Kyiv Oblast State Administration • Kyiv City State Administration, *Kyiv Communal Service (KKS), Energia Incineration Plant, Kyivspetstrans, Kompania Eko Stok*
Kharkiv	• Kharkiv Oblast State Administration • Kharkiv City State Administration, *Municipal Enterprise of Complex on Municipal Waste Removal (KVBO), Municipal Company for Solid Waste Management (MKPV)*
Dnipro	• Dnipropetrovsk Oblast State Administration • Dnipro City State Administration, *EcoDnipro*
Donner	• EBRD, GIZ

Survey methods conducted

Questionnaire survey

- The questionnaire sheets, which covers all the survey items for the different governmental levels, ministry level, oblast level, and city level, were prepared and distributed to obtain the answers.

Interview survey

- Specific meetings for interview survey with the organizations and the persons in-charge of solid waste management were conducted based on the questionnaire.

Field visit

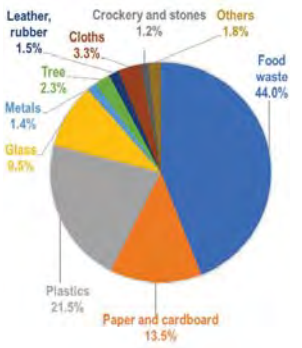
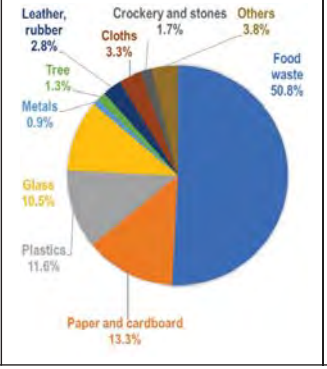
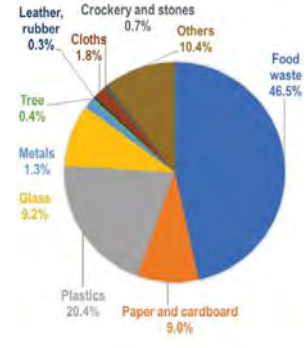
- Field visits were conducted at the waste collection including the garage, sorting facility, incineration facility, and final disposal site.

Waste composition survey

- Waste sampling and classification was completed.

Appendix 6

Result of Waste Composition Survey (only for reference)

Kyiv (May 15)	Kharkiv (March 29)	Dnipro (March 23)
		
		

Tentative Result of Survey

General in Ukraine

Municipal Solid Waste Management in Ukraine

Category	Situations
Generation	• Approximately 49 million m3 ,or 11 million tons of municipal waste was generated in 2016, means about 0.03 m3 or 685 gram generated per day • Waste generation increases, though population decreased
Collection	• Over 78% of the population is covered by the municipal waste collection services • 822 settlement implement the segregated waste collection
Recycling	• Only 3.09% of waste is recycled • There are more than 25 waste sorting lines
Incineration	• 2.71 % of waste is incinerated at the facility • Only one incinerator is still been operating in Kyiv
Final Disposal	• There are more than 5.5 thousand landfills and dumping sites
Tariff	• The average tariff for the municipal waste management in the country is about UAH 65.3 / m3, including for dumping - UAH 19.45 / m3.

Source: JICA Survey Team based on Questionnaire Survey

National Waste Management Strategy

- "National Waste Management Strategy" was approved on November 2017, which aims to establish a circular economy in Ukraine.
- <u>Waste Management Hierarchy:</u>

  1) Prevention → 2) Reuse → 3) Recycling (material recover) →

  4) Treatment (energy recover) → 5) Final Disposal
- Target indicators of implementation of the strategy are set for the short- (2017-2018), medium- (2019-2023), and long-term (2024-2030).

Appendix 6

Source: http://eco.ck.ua/docs/Prezentazja_Strategia.pdf

Target of National Solid Waste Management Strategy

Indicator	Unit	2016	2017-18	2019-23	2024-30
Segregated collection	settlement	575	800	2,500	5,000
Waste collection center	unit	-	25	100	250
Reuse rate target	%	5	7	8	10
Waste sorting facility	unit	65	100	250	800
Composting facility	unit	20	70	150	500
Recycling rate target	%	3.04	5	15	50
Thermal Treatment facility	unit	1	3	15	20
Thermal treatment rate	%	2.37	5.00	7.00	10.00
Dumping sites	unit	6,000	5,000	1,000	300
Direct landfill rate target	%	95	80	50	30
Regional landfill	unit	-	5	25	50

Source: National Waste Management Strategy

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Action Plan under Strategy

Category	Title	Target
Laws	On waste	01.03.2018
	On electronic and electrical equipment waste	01.04.2018
	On cells and batteries	
	On packaging waste	
	On domestic waste	01.06.2018
	On waste landfill	01.08.2018
	On waste incineration	
	On spent petroleum products	01.09.2018
	On decommissioned motor vehicles	
	On the management of extractive industry waste	31.12.2018
Plan	Draft of National Waste Management Action Plan	April 2018
	Agreement on National Waste Management Action Plan	June 2018

Source: Action Plan for National Waste Management Strategy

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Current Green Tariff for Renewable Energy

Power plant	Capacity of the power plant and other factors influencing the size of the 'green' tariff	Tariff for objects put into operation, €ct/kW·h		
		01.01.2017 - 31.12.2019	01.01.2020 - 31.12.2024	01.01.2025 - 31.12.2029
Wind power plant	Capacity up to 600 kW	5,82	5,17	4,52*
	Capacity from 600 kW to 2 MW	6,79	6,03	5,28*
	Capacity from 2 MW	10,18	9,05	7,92*
Solar power plant	Power stations on the surface	15,02	13,52	12,01*
	Power stations on roofs and / or facades of buildings, buildings and structures	16,37	14,75	13,09*
Bioenergy power plants	Biomass is a non-biologically biodegradable substance of organic origin, in the form of products, waste and residues. Biogas is a gas from biomass.	12,39	11,15	9,91*
Geothermal power plants	Geothermal energy	15,02	13,52	12,01*
Hydroelectric stations	Micro HPS (up to 200 kW inclusively)	17,45	15,72	13,95*
	Mini HPS (capacity from 200 kW to 1 MW)	13,94	12,55	11,15*
	Small HPS (capacity up to 10 MW inclusive)	10,45	9,42	8,35*
Power plants of private households	Solar power stations up to 30 kW	18,09	16,26	14,49*
	Wind power stations up to 30 kW	11,63	10,45	9,32*

** Before December 31, 2024, the green tariff is set in the national currency at the official exchange rate of the National Bank of Ukraine and is recalculated quarterly.*
** After December 31, 2024, the 'green' tariff will be calculated at the beginning of 2025, and remains unchanged until December 31, 2029.*

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Source: JICA Survey Team based on Questionnaire Survey to SAEE

Tentative Result of Survey

Kyiv

Appendix 6

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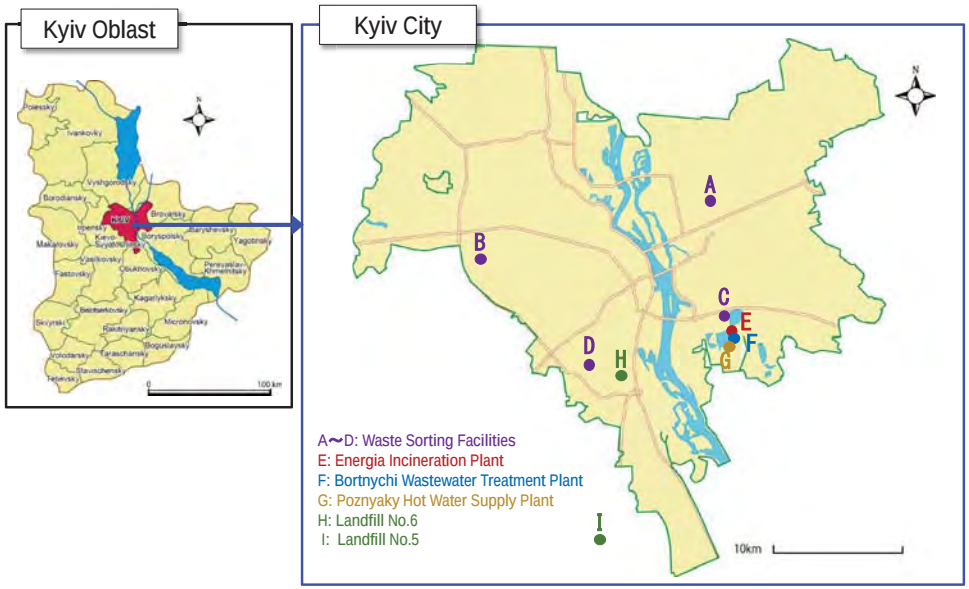
Map of major facilities in Kyiv City



Municipal Solid Waste Management in Kyiv City

Category	Situations
Generation	• Approximately 8.0 million m3 ,or 1.5 million tons of municipal waste was generated in 2018, means about 21,800 m3 or 4,000 tons generated per day.
Collection	• 100 % of the population is covered by the municipal waste collection services under the management of “Kyivkomunservis”. • Segregated waste collection has been tried to introduce.
Recycling	• There are some private companies who collect the recyclables to their sorting plant.
Incineration	• 200,000 to 260,000 tons of waste is incinerated at Energia Plant with heat recovery, annually (13 to 17% of all municipal waste).
Final Disposal	• Landfill No. 5 accepts the solid waste, while No. 6 accepts the construction waste and bulky waste, operated by Private Joint Stock Company, “Kievspetstrans”.
Tariff	• The waste removal tariff is set from UAH 74.45 to 92.78 per m3 for “Kyivkomunservis”.

Municipal Solid Waste Collection in Kyiv City (Photos)


Typical waste containers in the city


Waste collection work by service provider


Segregated waste containers


Hazardous waste container


Underground waste container

Recycling in Kyiv City


Recyclables collection point


Waste transported to sorting plant


Bundled PET bottes after sorting


Private recycling at Large Building


Recyclable Containers set at Fun zone for Final Kyiv 2018

Appendix 6

Municipal Solid Waste Collection in Kyiv City (Photos)

Weighing bridges

Unloading platform

Waste pit and crane

Rotary stoker type furnace

Heat distribution system

Ash remover

Final Disposal in Kyiv City (Photos)

Entrance of Landfill No. 5

Landfill area of Landfill No. 5

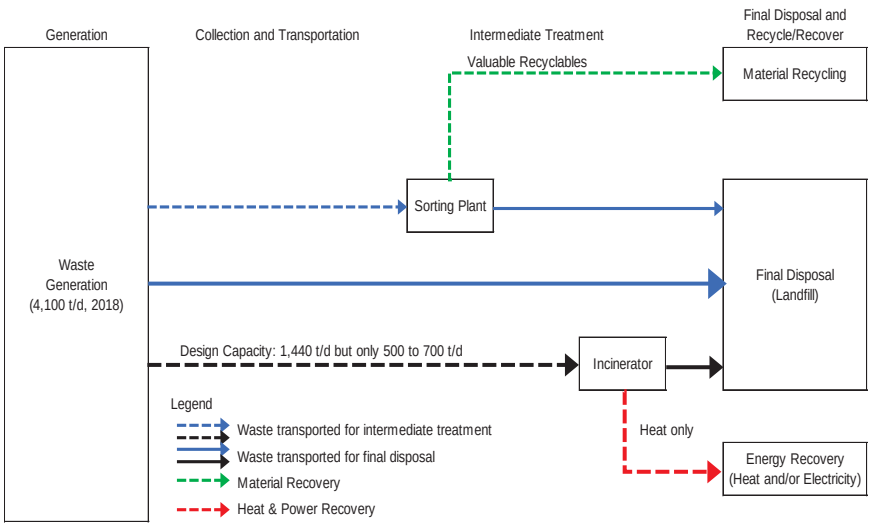
Leachate purifying facility

Entrance of Landfill No. 6

Distant view of landfill No. 6

Current Waste Flow of Kyiv City

WASTE MANAGEMENT PROCESS (KYIV CITY: 2018)



Current Waste Management Plan of Kyiv City

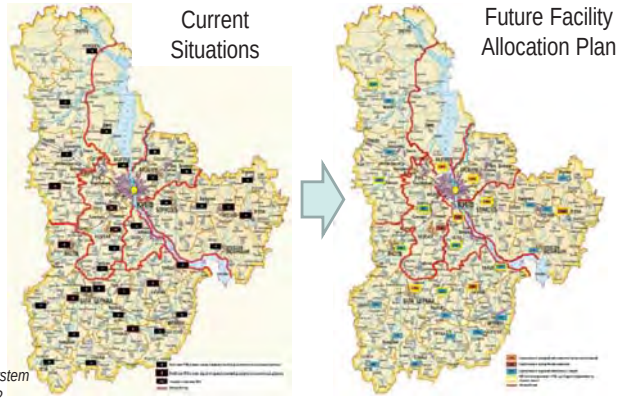
- "On Approval of Sanitary Cleaning Scheme (10 February 2014)".
- "On Approval of Complex Target Program of Energy Efficiency and Development of Housing and Communal Infrastructure of Kyiv in 2016 - 2020 and Measures for its Implementation (17 March 2016)."
- Action plan on solid waste management in Kyiv City for 2017-2025.
  - ➢ *Reconstruction and reclamation of Landfill No.5 (2017 – 2021)*
  - ➢ *Reconstruction and reclamation of Landfill No.6 (by 2019)*
  - ➢ *Improvement of gas treatment system at Energia plant (2017 – 2019)*
  - ➢ *Installation of power generation system at Energia plant (2018 – 2021)*
  - ➢ *Development of waste processing complex, if necessary (2018 – 2025)*
  - ➢ *Additional installation of heat/power recovery facility (2020 – 2025)*
  - ➢ *Installing and review the waste collection/disposal tariffs (constantly)*
  - ➢ *Improved development of segregated waste collection (constantly)*

Appendix 6

Concerned Waste Management Plan of Kyiv Oblast

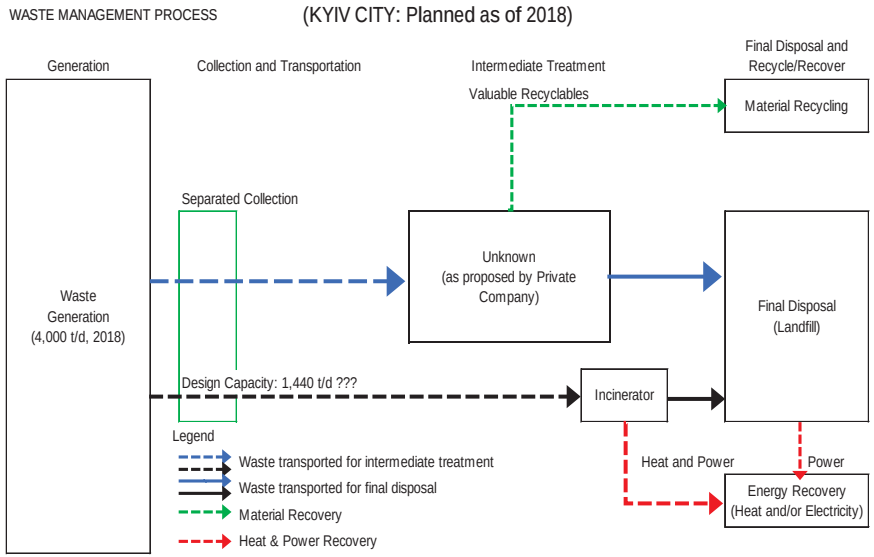
- Modern solid waste management system implementation in Kyiv Region for 2017-2022
- Municipal solid waste management program in Kyiv Region for 2017-2020

→ *Kyiv Region is divided into seven blocks, and each block has its own appropriate waste facility development plan based on each characteristics of the block, such as population, area, geological condition and road network.*



Source: Modern solid waste management system implementation in Kyiv Region for 2017-2022

Planned Waste Flow of Kyiv City as of 2018



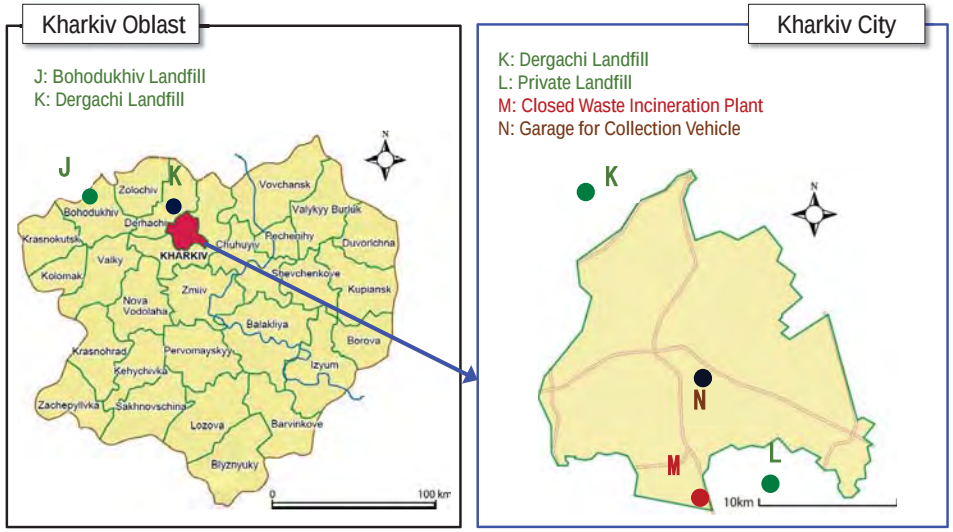
Tentatively Identified Needs of Kyiv City

1. Life-expansion or closure of Landfill No. 5
2. Closure of Landfill No.6
3. Development of new landfill(s) after the closure of No.5 and 6
4. Development of waste processing facilities to reduce the waste to be directly landfilled
5. Improvement, rebuilding or new construction of Energia incineration plant
6. Introduction and expansions of segregated waste collection, including the public awareness raising.
7. Preparation of solid waste management plan including facility development plan, following to the National Strategy

Tentative Result of Survey

Kharkiv

Map of major facilities in Kharkiv Region



Municipal Solid Waste Management in Kharkiv City

Category	Situations
Generation	• Approximately 400,000 tons of municipal solid waste was generated, means about 1,100 tons generated per day.
Collection	• About 80 % of the municipal solid waste is collected by "Municipal enterprises on municipal waste removal (KVBO)". • Remaining waste is collected by the private enterprises.
Recycling	• There are some private companies who collect the recyclables. • Waste sorting plant will be constructed by WB/IBRD project
Incineration	• There was the incineration plant but stopped its operation in late 1990's due to the high operation cost and low emission control.
Final Disposal	• Municipal landfill is located in Dergachi, and operated by "Municipal company of waste management (MKPV)". New landfill with 17 ha is under the construction by WB/IBRD project. • There is a private landfill for sourthern part of the city.
Tariff	• The waste removal tariff is set from UAH 55.56 to 79.32 per m3 for "KVBO".

Municipal Solid Waste Collection in Kharkiv City (Photos)

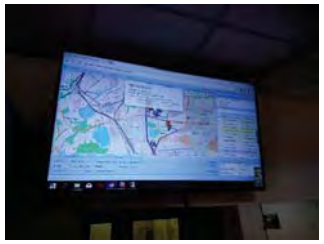
Typical waste containers in the city

Old type containers

Recyclable collection containers

Waste collection work by KVBO

New collection trucks in garage



Truck tracking system

Municipal Landfill of Kharkiv City (Photos)

Distant view of landfill area

Track scale and waste collection trucks

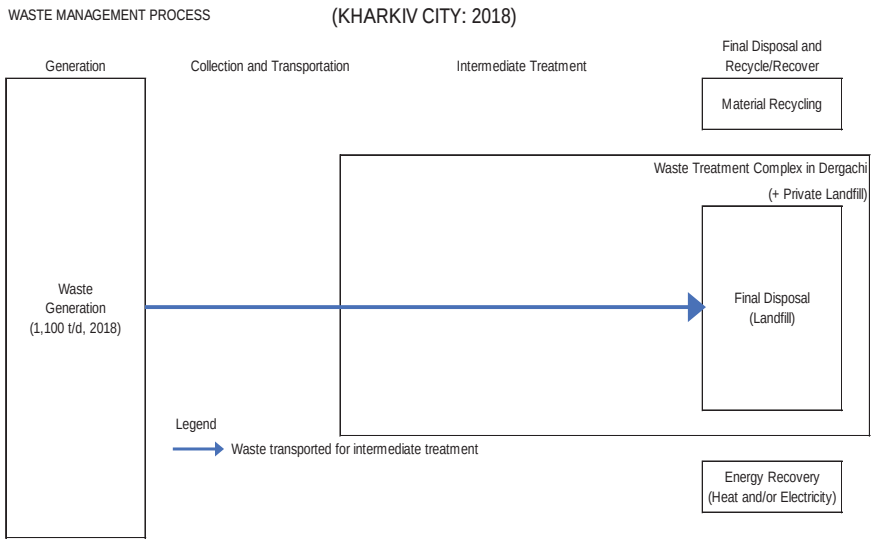
Operating area

Leachate storage pond

Land reclamation work under the WB/IBRD project

Appendix 6

Current Waste Flow of Kharkiv City



Current Waste Management Plan of Kharkiv City

- The Scheme of Sanitary Cleaning of Kharkiv for 2004-2020 (24 December 2003)".
- The Program of Development of the Solid Waste Management System in Kharkiv for 2015 – 2026 (24 December 2003)."
- Rules for Landscaping City of Kharkiv (16 November 2011)
- "Urban Infrastructure Project 2 (UIF2)" funded by the World Bank

➢ *One of the component of UIF2 is the phase one of the construction of a solid waste treatment facility for Kharkiv City beside the current municipal landfill in Dergachi City*

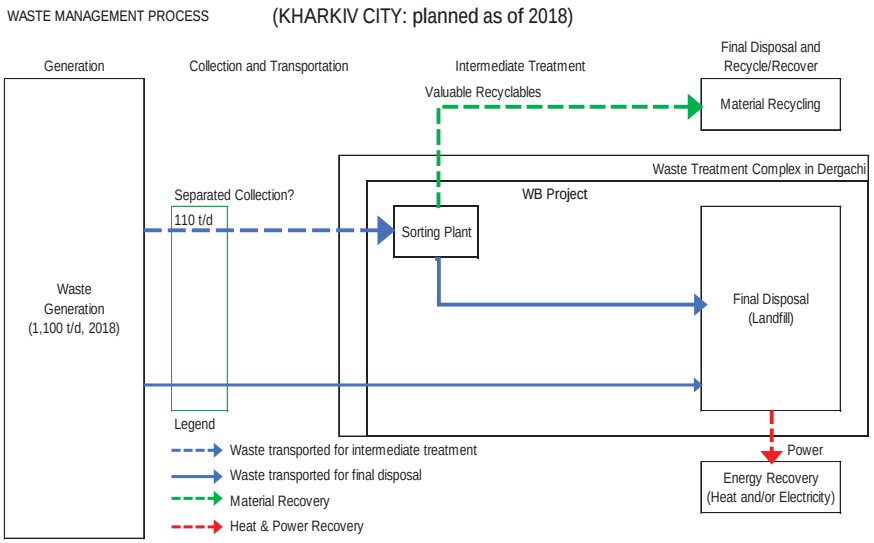
➢ *Project cost is USD 44 million for 1) New landfill, 2) waste sorting plant, 3) power plant with landfill gas and gas collection network, and 4) land preparation, within the area of 17 ha.*

➢ *Project cost is not included for the construction of the phase two in another 17 ha. It shall be invested by Kharkiv City's initiative.*

Concerned Waste Management Plan of Kharkiv Oblast

- The Kharkiv region has been implementing a complex Environmental Protection Program in Kharkiv Region for 2009-2013 and up to 2020 , approved by the decision of the Kharkiv Region Council as of 29.10.2009, No. 1413-V (including amendments). The Program has a section "Rational Usage, Storage and Utilization of Industrial and Household Wastes".
- The regional strategy "Kharkiv Region Ecology" for 2016-2020, approved by the decision of the Kharkiv Region Council as of 14.04.2016 No. 107-VII (with amendments).
- Kharkiv Oblast State Administration plans to construct 22 waste treatment complexes in the region. Two landfills are now under construction and other three are under preparation. Contents of this plan is subject to be revised based on the national waste management plan which is now under developing by the central government.

Planned Waste Flow of Kharkiv City as of 2018



Appendix 6

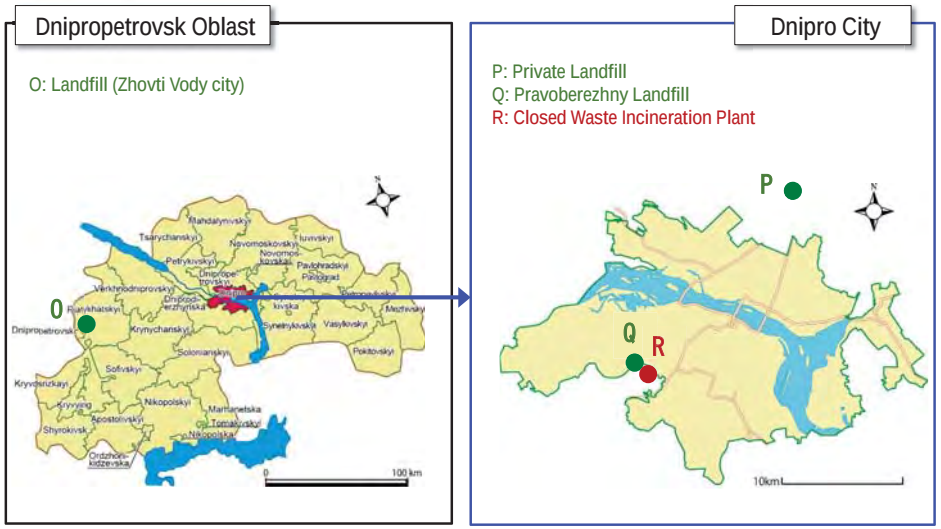
Tentatively Identified Needs of Kharkiv City

1. Introduction segregated waste collection, including the public awareness raising.
2. Efficient operation of sorting plant
3. Consideration of further waste reduction at the landfill, following to the National Strategy
4. Preparation of solid waste management plan, updating the sanitation scheme, including future facility development plan such as 2nd Phase of landfill and waste processing plant (17 ha)

Tentative Result of Survey

Dnipro

Map of major facilities in Dnipropetrovsk Region



Municipal Solid Waste Management in Dnipro City

Category	Situations
Generation	• Approximately 350,000 tons of municipal solid waste was generated, means about 960 tons generated per day.
Collection	• About 70 % of the waste was used to be collected and transported to the Right Bank Landfill by private enterprise, but is now tentatively shifting to be by the communal enterprise due to the low performance of the current contractor until the next tender. • Remaining waste is collected by the private enterprises to transport to the private landfill in the left bank.
Recycling	• There are some private companies who collect the recyclables. • Waste sorting plant is going to be constructed by "EcoDnipro". • There is the private investment plan by the British company to construct waste sorting plant and biogas plant.
Incineration	• There was the incineration plant but stopped its operation in 2012 due to the high operation cost and low emission control. • There is the private investment plan by Dnipropetrovsk Oblast.
Final Disposal	• Municipal landfill is located in Dergachi, and operated by "EcoDnipro". New landfill section # 4 is now under development. • There is a private landfill for sourthern part of the city.
Tariff	• The waste removal tariff is set from UAH 35.00 to 70.00 per m3.

Appendix 6

Municipal Solid Waste Collection in Dnipro City (Photos)

Waste Crisis due to the heavy snow on March 19, 2018

Waste collection work by Dniprokomuntrans

Interview with a private recyclables collector

New waste container without lid opening device

New waste container with lid opening device

Municipal Landfill of Dnipro City (Photos)

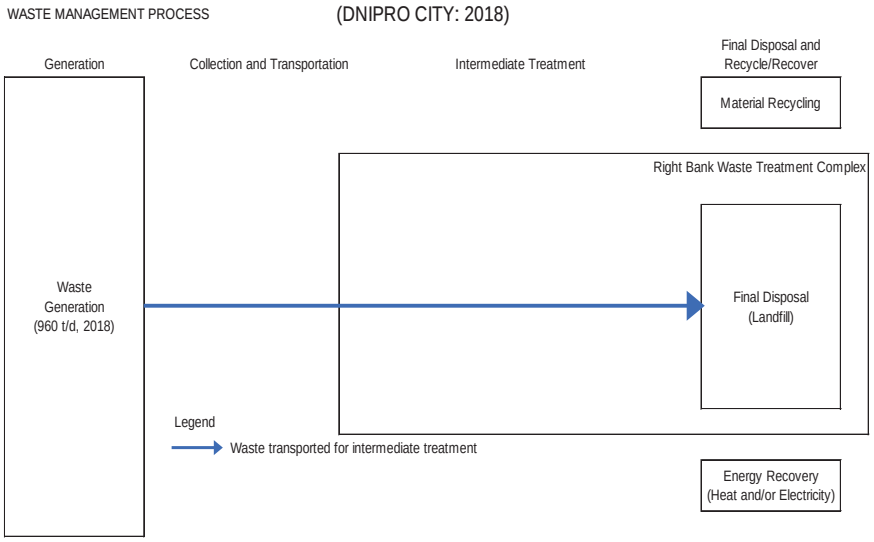
Truck scale

Signboard for Driving Route in the Site

Landfill Operation Area

Waste Pickers

Current Waste Flow of Dnipro City



Current Waste Management Plan of Dnipro City

- The fundamental plan for the solid waste management of Dnipro can be stated on “the Scheme of Sanitary Cleaning of Dnipropetrovsk (No. 31/32)” approved on 27 February 2013 which was developed based on “the Waste Management Rules in the City of Dnipropetrovsk (No. 403)” approved on 24 April 2012.
- According to the plan, EcoDnipro which is the authorized operator of the “Right Bank” Waste Treatment Complex is proceeding to construct the waste sorting facility firstly with the capacity of 100,000 tons/y, then extended its capacity up to 350,000 tons/y in future.
- On the other hand, Dnipro City also conducted another feasibility study for the development of waste processing facility under the PPP scheme. Component of this PPP project is a combination of waste sorting plant and digestion plant that produces biogas for its energy recovery.
- Based on the feasibility study, Dnipro City conducted the international tender to select a private investor who will implement the project. As a result of the tender, a British company named “Stopford Project Limited” was selected.

Appendix 6

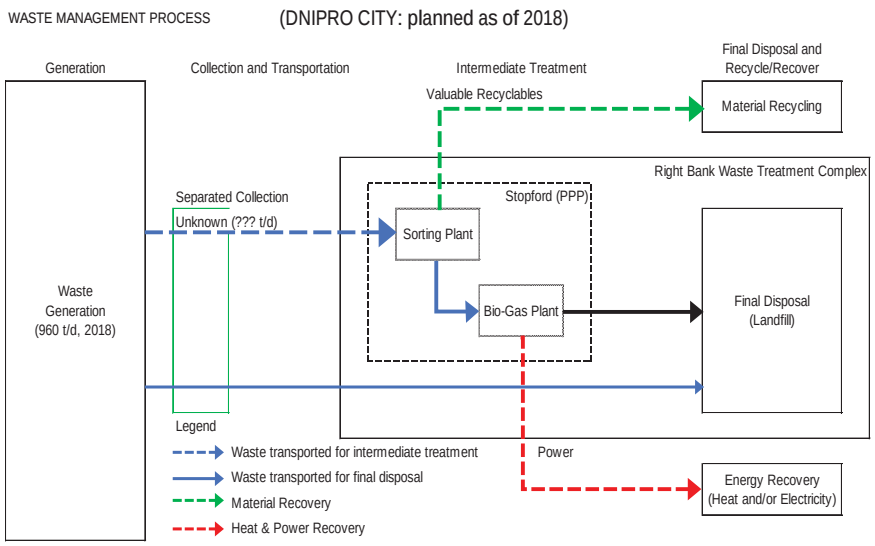
Concerned Waste Management Plan of Dnipropetrovsk Oblast

- Development strategy of Dnipropetrovsk region for the period till 2020 approved by the Decision of Dnipropetrovsk Regional Council dated 26.09.2014 № 561-27/VI
- Dnipropetrovsk Regional Integrated Environmental Safety Strategy for 2016 – 2025 approved by the Decision of the Regional Council dated 21.10.2015 № 680-34/VI (as amended).
- Dnipropetrovsk Regional Strategy for Solid Municipal Waste Management approved by the Decision of the Regional Council dated 29.07.016 № 80-5/VII.

➢ In this strategy, the region will be divided into six blocks and each block will develop its regional landfill and other related waste processing facilities. After waste processing, 50 % of collected waste will be disposed of at the landfill.

- A PPP project with waste incineration plant by Austrian company is also undergoing.

Planned Waste Flow of Dnipro City as of 2018



Tentatively Identified Needs of Dnipro City

1. Development of waste allocation plan, by verifying the private investment plan of both city and oblast.
2. Preparation of solid waste management plan, updating the sanitation scheme, including future facility development plan in both right and left bank.
3. Introduction segregated waste collection, including the public awareness raising.
4. Efficient operation of sorting plant.

End of Report

Thank you very much for your attention!

Outline of new National Waste Management Strategy and status of development of National Waste Management Plan


NATURAL RESOURCES
RAW MATERIALS
RECYCLED WASTE
PRODUCT MANUFACTURING
WASTE GENERATION
WASTE RECYCLING
PRODUCT CONSUMPTION
CIRCULAR ECONOMY
Ministry of Ecology and Natural Resources of Ukraine

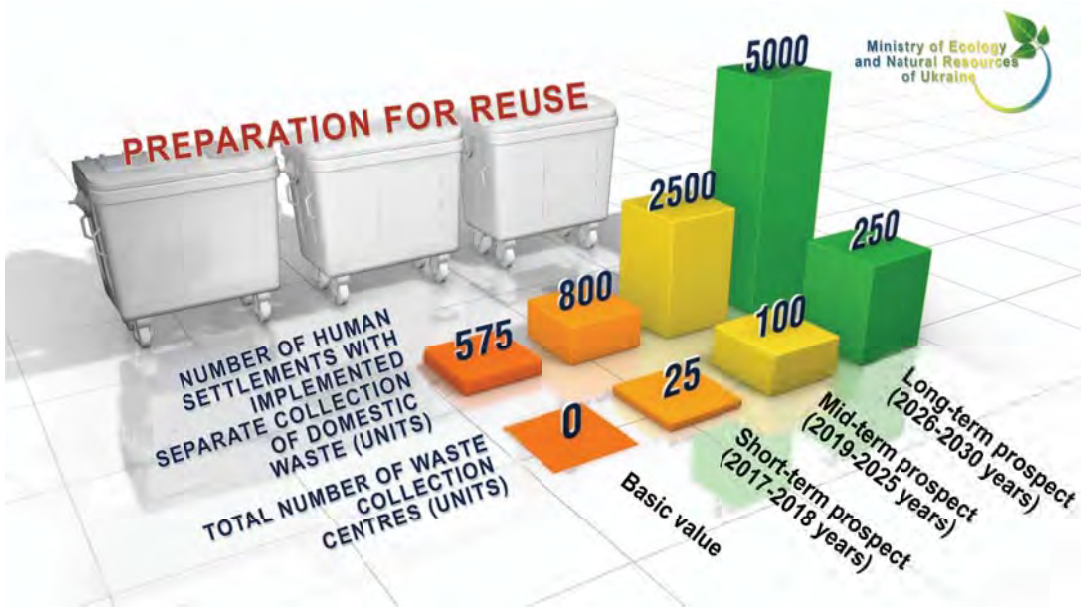

COMPLIANCE WITH WASTE MANAGEMENT "HIERARCHY", ACCEPTED IN EU
Waste prevention
Preparation for reuse
Recycling
Other types of disposal
Removal
THE MOST ACCEPTABLE OPTION
PRODUCT LIFE SUPPORT
Ministry of Ecology and Natural Resources of Ukraine

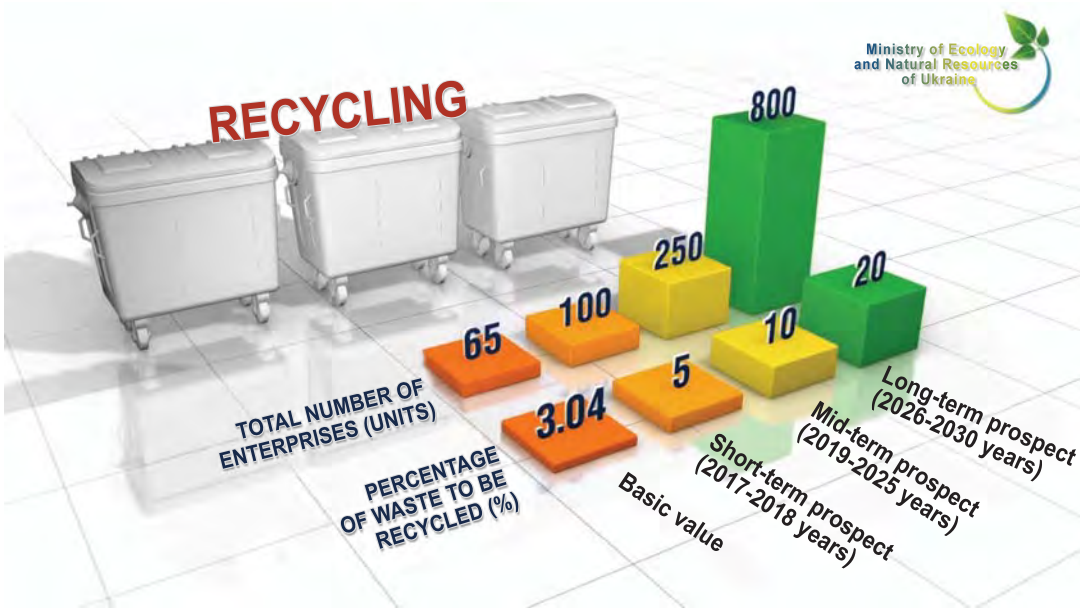

Ministry of Ecology and Natural Resources of Ukraine
INFORMING
WASTE RECYCLING
PRODUCER
CONSUMER
LOCAL GOVERNMENT AUTHORITY
SEPARATE COLLECTION
ORGANIZATION OF EXTENDED PRODUCER RESPONSIBILITY

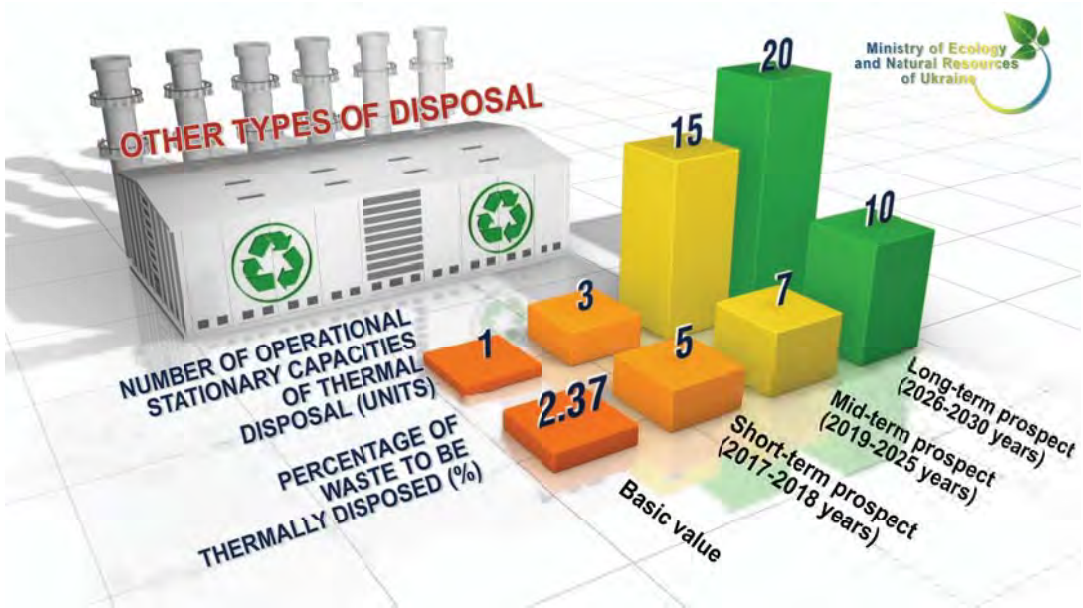

WASTE STREAMS MANAGEMENT
SOLID DOMESTIC WASTE
INDUSTRIAL WASTE
BUILDING WASTE
HAZARDOUS WASTE
AGRICULTURAL WASTE
SEPARATE GROUPS OF WASTE INCLUDING ELECTRICAL AND ELECTRONIC WASTE, DEAD BATTERIES AND ACCUMULATOR BATTERIES, MEDICAL WASTE
Ministry of Ecology and Natural Resources of Ukraine

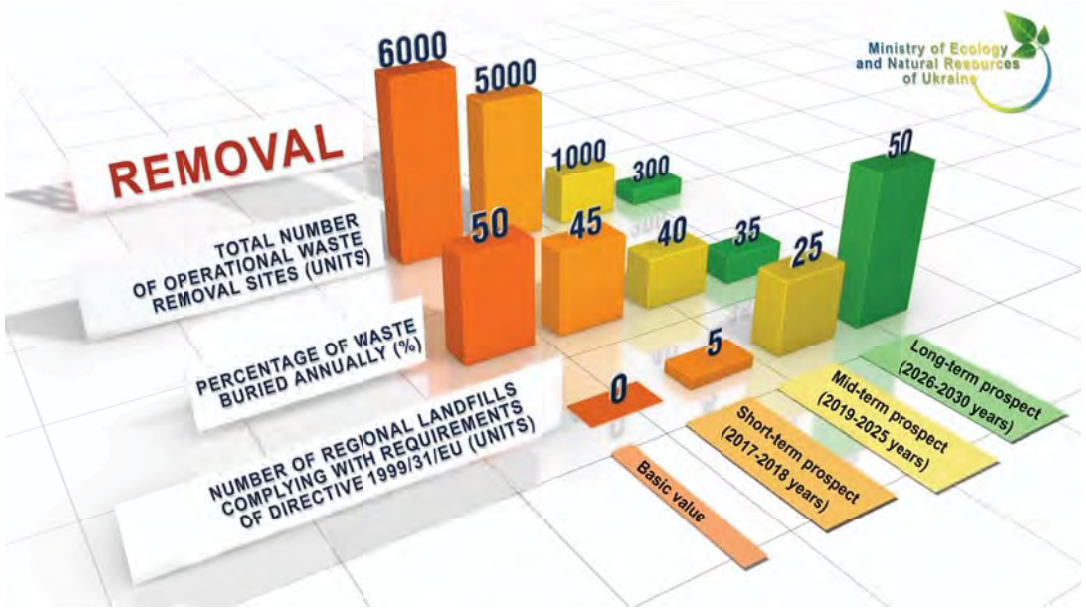
Appendix 6


REUSED AS IT IS FOR PRODUCTION
TO BE RECYCLED IN MATERIALS SUITABLE FOR PRODUCTION
REDUCTION OF ENERGY CONSUMPTION
PRODUCT LIFE SUPPORT
MATERIALS SUITABLE FOR RECYCLING
WASTE PREVENTION
Ministry of Ecology and Natural Resources of Ukraine


PREPARATION FOR REUSE
Ministry of Ecology and Natural Resources of Ukraine
NUMBER OF HUMAN SETTLEMENTS WITH IMPLEMENTED SEPARATE COLLECTION OF DOMESTIC WASTE (UNITS)
TOTAL NUMBER OF WASTE COLLECTION CENTRES (UNITS)
575
0
800
25
2500
100
5000
250
Basic value
Short-term prospect (2017-2018 years)
Mid-term prospect (2019-2025 years)
Long-term prospect (2026-2030 years)


RECYCLING
Ministry of Ecology and Natural Resources of Ukraine
TOTAL NUMBER OF ENTERPRISES (UNITS)
PERCENTAGE OF WASTE TO BE RECYCLED (%)
65
3.04
100
5
250
10
800
20
Basic value
Short-term prospect (2017-2018 years)
Mid-term prospect (2019-2025 years)
Long-term prospect (2026-2030 years)


OTHER TYPES OF DISPOSAL
Ministry of Ecology and Natural Resources of Ukraine
NUMBER OF OPERATIONAL STATIONARY CAPACITIES OF THERMAL DISPOSAL (UNITS)
PERCENTAGE OF WASTE TO BE THERMALLY DISPOSED (%)
1
2.37
3
5
15
7
20
10
Basic value
Short-term prospect (2017-2018 years)
Mid-term prospect (2019-2025 years)
Long-term prospect (2026-2030 years)


REMOVAL
TOTAL NUMBER OF OPERATIONAL WASTE REMOVAL SITES (UNITS)
PERCENTAGE OF WASTE BURIED ANNUALLY (%)
NUMBER OF REGIONAL LANDFILLS COMPLYING WITH REQUIREMENTS OF DIRECTIVE 1999/31/EU (UNITS)
6000
5000
1000
300
50
45
40
35
25
50
0
5
Basic value
Short-term prospect (2017-2018 years)
Mid-term prospect (2019-2025 years)
Long-term prospect (2026-2030 years)
Ministry of Ecology and Natural Resources of Ukraine


TEMPORARY STORAGE SITE
REMOVAL
OTHER TYPES OF DISPOSAL
WASTE RECYCLING
WASTE GENERATION
INFORMING
WASTE MOVEMENT CONTROL
Ministry of Ecology and Natural Resources of Ukraine


DOMESTIC WASTE
11 mln. t
5000
HUMAN SETTLEMENTS
SEPARATE COLLECTION
DOMESTIC WASTE
3%
97%
6 THOUSAND DUMPS
WASTE COLLECTION CENTRES
WASTE RECYCLING PLANTS
TRANSFER AND SORTING STATIONS
250 UNITS
200 UNITS
300 UNITS OF LANDFILLS
60 UNITS
SECONDARY RAW MATERIALS
Ministry of Ecology and Natural Resources of Ukraine


INDUSTRIAL WASTE
WASTE MANAGEMENT INFORMATION SYSTEM
WASTE RECYCLING AND DISPOSAL CAPACITY
INDUSTRIAL WASTE MANAGEMENT FOUNDATION
FINANCIAL GUARANTEE MECHANISM FOR CLOSING, RECLAMATION OF LANDFILLS
Ministry of Ecology and Natural Resources of Ukraine

Specific kinds of waste

left) Packaging waste, Waste of batteries, radiators(batteries) and accumulators, Waste of electrical and electronic equipment --->
The principle of extended producer responsibility, Target indexes of collection/processing(recycling)/reuse/segregated collection, Prevention of waste getting to landfills/dumps
right) Medical waste---> Segregated collection, Primary processing network at places of generation; Centralized network of high-temperature incineration Prohibition of burial and incineration in cement kilns and at CHP

EDUCATIONAL AND INFORMATION ACTIVITIES
IDENTIFICATION OF NEED IN HUMAN RESOURCING IN WASTE MANAGEMENT SPHERE
DEVELOPMENT OF TRAINING PLAN TYPE DESIGN OF WASTE MANAGEMENT DEGREE EDUCATION
DEVELOPMENT OF EDUCATIONAL STANDARDS AND PROFESSIONAL PROGRAMS FOR SPECIALIST TRAINING
DEVELOPMENT OF SYSTEMATIC RECOMMENDATIONS AND MANUALS ON WASTE MANAGEMENT FOR ALL INTERESTED PARTIES
CONDUCT OF NATIONAL CAMPAIGN TO PROMOTE WASTE MANAGEMENT ISSUES
Ministry of Ecology and Natural Resources of Ukraine

Appendix 6

Historical Footsteps of Solid Waste Management and Experience of Japan

Historical Footsteps of Solid Waste Management

Experience of Japan

June 2018

Hideaki FUJIYOSHI

Executive Vice President
Japan Environmental Sanitation Center

Contents

日本環境衛生センター JESC
Japan Environmental Sanitation Center

1 . Changes in Legal System

- Generation of Municipal Solid Waste and Waste Management Laws

日本環境衛生センター JESC
Japan Environmental Sanitation Center

1-1 Changes in Municipal Solid Waste Generation in Japan

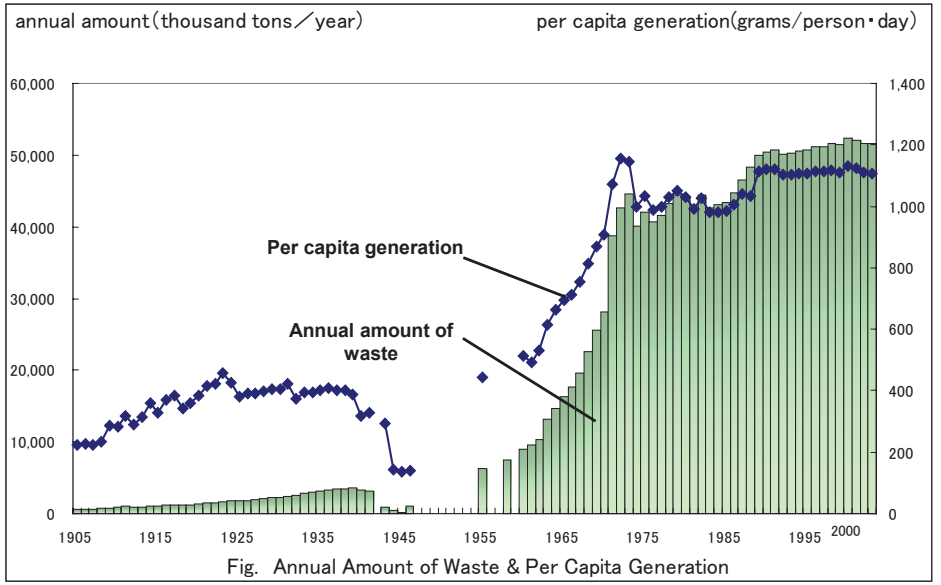


Fig. Annual Amount of Waste & Per Capita Generation

Provided by Dr. Shigeru Mizoirii

Appendix 6

日本環境衛生センター JESC
Japan Environmental Sanitation Center

1-2 Changes in Waste Management Laws

Waste Management Laws revised reflecting social situations

1877～ Prevalence of Serious Infectious Disease	
1900	Waste Material Cleansing Law
(1945)～ Sharp Increase of Waste Accompanied with rapid recovery from ww2	
1954	Public Cleansing Law
(1960)～ Economical growth and Serious Environmental Pollution	
1970	Law for Waste Management and Public Cleansing

1-3 Revision of Law for Waste Treatment and Public Cleansing and Enactment of Recycling Laws

Regulation of Specially Controlled Waste and Reducing Wastes

1991 Revision of Waste Management Law
- Regulation of Specially Controlled Waste for both Industrial waste and Municipal Waste
- Obligation of Remediation for Illegal Dumping

1993 Enactment of Basic Environment Law

1995 Enactment of Law for Promotion of Sorted Collection and Recycling Containers and Packaging

1997 Revision of Waste Management Law
- Regulation of Assessment of Effects to Living Environment by Waste Disposal Facility
- Expanded Manifest System to All Industrial Wastes

1998 Enactment of Law for Specified Kinds of Home Appliances

1999 Enactment of Law Concerning Special Measures against Dioxins

2000 Enactment of Law Concerning Recycling of Materials for Construction Works, Law on Recycling Food Waste, Basic Act on Establishing a Sound Material-Cycle Society

2001 Enactment of Law Concerning Special Measures against PCB Waste

2002 Enactment of End-of-Life Vehicle Recycling Law

1-4 Legal System to Establish a Sound Material-Cycle Society

Basic Environment Act(1993) — Basic Environment Plan(1994)

The Basic Act for Establishing a Sound Material-Cycle Society(2000)

The Fundamental Plan for Establishing a Sound Material-Cycle Society(2003)

- Ensure material cycle in society
- Control consumption of natural resource
- Reduce environmental burden

<Appropriate waste treatment>

Law for Waste Management and Public Cleansing (1970)

1. Waste generation control
2. Appropriate waste treatment(including recycle)
3. Regulation on the establishment of waste management facilities
4. Regulation on waste management operators
5. Establishment of waste management standard, etc.

<Promotion of recycling>

Law for Promotion of Effective Utilization of Resources (1993)

1. Recycling of reusable resources
2. Development of easy-to-recycle structures and materials
3. Labeling for sorted waste collection
4. Promotion of the effective use of by-products

Containers and Packaging Recycling Act	Home Appliance Recycling Act	Food Recycling Act	Construction Recycling Act	Automobie Recycling Act	Small Home Appliance Recycling Act
					

Green Purchasing Act : Promote the procurement of recycled products by the government

2 Era of The Waste Material Cleansing Law

- 1900 Enactment of The Waste Material Cleaning Law
  - Outbreak of infectious disease and needs to ensure hygienic living environment
- 1930 Revision of The Waste Material Cleaning Law
  - Gradual waste increase accompanied by population growth in cities

Era of The Waste Material Cleaning Law

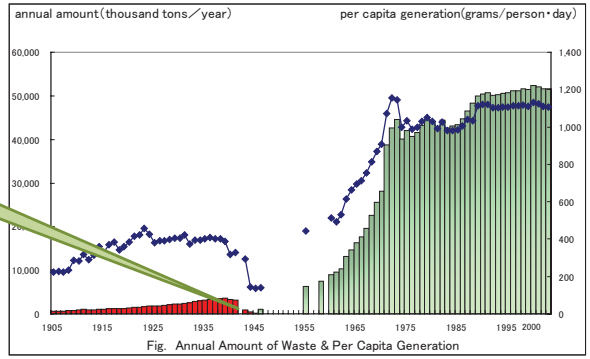


Fig. Annual Amount of Waste & Per Capita Generation

Appendix 6

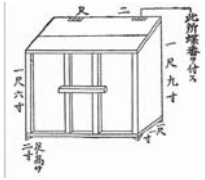
2- 1 Waste Material Cleaning Law 1900

1877- Repeated serious prevalence of infectious disease such as cholera, the situations are similar in European countries

1900 The Waste Material Cleaning Law was enacted

Objectives; To ensure hygienic living environment

- ･Poor awareness to hygiene ⇒ Construction of public toilets
- ･Picking valuables from waste ⇒ Periodical waste collection by municipalities
- ･Prevention of smoke problem ⇒ Prohibition of open burning and generation of flies



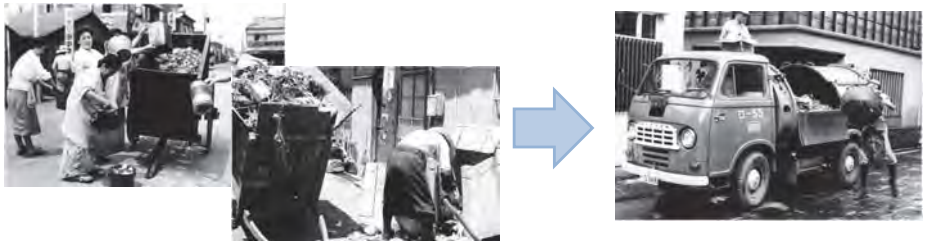
It was obligated for residents to place a dust bin on the road side in front of their residence.

3-1 The Public Cleansing Law 1954

(1950-) Sharp increase accompanied with high economic growth

Economical development caused deterioration of living environment

- ･Financial and technical assistance to municipalities by the national government
- ･higher degree of hygienic treatment
- ･the citizens obligation in waste management specified in the law.



More efficient MSW collection by mechanization started more than 60 years ago

3 Era of The Public Cleansing Law

1954 Enactment of The Public Cleansing Law

- ･Sharp MSW increase accompanied with rapid recovery from ww2
- ･Countermeasures which could not catch up with MSW increase

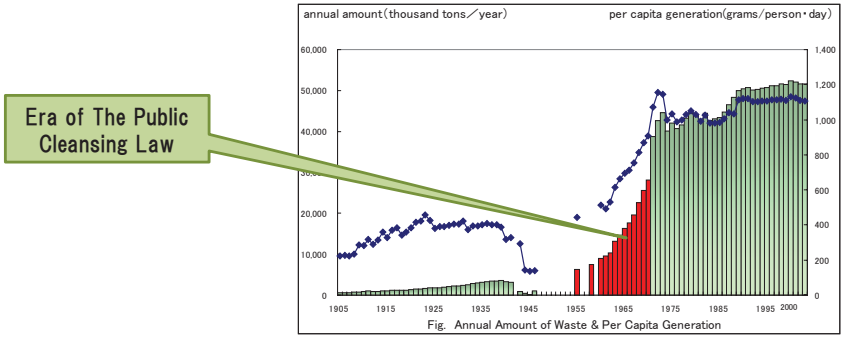


Fig. Annual Amount of Waste & Per Capita Generation

3-2① Problems, Municipal Waste(in 1950s-1960s)

littered trash in a park

Source:Pollution scenery of Tokyo, Tokyo Metropolitan Government

Appendix 6

3-2② Problems, Municipal Waste(in 1950s-1960s)

Bulky wastes heaped up a corner of town

Source:Pollution scenery of Tokyo, Tokyo Metropolitan Government

3-3 Problems, Industrial Waste

Industrial waste management was not well enough.
Illegal dumping was often found at where people did not live. Something inconvenient was hided under carpet.
Disease caused by improper treatment of industrial waste such as “Minamata Disease” was experienced.

Left: Sulfuric acid pitch dumped into clear stream
Center: Waste wood flamed up in open area
Right: Tens of thousands waste tires heaped up

Source: Material provided by MOEJ

⇨ Comprehensive challenges were commenced.

4 Era of The Waste Management and Public Cleansing Law

- 1970 Enactment of the Waste Management and Public Cleansing Law along with other pollution control related laws
- 1980- High economic growth to stable economic growth
- 1990- Enactment of recycling related laws

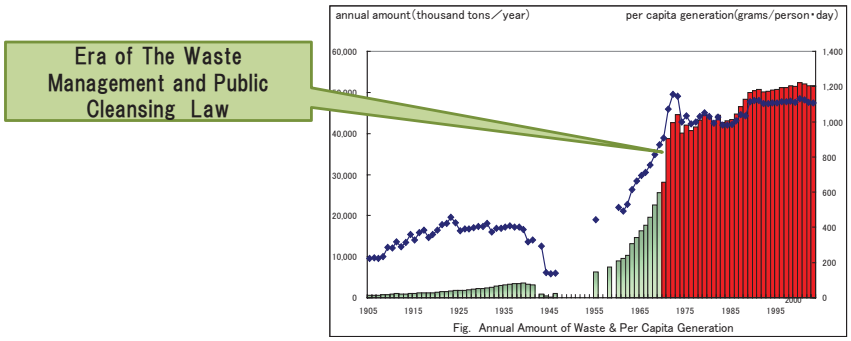


Fig. Annual Amount of Waste & Per Capita Generation

4-1 The Waste Management and Public Cleansing Laws 1970

Legally specified pollution control and increasing industrial waste

Enactment of laws related to pollution control

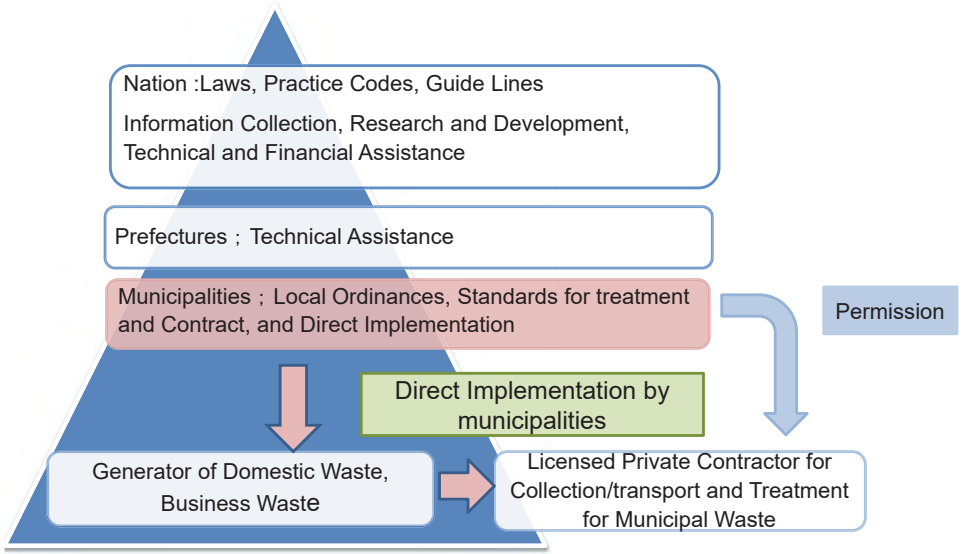
- Air Pollution Control Law 1968
- Water Contamination Control Law 1970

Enactment of Waste Management and Public Cleansing Law 1970

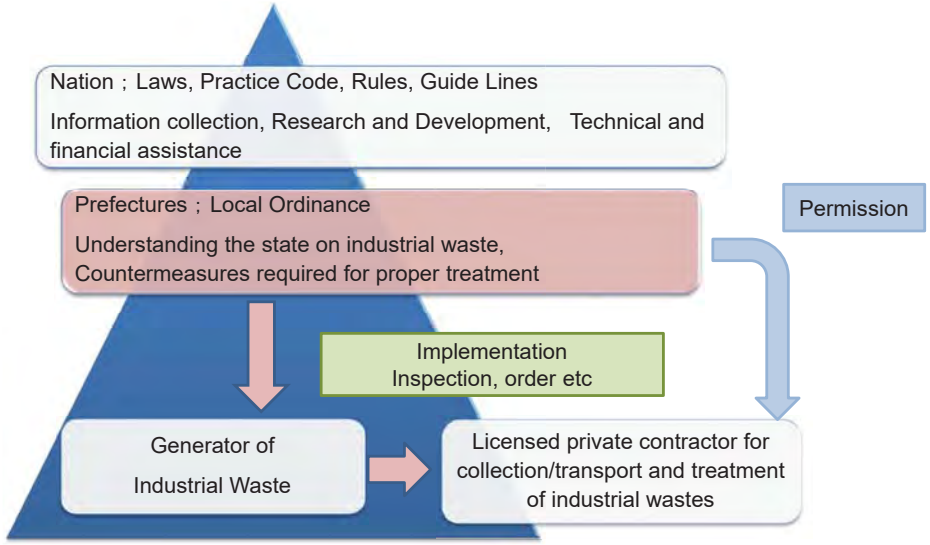
- Industrial waste prescribed ; responsibility of business enterprises, governorate duty, practice codes on waste collection, transport and disposal etc

Appendix 6

4-2① Roles of Administrative Body 1
- Municipal Waste

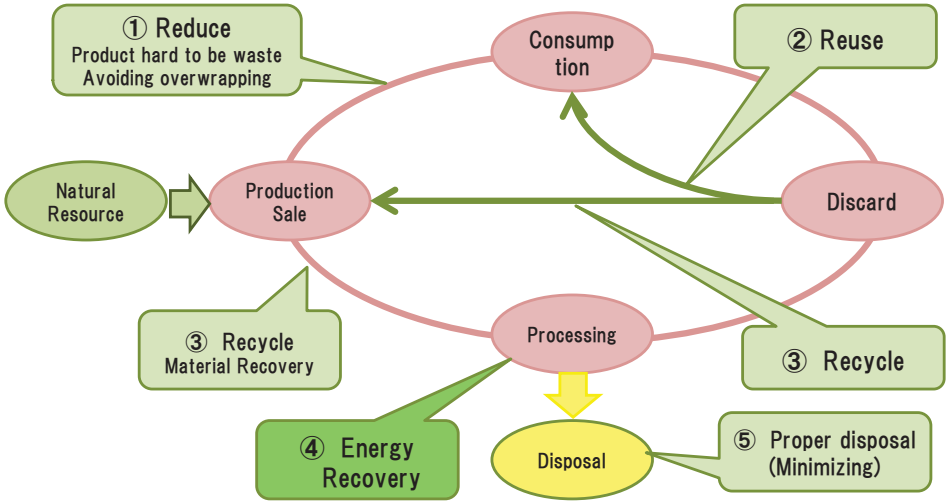


4-2② Roles of Administrative Body 2
- Industrial Waste



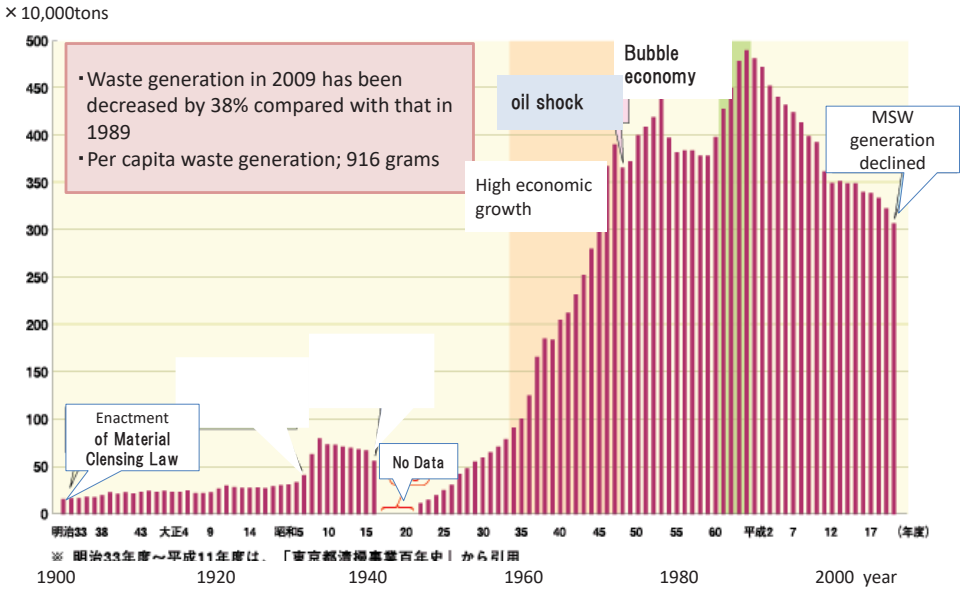
5 Situation of Today
- Toward Sound Material-Cycle Society (Circular Economy)

5-1 From Mass Consumption & Disposal to 3Rs
- Toward Sound Material-Cycle Society, SMS



Proper treatment of waste generated is not only business but integrated policy, in which various environmental aspects and resource saving are considered, also become necessary in waste management.

5 - 2 Changes in Waste Generation in Tokyo 23 City Area

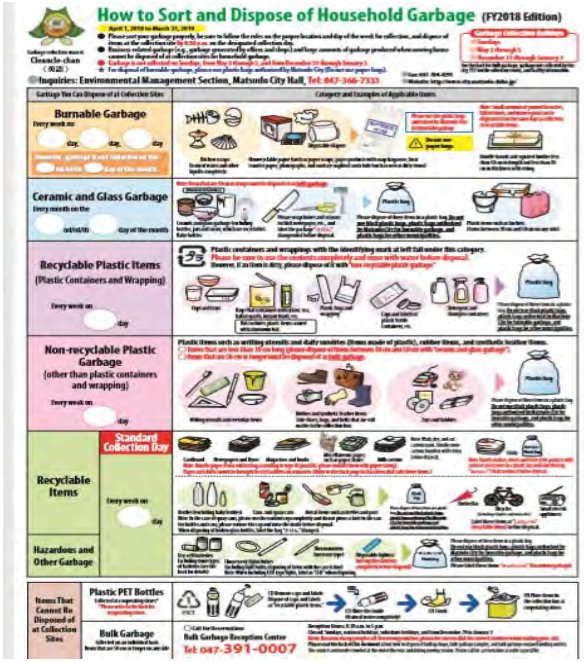


5-3-1 Alternative Systems to Reduce and Recycle Wastes

Recycling activity by every stakeholder, citizens, municipalities and business.

Community Recycle	Municipal Recycle	Recycling by Business
Citizens carry recyclable matters to designated place on designated day. Gains are turn to community.	Collection 3times a week reduce to 2 times, instead it was started to collect recyclables once a week.	Stores such as super markets and convenience stores place recycling boxes. Customers return recyclables.

5-3-2 Typical Example to Discharge Recyclable and Waste



5-3-3 Typical Example to Discharge Recyclable and Waste

5-4 Treatment of Municipal Combustible Waste

High Degree Pollution Control, Energy Recovery and Building Design Improved

1990～ Not only pollution control performance but energy recovery technology and building design were also improved to fit to surrounding situations to get better understanding by residents.

Toshima Incineration plant 1999

Chuo Incineration plant 2000

Appropriate collection transport processing and landfill are not enough in waste management.

6 Waste-to-Energy Facility in Japan

日本環境衛生センター
JAPAN ENVIRONMENTAL SANITATION CENTER JESC

6-1 Introduction Effects of WtE Facility

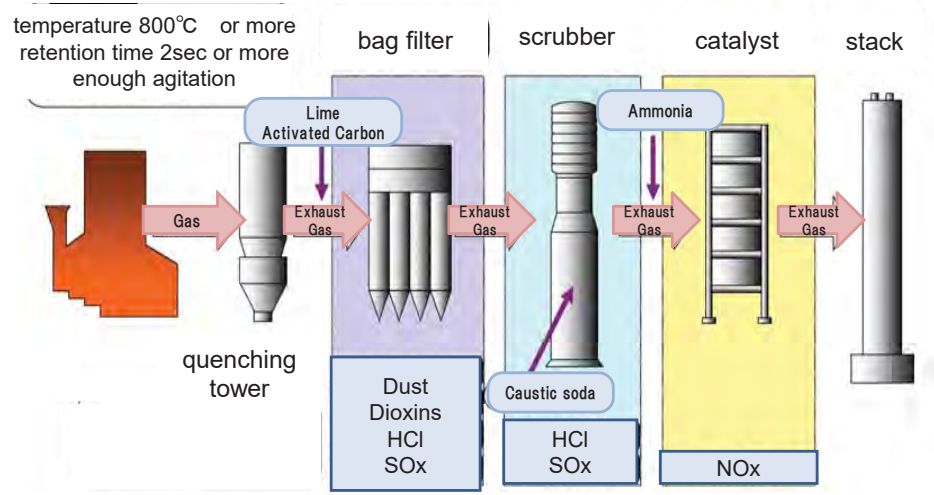
Aspect	Contents
Hygienic treatment	Organic matters turn into inorganic and bacteria including pathogenic bacteria perish by heat. Problems on smell, hazardous insect and animals, and fires are solved.
Volume reduction	Volume of ash produced is 1/20 of original volume, 1/10 in weight basis. A landfill site is possible to use longer period.
Transporting efficiency Landfill site operation	Number of vehicles go to landfill site are significantly reduced. Operation in landfill site is improved.
Energy recovery	Energy is recovered through incineration and electricity is generated. CO_2 generated is considered as carbon neutral. Methane gas does not come out from landfill site.

6-2-1 Typical Air Pollution Control in WtE Facility

Contaminants contained in exhaust gas from incinerator are controlled enough to be less than emission standard.

Furnace to realize complete combustion

Equipment to control contaminants



Source: Web site of Clean Association of Tokyo 23

6-2-2 Emission Standards and Control Performance

Type of contaminant	Cause of generation	Regulatory value and measures for removal	Removable value
Soot and dust	Solid matter in effluent gas	0.04 to 0.1 g/m^3N Remove solid matter using a dust collector (bag filter)	0.01 g/m^3N or less
Hydrogen chloride	Combustion of chlorine content in dust (plastics, salts, etc.)	700 mg/m^3N Remove hydrogen chloride using alkaline chemicals (hydrated lime, etc.)	10 to 30 ppm or less
Sulfur oxide	Combustion of sulfur content in dust, and petroleum	(Varies according to area.) Same as hydrogen chloride	30 ppm or less
Nitrogen oxide	Combustion of nitrogen content in dust Reaction of nitrogen and oxygen in the air	250 ppm Degradation with urea and ammonia	60 to 80 ppm (non-catalyzer) 50 ppm or less (catalyzer)
Dioxin	Incomplete combustion Chemical reaction with organic substances and chloride	0.1 ng-TEQ/m^3N Combustion management, absorption, and degradation	0.1 ng-TEQ/m^3N or less

m^3N: Volume of gas under normal conditions (0°C, 1 bar)
ppm: A unit one-millionth of one gram
ng (nanogram): A unit one billionth of one gram ("Nano" means "one-billionth.")
TEQ (Toxic Equivalent) An amount of dioxin converted into a unit of the most toxic substance, 2,3,7,8-TCDD.

6-3 Plant Operation under The Trust of Citizens

The contents of construction project and state of plant operation are frankly and repeatedly explained to the citizens to get better understanding.

Left : Conference on plant management with citizens participation
Center: Many citizens visit Incineration plants, learn method of waste treatment and understand correct environmental consideration.
Right : Citizens enjoying cherry blossom in open space of an waste incineration plant knowing actual state

Source: Web site of The Clean Authority of Tokyo 23

6-4-1 Major Factors for Power Generation Efficiency

Incinerating capacity	It may not be practical to install electricity generation system in small facility in which incinerating capacity is 80 tons/day or less Also, generation efficiency has trend to be in proportion to facility scale.
Boiler efficiency	Electricity generated is simply in proportion to amount of steam produced..
Steam temperature and pressure at inlet of turbine	Energy contained in steam is in proportion to temperature and pressure of steam. Also, superheated steam enables heat drop bigger.
Steam pressure at outlet of turbine	Back pressure of turbine is another critical parameter to determine the range of heat drop. Thus water cooling condenser is sometimes considered to introduce.

6-4-2 Incinerating Capacity and PG Efficiency

Incinerating Capacity (tons/day)	Efficiency required (%)
100 or less	12
More than 100 - 150 or less	14
More than 150 – 200 or less	15.5
More than 200 – 300 or less	17
More than 300 – 450 or less	18.5
More than 450 – 600 or less	20
More than 600 – 800 or less	21
More than 800 – 1,000 or less	22
More than 1,000 – 1,400 or less	23
More than 1,400 – 1,800 or less	24
1,800 or more	25

Conditions;

- Lower heat value of waste ; 8,000 kJ/kg
- Combustion air ratio; 1.4 ～ 1.5
- Steam 4MPa, 400℃

7 Subsystems to Ensure Implementation

日本環境衛生センター
JAPAN ENVIRONMENTAL SANITATION CENTER
JESC

7-1 Various Tools to Steadily Carry Out Laws

Ministry of the environment establish the laws, in addition, prepare necessary tools for the laws to be implemented by stakeholders such as local governments, businesses etc.

	The Laws	
	Enforcement Orders	
	Rules	・Detail and concrete rule such as structure and maintenance standard
	Notice	・Interpretation of the laws
Typical Guidelines	Guideline to Develop Waste Management Plan	・Parameters included and methods to study to fulfill the waste management plan
	Performance Guidelines	・Performance required for each type of waste treatment facility
	Conditions to Provide National Subsidy	・Conditions of waste disposal facility to provide national subsidy
	Model Technical Specification	・Technical specification for local government staff who have a little experience of project
	Guideline for Proper Bid and Contract	・Procedure to correctly proceed project
	Trainings, seminar	・Events for stakeholder to understand laws, ordinances, guidelines etc

7-2 Various Technologies Used for Various Wastes

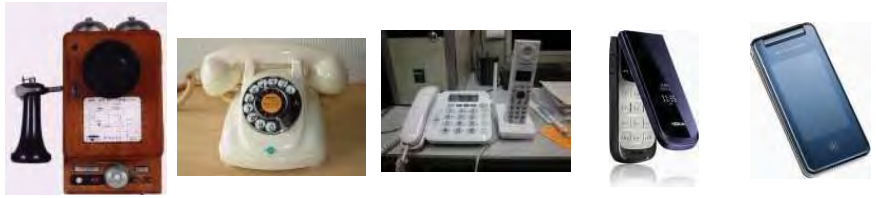
Typical Examples

Eco-town is a facility complex to efficiently recycle and properly treat various type of Industrial wastes.

Left: Facility for recycling mixed construction waste
Center: Facility for processing food waste to fodder
Right: Facility for treat infectious medical waste and waste plastics

Source: Web site of Tokyo super eco-town, Bureau of the Environment, TMG

We are always required to catch up with changes of the society and wisely improve our waste management systems.



Thank you for kind listening

Appendix 6

Introduction of JICA Assistance Schemes

Information Collection and Verification Survey for Municipal Solid Waste Management in Ukraine

Solid Waste Management Seminar

(Introduction of JICA Assistance Schemes)

1 June 2018

JICA Survey Team

JICA

NIPPON KOEI

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1. Japanese ODA
2. Types of Assistance of JICA
3. Technical Cooperation
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5. JICA's Strategy on Solid Waste Management

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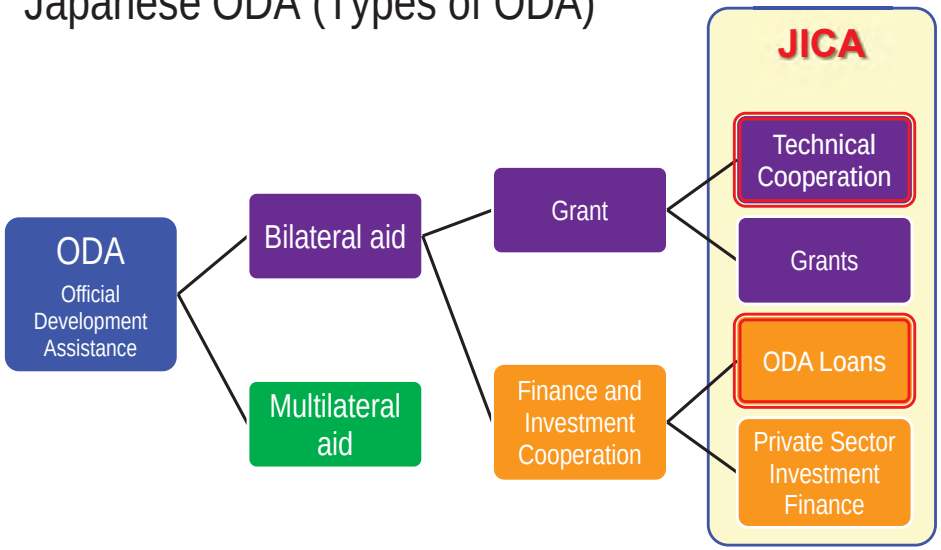
NIPPON KOEI

Japanese ODA (Types of ODA)



https://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/overseas/index.html

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1. Japanese ODA
2. Types of Assistance of JICA
3. Technical Cooperation
4. ODA Loan
5. JICA's Strategy on Solid Waste Management

NIPPON KOEI

Types of Assistance of JICA

JICA uses an array of development assistance schemes to meet the diverse needs of partner countries.

Technical Cooperation - Technical Cooperation Projects - Acceptance of technical training participants - Follow-up cooperation
Official Development Assistance Loans
Official Development Assistance Grants
Citizen Participation - Volunteers - JICA Partnership Program
Public-Private Partnerships
Emergency Disaster Relief

https://www.jica.go.jp/english/our_work/types_of_assistance/index.html

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Technical Cooperation

JICA's Technical Cooperation supports human resource development, research and development, technology dissemination and the development of institutional frameworks essential for the development of economies and societies in recipent countries by dispatching experts, accepting training participants and/or providing equipment.

Dispatch of Experts Japanese experts are dispatched to disseminate necessary technologies and knowledge to partner country government officials and engineers (counterparts).
Acceptance of Training Participants JICA invites competent personnel, who have significant responsibility in social and economic development, to Japan as training participants.
Technical Cooperation Projects
Technical Cooperation for Development Planning

https://www.jica.go.jp/english/our_work/types_of_assistance/tech/projects/index.html

NIPPON KOEI

Technical Cooperation Project

- Technical Cooperation projects, which optimally combine the "Dispatch of Experts," "Acceptance of Training Participants" and/or provision of equipment.
- Even more reliable project outcomes can be obtained through systematic and comprehensive project operation and implementation from planning to implementation and evaluation.
- To raise a sense of ownership of partner side, many projects adopt "participatory" methods, whereby local people in each project's target area participate in planning, operation management and evaluation activities.
- JICA also collaborates with private enterprises, universities, NGOs and other organizations to utilize their cumulative experience, knowledge and know-how in projects in order to address more-complex and high-level issues.

Process of Technical Cooperation Project

Project Identification and Formulation
- Through information gathering and discussion with the government of the partner country.

Request and Approval
- Based on a request from the partner country, JICA and other concerned discuss on whether or not to approve the project, If approved, not verbal is exchanged.

Examination/Ex-Ante Evaluation
- In order to clarify details and expected outcomes of the project and its appropriateness, ex-ante evaluation is conducted.

Project Implementation/Mid-Term Review/Terminal Evaluation
- Record of Discussions (R/D) regarding project implementation is signed.
- Mid-term review is conducted at a certain point from the project inception and terminal evaluation is conducted a half year prior to the project completion.

Follow Up/Ex-Post Evaluation
- In case unexpected problems emerge, Follow-up Cooperation is provided.
- Ex-post evaluation is carried out several years after the project completion.

Technical Cooperation for Development Planning

JICA conducts following studies to support counterparts in the partner country to formulate policies and master plans.

Master plans (M/P) and policy support studies (fiscal reforms, establishment of legal systems, etc.) to support policymaking and the planning of public projects
Emergency support studies (rehabilitation and reconstruction of basic infrastructures that has been damaged by natural disasters, conflicts or other factors)
Feasibility studies (F/S) for projects which will be realized by the developing country government or other donor
Other studies (topographic mapping, groundwater surveys, etc.)

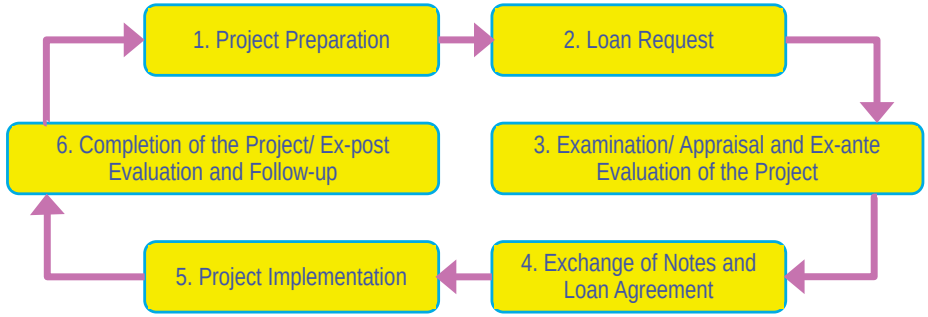
① formulate plans for sector/regional development or rehabilitation/reconstruction by utilizing results,
② implement plans (projects) by raising funds from international organizations and others, and/or
③ carry out the recommended organizational/institutional reforms.

Contents

ODA Loans

- ODA loans support partner countries by providing low-interest, long-term and concessional funds to finance their efforts for the development of economic and social infrastructure, following “JICA guidelines for environmental and social considerations”.
- JICA has supported a wide range of countries and regions totaling 108 with ODA loans.

Project Cycle of ODA Loans with the following six steps



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Types of ODA Loans

Project-Type Loans

- Project Loans
  - largest portion of ODA Loans
  - To finance the infrastructure development
- Engineering Service (E/S) Loans
  - For engineering services which are necessary at the survey and planning stages of projects.
- Financial Intermediary Loans (Two-Step Loans)
  - Funds pass through two or more financial institutions before the end-beneficiaries receive the funds
- Sector Loans
  - For materials and equipment, services and consulting required for the implementation of development plans in a specific sector consisting of multiple sub-projects.

Non-Project Loans

- Program Loans
- Commodity Loans
- Sector Program Loans

https://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/overseas/types.html

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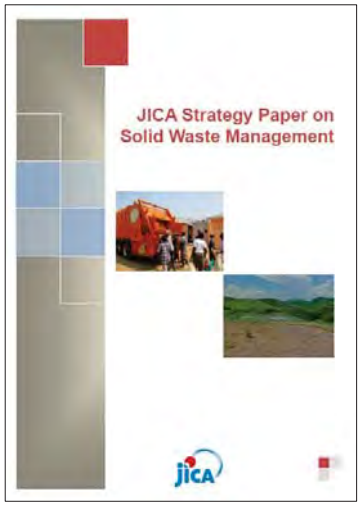
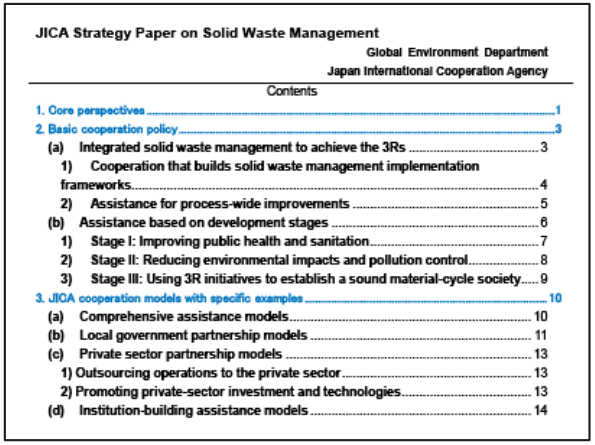
JICA Strategic Paper on SWM





JICA Strategy Paper on Solid Waste Management

Global Environment Department
Japan International Cooperation Agency

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Source: JICA Strategy Paper on Solid Waste Management ver. 2.0 (March, 2015)

NIPPON KOEI

Appendix 6

Overview of JICA SWM cooperation

http://gwweb.jica.go.jp/km/FSubject1801.nsf/ff4eb182720efa0f49256bc20018fd25/1710a8711dffc41b492579d4002d25af/$FILE/JICA_Strategy%20Paper%20on%20Solid%20Waste%20Management_2014Edtion(Eng).pdf

Source: JICA Strategy Paper on Solid Waste Management ver. 2.0 (March, 2015)

JICA's Basic Cooperation Policy on SWM

A) Integrated solid waste management to achieve the 3Rs

1) Cooperation that builds SWM implementation frameworks

To increase SWM capacity from the aspects of (1) legal and institutional improvements, (2) organizational improvements, (3) financial improvements, (4) private sector involvement, (5) waste producer initiatives, (6) citizen, participation, and (7) cultural and social, considerations.

2) Assistance for process-wide improvement

From the wide views on the SWM process, (1) optimizing production and consumption; (2) minimizing generation and optimizing discharge; (3) improving collection and transport; (4) encouraging intermediate treatment, reuse, and recycling; and (5) improving final disposal, will be considered.

B) Assistance based on development stages

Stage I: Improving public health and sanitation

Stage II: Reducing environmental costs and pollution control

Stage III: Using 3R initiatives to establish a material-cycle society

JICA Cooperation Model on SWM

a) Comprehensive Assistance Models

- Combination of appropriate schemes
- Continuous assistances from M/P to capacity development and infrastructure improvement
- Program-based approach in the period of about 10 years

b) Local Government Partnership Models

- Utilization of Japanese Municipality's Know-how

c) Private Sector Partnership Models

- Outsourcing operations to the private sector
- Promoting private-sector investment and technologies

d) Institution-building Assistance models

- National level approach

https://www.jica.go.jp/english/our_work/types_of_assistance/tech/projects/index.html

End of Presentation

Thank you very much for your attention!

Appendix 7

Tentative Evaluation of Introduction of WtE System

Appendix 7. Tentative Evaluation of Introduction of Waste to Energy System
< Back Data>

JICA's Pre-Check list for Waste to Energy Project (Draft)

Classification	Importance	Item	Content
1) Social aspect	Most important	(1) Population of the target city	The target city population is 100,000 or more. (Or plant capacity is 70 ton/day or more).
	Inportant	(2) Social needs	There are high social needs, such as "The remaining capacity of final disposal sites is limited.", "Sanitary waste treatment is highly required."
	Recommended	(3) Development status of social infrastructure pertaining to environmental sanitation	Administrative services of energy, waterworks and sewerage works are provided in the target city without problems.
	Recommended	(4) Integration of environmental and social considerations	Laws with regards to pollution prevention and environmental impact assessment (environmental laws etc.) have been developed and enacted in target countries and target areas.
2) Public understanding aspect	Most important	(1) Cooperation of residents in waste sorting	Cooperation of the residents concerning the sorting of wastes can be obtained. (Delivery of wastes not suitable for WtE can be controlled.)
	Most important	(2) Understanding of residents about waste- to- energy system	Understanding of the residents about WtE has been obtained.
3) Institutional aspect	Most important	(1) Development of laws, enforcement orders and rules	In addition to laws with regards to solid waste management, enforcement orders and rules have been developed.
	Important	(2) Stability of administrative organization	There is an administrative organization in charge of the project for construction and operation of WtE and the organization is stable. Also, there is a personnel management system enabling long-term employment (for 3 years or longer) of the core staff.
	Important	(3) Adequacy of the construction site	Construction site in which WtE can be built is available.
4) Administrative governance aspect	Most important	(1) Positioning of waste- to-energy system in upper level plan	WtE has its position in the upper level plans (comprehensive plan, regional development strategy, etc.).
	Most important	(2) Political stance of the head of local government	The head of local government is positive towards WtE.
	Important	(3) Performance capability of the government	The government is able to leverage committees comprised of external experts and external specialist organizations, such as consulting firms, to perform the project appropriately.
	Important	(4) Technical standards and operation pertaining to selling electricity	By energy department and electric power company, technical standards and operation pertaining to selling electricity, and selling price of electricity are set forth.
5) Financial aspect	Most important	(1) Securing of financial resources	Project cost (construction cost and operating cost) of WtE can be secured. The government is prepared to bear the cost such as tipping fee (fee for outsourcing disposal) and reliable investors are expected to participate in the project.
	Important	(2) Tipping fee	It is possible to set the tipping fee at a stable price over a long period by contract.
	Important	(3) Revenue by selling electricity	It is reasonable to assume selling price and the amount of electricity and recyclable waste.

Classification	Importance	Item	Content
	Recommended	(4) Project scheme	Project schemes (DB, DBO, BTO, etc.) are being discussed among stakeholders.
	Recommended	(5) Project risks	Major project risks are confirmed and the difference of responsibility division points according to project schemes are understood.
6) Technical aspect	Most important	(1) Collecting basic data concerning waste	Basic data and information concerning waste (amount and composition of waste, waste treatment process etc.) have been clalified.
	Important	(2) Technical capacity of manufacturers	Reliable manufacturers (of stoker incinerators) are expected to participate in the project.
	Important	(3) Proper disposal of incineration residue (incineration ash)	Proper disposal of incineration residue (incineration ash) is possible. (For example, measures for preventing the outflow of leachate have been taken at the final disposal site.)
	Recommended	(4) Environmental monitoring system	Laboratories for analysis of exhaust gas, wastewater, noise, vibration, odor, etc. exist and enable perform appropriate monitoring.
	Recommended	(5) Practical experiences of similar facilities	Similar facilities, such as thermal power plants, exist and are managed appropriately.
	Recommended	(6) Securing of engineers	It is possible to secure engineers (personnel with skills equivalent to technical high school graduates).

Evaluation indicators of Importance

Most important: It is considered extremely difficult to introduce WtE if this criterion is not fulfilled.

Important: The criterion should be fulfilled for and is expected to be fulfilled if assistance is provided.

Recommended: This criterion should desirably be fulfilled.

Tentative Evaluation Result
【Targeted Area】Kyiv City　　【Date of Evaluation】26th May 2018

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
1) Social aspect	Most important	(1) Population of the target city	The population of Kyiv city is approx. 2900 thousand, in addition, there are the citizens who are not registrated and acutual population exceeds 29000 thousand.	Studied by JICA survey team	No. of citizens is enough	3	4	12
	Inportant	(2) Social needs	The necessity to reduce waste is recognized as the Waste Disposal Site No.5 is scheduled to close on Dec. 2018 by the request of neighboring inhabitants and the city council is also approve it.	Studied by JICA survey team	The necessity of waste processing is really recognized.	2	4	8
	Recommended	(3) Development status of social infrastructure pertaining to environmental sanitation	Electric supply is stable. Resional sewage treate plant is under operation. In addition, central heating system is arranged.	Studied by JICA survey team	Social infrastructure related to environmental health is highly arranged.	1	4	4
	Recommended	(4) Integration of environmental and social considerations	The law on environmental impact assesment is established. The facility constructed is expertised on the process of project from environmetal aspect. Legal system is now being established seekiing for EU participation.	Studied by JICA survey team	Environmental and social considerations are established.	1	4	4
2) Public understanding aspect	Most important	(1) Cooperation of residents in waste sorting	Base collection for dry battery is carried out. Environmental education focusing on school children is seeked.	Studied by JICA survey team	Removing unsuitable waste is possible through raising public awareness	3	3	9
	Most important	(2) Understanding of residents about Waste- to- Energy system	Neighboring inhabitants occasionally complain about odor. But they hear and understand the explanation by plant staff. And the plant continues stable operation for a long time.	Investigation at the Energia Waste Incineration Plant	Understanding is achieved.	3	3	9
3) Institutional aspect	Most important	(1) Development of laws, enforcement orders and rules	The Energia Waste Incineration Plan is operated following to Ukrainian emission standard. Examination on the Law on Wastes, Recycling law for container amd packages and the law for controlling hazardous waste is pushed forward seeking for EU participatiion.	Investigation at the Ministry of Natural Resources and Environment and Kyiv Energo. Co	To reconfirm is desirable founding the establishment of laws.	3	3	9
	Important	(2) Stability of administrative organization	The organization in charge, Department of Social Infrastructure, is clear and stable. The staff of State administration and local government have common recognition to challenges on waste management.	Studied by JICA survey team	Organizations are stable and staff remained in the post long enough	2	4	8

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Important	(3) Adequacy of the construction site	There is not actual construction plan of a facility and the site is not determined het. But the importance of the site selection is recognized.	Investigation at the Kyiv city administaration	The importance of site selection is recognized thogh the actual construction plan is not developped.	2	2	4
4) Administrative governance aspect	Most important	(1) Positioning of Waste- to- Energy in upper level plan	The construction of thermal treatment facility is described in The National Waste Management Plan and the schedule and number of facilities are clarified.	National Waste Management Strategy	The number and time to construct thermal treatment facility is described in uppre level plan, the National Waste Management Strategy.	3	4	12
	Most important	(2) Political stance of the head of local government	The mayor understands the importance of waste incineration plant and approved the renovation works of the Energia Waste Incineration Plant.	Investigation at the Kyiv city administaration	Significance of the Energia Incineration Plant and the Neccesity of thermal treatment are understood by the mayor.	3	4	12
	Important	(3) Performance capability of the government	Founding the report by a consultant, the renovation works are scheduled	Investigation at the Energia Waste Incineration Plant	There is a result to use foreign consultant.	2	3	6
	Important	(4) Technical standards and operation pertaining to selling electricity	The system to sell electricity generated by waste-to-energy plant is not prepared yet. But it is now examined ny the organization in charge. Pipeline grid is arranged in urban area and the system to sell heat energy is already established.	Investigation at the Energia Waste Incineration Plant	Sale system of electricity including FIT is examined now. The system to sell heat energy is already extablished and implemented.	2	4	8
5) Financial aspect	Most important	(1) Securing of financial resources	Almost all expense required for operation and maintenance in the Energia Waste Incineration Plant are covered with the revenue from heat sale and waste processing tariff. Financial resource required for renovation works which are out of resposibility of private company is prepapered by the city authority. To secure the finance resources for constructing a new facility is not easy.	Investigation at Kyiv city administration and Kyiv energo. Co.	The expense for operation and maintenance is covered by revinue of heat energy and processing tariff for a long time. But it is not easy to secure finance resource to construct a new facility.	3	3	9
	Important	(2) Tipping fee	There is the system that the tariff is determined by the city council and reviced as is necessary. Waste collection service is stably provided for a long time. Careful posture is seen in a raise of tariff.	Investigation at the Energia Waste Incineration Plant	The system to revice tariff but careful posture to raise is observed.	2	3	6
	Important	(3) Revenue by selling electricity	As there is not an actual construciton plan of waste-to-energy facility, it is not possible to directly evaluate. But the experience to sell heat is utilized.	Investigation at the Kyiv city administaration	It is difficult to directly evaluate now. It is possible to expect resonable assumption fouding the result in the Energia Waste Incineration Plant.	2	3	6

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Recommended	(4) Project scheme	The defference of bisiness scheme is recognizened as the city authority thinks to apply PPP scheme for constructing a new facility first and then apply the scheme of construction and operation by public or construction by public/poperation by private in case investors are not expected.	Investigation at the Kyiv city administaration	The defference of schemes are understood.	2	3	6
	Recommended	(5) Project risks	The Energia Waste Incineration Plant is managed by DBO scheme. Risk allocation is clear in the scheme. Reasonable risk allocation is expected."	Investigation at Kyiv city administration and Kyiv energo. Co.	Possible to expect reasonable risk allocation.	2	4	8
6) Technical aspect	Most important	(1) Collecting basic data concerning waste	As weighing bridges are installed in the waste disposal site, almost all waste flow is clear though a part of waste collected by private companies is not clear. Analyses of waste composition is not carried out periodicallhy but it is possible to estimate by the accumulated result of waste analyses occsionallh carry out before.	Studied by JICA survey team	Processing route is known for almost all waste and controlled.	3	4	12
	Important	(2) Technical capacity of manufacturers	There is the result that the Europian branch of a Japanes plant maker negotiate to sell a facility in past. Participation of reliable manufacturer is expected if the condintions are reasonable.	Investigation at Facility provider	Possible to expect reliable provider if resonable conditions are prepared.	2	3	6
	Important	(3) Proper disposal of incineration residue (incineration ash)	In The Waste Disposal Site No.5, sanitary lanfill method is applied and the site is equipped with leachate treatment facility. Incineration residue is now transported into the site.	Investigation at the Energia Waste Incineration Plant	Incineration residue is acturally accepted in the disposal site.	2	3	6
	Recommended	(4) Environmental monitoring system	Environmental monitoring system legally established in overall Ukraine and there are a lot of analysis laboratries. Leachate and atmosphere are now analized in the disposal site.	Limit Plus LLC - environmental laboratory.http://www.ecolab-plus.com.ua/	Environmental monitoring system is properly established.	1	4	4
	Recommended	(5) Practical experiences of similar facilities	A waste incineration plant already exists, and Cogeneration facilities, CHP, are stably operated.	Studied by JICA survey team	a waste incineration Plant acctuall exists and properly managed/.	1	4	4
	Recommended	(6) Securing of engineers	There is not unease to secure engineers required because there are a lot of engineers and technicians working in neuclear generation plant and CHP.	Studied by JICA survey team	There is not uneasiness for securing engineers required.	1	4	4
					Business Promotion (yes) nil・defer	【Total】 176/204		

Tentative Evaluation Result

【Targeted Area】Kharkiv City　　【Date of Evaluation】26th May 2018

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
1) Social aspect	Most important	(1) Population of the target city	The population of Kharkiv city is approx. 1400 thousand, and stable for past 10 years.	Studied by JICA survey team	No. of citizens is enough	3	4	12
	Inportant	(2) Social needs	The waste disposal site Dergachi is almost full in present landfill area, and a new landfill site is being constructed in neighboring area now financed by the World Bank. There is not unesiness for landfill capacity at this moment. Sanitarhy treatment is considered.	Studied by JICA survey team	The is not uneasiness in landfill capacity at this moment, and the necessity to consrtuct a waste-to-energy facility is not recognized as an urgent task.	2	2	4
	Recommended	(3) Development status of social infrastructure pertaining to environmental sanitation	Electric supply is stable. Resional sewage treate plant is under operation. In addition, central heating system is arranged.	Studied by JICA survey team	Social infrastructure related to environmental health is highly arranged.	1	4	4
	Recommended	(4) Integration of environmental and social considerations	The law on environmental impact assesment is established. The facility constructed is expertised on the process of project from environmetal aspect. Legal system is now being established seekiing for EU participation.	Studied by JICA survey team	Environmental and social considerations are established.	1	4	4
2) Public understanding aspect	Most important	(1) Cooperation of residents in waste sorting	Base collection for dry battery is carried out. Environmental education focusing on school children is seeked.	Studied by JICA survey team	Removing unsuitable waste is possible through raising public awareness	3	3	9
	Most important	(2) Understanding of residents about Waste-to- Energy system	The waste incineratio plant existed in the past time, it abolished because of aging and problems of maintenance. Understanding of residents about waste-to -energy system is not clear. But the city administration is optimistic to get residents understanding.	Investigation at Kharkiv city administration	It is necessary to explain about the necessity of waste-to-energy system	3	3	9
3) Institutional aspect	Most important	(1) Development of laws, enforcement orders and rules	The Energia Waste Incineration Plan is operated following to Ukrainian emission standard. Examination on the Law on Wastes, Recycling law for container amd packages and the law for controlling hazardous waste is pushed forward seeking for EU participatiion.	Investigation at the Ministry of Natural Resources	To reconfirm is desirable founding the establishment of laws.	3	3	9
	Important	(2) Stability of administrative organization	The construction works of a new landfill site and a sorting facility, financed by the World Bank, have been pushed forward over 10 years. Organization in charge is clear and stable.	Studied by JICA survey team	Organizations are stable and staff remained in the post long enough	2	3	6

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Important	(3) Adequacy of the construction site	The necessity of waste processing facility is recognized. But there is not actual construction plan and construction site is not determined.	Investigation at the Kharkiv city administration	It is desirable to reconfirm when the construction plan is developed	2	3	6
4) Administrative governance aspect	Most important	(1) Positioning of Waste-to- Energy in upper level plan	The construction of thermal treatment facility is described in The National Waste Management Plan and the schedule and number of facilities are clarified.	National Waste Management Strategy	The number and time to construct thermal treatment facility is described in uppre level plan, the National Waste Management Strategy.	3	4	12
	Most important	(2) Political Stancestance of the head of local government	Stance is not clear because argument is not started. As there is not uneasiness in the shortage of landfill capacity, it is thought not easy to achieve understanding as an urgent issue.	Studied by JICA survey team	It is not always easy to get understanding urgent necessity.	3	2	6
	Important	(3) Performance capability of the government	German consultant and Polish consultant are effectively utilized and the projects are being pushed forward smoothly.	Studied by JICA survey team	enough experience	2	4	8
	Important	(4) Technical standards and operation pertaining to selling electricity	The system to sell electricity generated by waste-to-energy plant is not prepared yet. But it is now examined ny the organization in charge. Pipeline grid is arranged in urban area and the system to sell heat energy is already established.	Studied by JICA survey team	Sale system of electricity including FIT is examined now. The system to sell heat energy is already extablished and implemented.	2	3	6
5) Financial aspect	Most important	(1) Securing of financial resources	The city administration and MKPV have high ability to secure financial resources by such means to utilize IBRD. It is thought that the authority seeks for the finance resoures utilizing the World Bank.	Studied by JICA survey team	There are results to utilize donors	3	3	9
	Important	(2) Tipping fee	There is the system that the tariff is determined by the city council and reviced as is necessary. Waste collection service is stably provided for a long time. Careful posture is seen in a raise of tariff.	Investigation at Kharkiv administration	The system to revice tariff but careful posture to raise is observed.	2	3	6
	Important	(3) Revenue by selling electricity	As there is not an actual construciton plan of waste-to-energy facility, it is not possible to directly evaluate. But the experience to sell heat is utilized.	Studied by JICA survey team	It is difficult to directly evaluate now. It is possible to expect resonable assumption fouding the result in the Energia Waste Incineration Plant.	2	3	6

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Recommended	(4) Project scheme	The projects are pushed forward in DB scheme achieving the assistance by IBRD and the intention to utilize private finance is small. Waste management as public service is examined enough.	Studied by JICA survey team	Schemes are examined	2	4	8
	Recommended	(5) Project risks	As the construction of facility utilizing private finance, it is not possible to directly evaluate. But the experience to sell heat is utilized.	Studied by JICA survey team and Investigation at Energia Waste Incineration Plant	Reasonable risk allocation can be expected	2	4	8
5) Technical aspect	Most important	(1) Collecting basic data concerning waste	As weighing bridges are installed in the waste disposal site, almost all waste flow is clear though a part of waste collected by private companies is not clear. Analyses of waste composition is not carried out periodicallhy but it is possible to estimate by the accumulated result of waste analyses occsionallh carry out before.	Studied by JICA survey team	Almost all are known	3	4	12
	Important	(2) Technical capacity of manufacturers	There is the result that the Europian branch of a Japanes plant maker negotiate to sell a facility in past. Participation of reliable manufacturer is expected if the condintions are reasonable.	Investigation at Facility provider	Possible to expect if conditions are reasonable	2	3	6
	Important	(3) Proper disposal of incineration residue (incineration ash)	The Waste Disposl site is equipped with sealing coat and leachate collection system. Leachate collected is transported to sewage treatment facility by a tank lorry.	Investigation at the Energia Waste Incineration Plant	Possible to accept	2	3	6
	Recommended	(4) Environmental monitoring system	Environmental monitoring system legally established in overall Ukraine and there are a lot of analysis laboratries. Leachate and atmosphere are now analized in the disposal site.	Limit Plus LLC - environmental l aboratory. http://www.ecolab -plus.com.ua/	Environmental monitoring system is properly established.	1	4	4
	Recommended	(5) Practical experiences of similar facilities	A waste incineration plant already exists, and Cogeneration facilities, CHP, are stably operated.	Studied by JICA survey team	a waste incineration Plant acctuall exists and properly managed/.	1	4	4
	Recommended	(6) Securing of engineers	There is not unease to secure engineers required because there are a lot of engineers and technicians working in neuclear generation plant and CHP.	Studied by JICA survey team, investigation at the Energia Waste Incineration Plant	There is not uneasiness for securing engineers required.	1	4	4
					Business Promotion (yes) nil・defer	【Total】 168/204		

Tentative Evaluation Result

【Targeted Area】Dnipro City　　【Date of Evaluation】26th May 2018

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
1) Social aspect	Most important	(1) Population of the target city	The population of Dnipro city is approx. 1000 thousand, and stable for past 10 years. A part of waste is carried into Dnipro city from neighboring area	Studied by JICA survey team	No. of citizens is enough	3	4	12
	Inportant	(2) Social needs	The waste disposal site, Right Bank, has large area of 131.5 hecare. The city accepts strong request on the management of the sisposal site. The city pushes forward to construct waste processing complex in the Right Bank.	Investigation at Dnipro city and Eco Dnipro	Waste-to-energy system is not excluded.	2	3	6
	Recommended	(3) Development status of social infrastructure pertaining to environmental sanitation	Electric supply is stable. Resional sewage treate plant is under operation. In addition, central heating system is arranged.	Studied by JICA survey team	Social infrastructure related to environmental health is highly arranged.	1	4	4
	Recommended	(4) Integration of environmental and social considerations	The law on environmental impact assesment is established. The facility constructed is expertised on the process of project from environmetal aspect. Legal system is now being established seekiing for EU participation.	Studied by JICA survey team	Environmental and social considerations are established.	1	4	4
2) Public understanding aspect	Most important	(1) Cooperation of residents in waste sorting	Base collection for dry battery is carried out. Environmental education focusing on school children is seeked.	Studied by JICA survey team	Removing unsuitable waste is possible through raising public awareness	3	3	9
	Most important	(2) Understanding of residents about Waste-to- Energy system	The waste incineratio plant existed in the past time, it abolished because of aging and problems of maintenance. Understanding of residents about waste-to -energy system is not clear. But the city administration is optimistic to get residents understanding.	Investigation at Dnipro city and Dnipropetrovsk Oblast	It is possible to achive understanding through explanation.	3	3	9
3) Institutional aspect	Most important	(1) Development of laws, enforcement orders and rules	The Energia Waste Incineration Plan is operated following to Ukrainian emission standard. Examination on the Law on Wastes, Recycling law for container amd packages and the law for controlling hazardous waste is pushed forward seeking for EU participatiion.	Investigation at the Ministry of Natural Resources and Environment	To reconfirm is desirable founding the establishment of laws.	3	3	9
	Important	(2) Stability of administrative organization	The organization in charge, partment of Ecology Policy, is clear and stable. The staff of city administration and local government have common recognition to challenges on waste management.	Studied by JICA survey team	Organizations are stable and staff remained in the post long enough	2	2	4

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Important	(3) Adequacy ofthe construction site	The waste processing complex is planed to costruct. The site is recognized to suit for the construction site.	Investigation at Dnipro city	Available in case of the Right Bank	2	4	8
4) Administrative governance aspect	Most important	(1) Positioning of Waste-to- Energy in upper level plan	The construction of thermal treatment facility is described in The National Waste Management Plan and the schedule and number of facilities are clarified.	National Waste Management Strategy	The number and time to construct thermal treatment facility is described in uppre level plan, the National Waste Management Strategy.	3	4	12
	Most important	(2) Political Stancestance of the head of local government	The mayor is intested in waste-to-energy plant and goes to foreign countires to study the plant.	Investigation at Dnipro city	Need to get understanding on advantages of waste-to-energy system]	3	3	9
	Important	(3) Performance capability of the government	The project is being pshed forward making full use of experienced local engineers.	studied by JICA survey team	Positively using outer orgnizations.	2	4	8
	Important	(4) Technical standards and operation pertaining to selling electricity	The system to sell electricity generated by waste-to-energy plant is not prepared yet. But it is now examined ny the organization in charge. Pipeline grid is arranged in urban area and the system to sell heat energy is already established.	studied by JICA survey team	Sale system of electricity including FIT is examined now. The system to sell heat energy is already extablished and implemented.	2	3	6
5) Financial aspect	Most important	(1) Securing of financial resources	Eco-Dnipro is trying to costruct facilities using private sector, but it is thought that enough financial resources are prepared for pivate sector to proceed the business.	Investigation at Dnipro city and Kyiv Energo	To secure finance resouces is a problem.	3	3	9
	Important	(2) Tipping fee	There is the system that the tariff is determined by the city council and reviced as is necessary. Waste collection service is stably provided for a long time. Careful posture is seen in a raise of tariff.	Investigation at Dnipro city	The system to revice tariff but careful posture to raise is observed.	2	3	6
	Important	(3) Revenue by selling electricity	As there is not an actual construciton plan of waste-to-energy facility, it is not possible to directly evaluate. But the experience to sell heat is utilized.	Investigation at Dnipro	Possible to set reasonably based on information and accumulated results	2	3	6
	Recommended	(4) Project scheme	A new waste processing facility is pushed forward to construct by PPP scheme, BOT or BOO, but the flamework of a facility is not dertermined by the city administration and mostly entrusted to the proposals of private companis. It is not thought that examination is enough.	Investigation at Dnipro city and Kyiv Energo	It can be found that there is a tendency to entrust to suggestion of private companies	2	2	4

Legend: Wt (weight, 0 -3), Pt (point, 0-4), TS (Total Score)

Classification	Importance	Item	situation in target city	Means to identify	Result	Wt	Pt	TS
	Recommended	(5) Project risks	PPP scheme including risk allocations are considered, it is not thought that risk allocation is understood enough at this moment.	Investigation at Dnipro city	It's advisable to check actual cases.	2	2	4
5) Technical aspect	Most important	(1) Collecting basic data concerning waste	As weighing bridges are installed in the waste disposal site, almost all waste flow is clear though a part of waste collected by private companies is not clear. Analyses of waste composition is not carried out periodicallhy but it is possible to estimate by the accumulated result of waste analyses occsionallh carry out before.	Studied by JICA survey team	Almost all are known	3	4	12
	Important	(2) Technical capacity of manufacturers	There is the result that the Europian branch of a Japanes plant maker negotiate to sell a facility in past. Participation of reliable manufacturer is expected if the condintions are reasonable.	Investigation at Facility provider	Possible to expect if conditions are reasonable	2	3	6
	Important	(3) Proper disposal of incineration residue (incineration ash)	The waste disposal site is equipped with sealing coat, It is thought that here is experience accept incineration residue in disposal site because the waste icncineration plant was operated until 2012.	Studied by JICA survey team, investigation at the Energia Waste Incineration Plant	Confirm when the processing method i.e bio-gasification or incineration, is determined.	2	3	6
	Recommended	(4) Environmental monitoring system	Environmental monitoring system legally established in overall Ukraine and there are a lot of analysis laboratries. Leachate and atmosphere are now analized in the disposal site.	Studied by JICA survey team, investigation at the Energia Waste Incineration Plant	Environmental monitoring system is properly established.	1	4	4
	Recommended	(5) Practical experiences of similar facilities	There is not unease to secure engineers required because there are a lot of engineers and technicians working in neuclear generation plant and CHP.	Studied by JICA survey team	a waste incineration Plant acctuall exists and properly managed/.	1	4	4
	Recommended	(6) Securing of engineers	There is not unease to secure engineers required because there are a lot of engineers and technicians working in neuclear generation plant and CHP.	Studied by JICA survey team, investigation at the Energia Waste Incineration Plant	There is not uneasiness for securing engineers required.	1	4	4
					Business Promotion (yes) nil・defer	【Total】 165/204		

Appendix 8

Japanese Experiences on Solid Waste Management

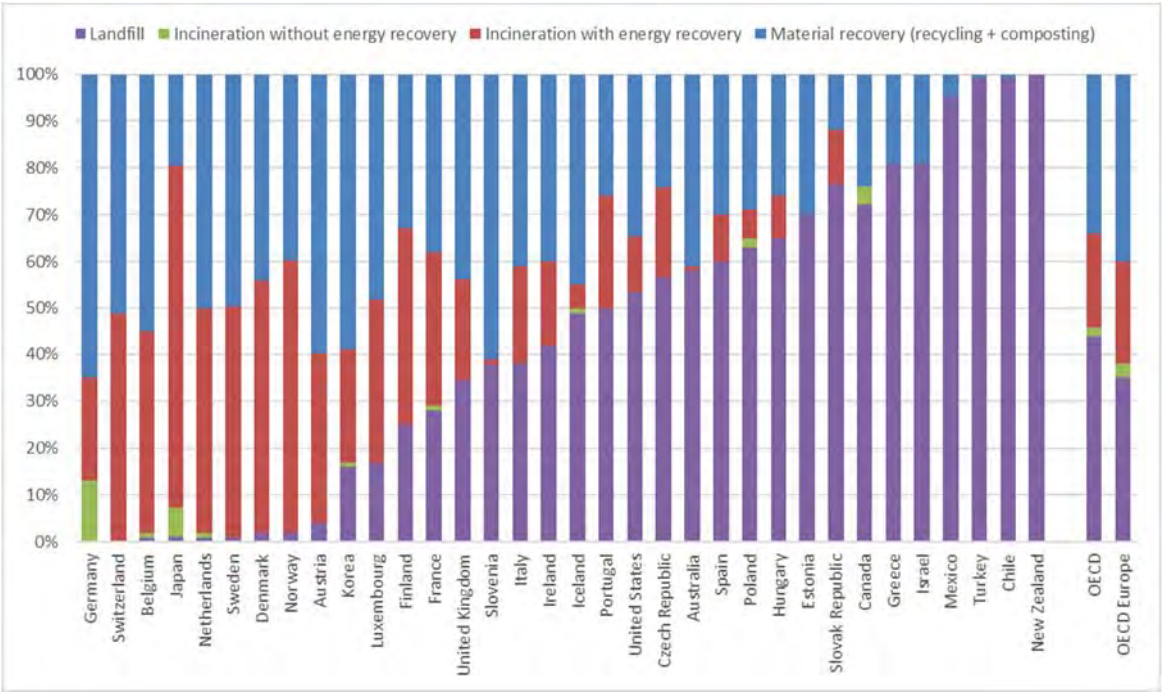
Appendix8 Japanese Experiences on Solid Waste Management

1. Distinctive Features of Japanese System

1.1 Overview

(1) Municipal Waste Disposal and Disposal in OECD Member Countries

Situations of municipal waste and disposal in OECD member countries are shown in Figure 1.



Source: Environment at a glance 2015 OECD INDICATORS

Figure 1 Situations of Municipal Waste Treatment in OECD Member Countries

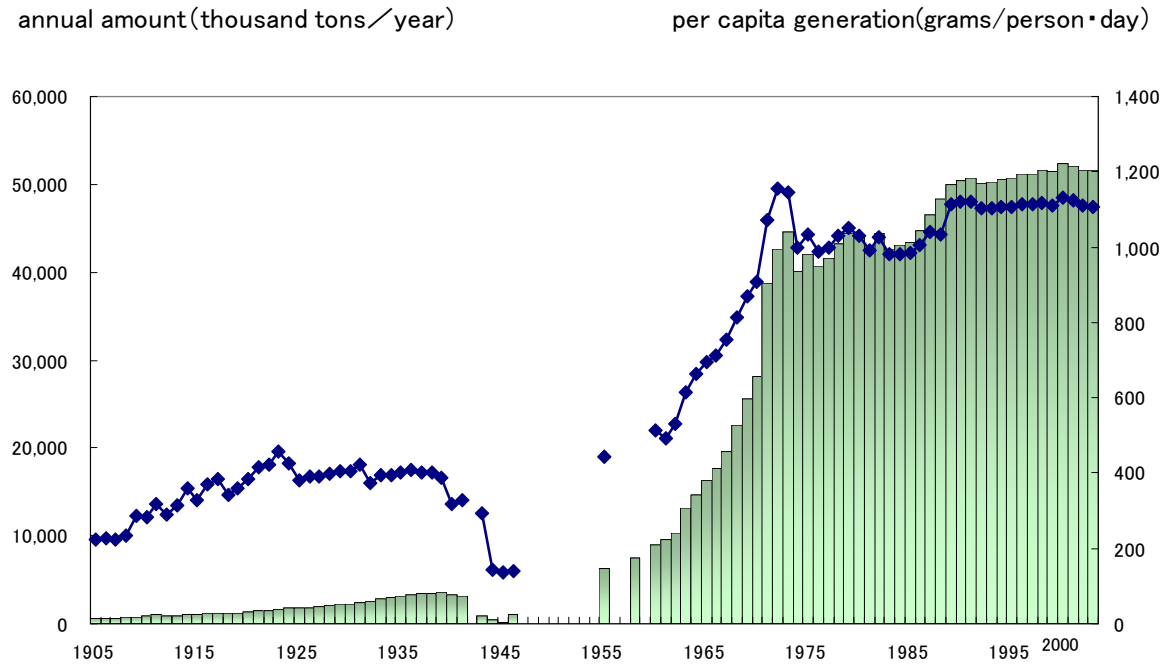
The most distinctive feature of the Japanese waste management system is the high ratio of municipal waste incineration and extremely low ratio of landfill. The same trend can be observed in countries with small land area such as Switzerland, Belgium, the Netherlands, and Denmark. In these countries, the ratio of material recovery from municipal waste is considerably lower than the other OECD member countries.

Figure 1 shows that some incineration plants in Japan are not equipped with an energy recovery facility. This situation is also similar in Germany. Other countries such as Switzerland, Belgium, the Netherlands, Sweden, and Denmark, where significant ratio of waste is incinerated, incineration plants are basically equipped with energy recovery facilities.

OECD also shows per capita municipal waste generation per year. In 2010, Japan has 350 kg, while 710 kg in Switzerland, 460 kg in Belgium, 570 kg in the Netherlands, 460 kg in Sweden, and 670 kg in Denmark. Lower per capita generation of municipal waste is another distinctive feature of the Japanese system.

(2) Changes in Municipal Waste Generation in Japan

The state of municipal waste generation has been changed along with the development of cities and economy. In the process of change, various improvement of management system and technology has been accomplished coping with newly appearing problems. Changes in municipal waste generation are shown in Figure 2.



Source: Ministry of Environment, Japan

Figure 2 Annual Amount of Municipal Waste and Per Capita Generation

1.2 Changes in Waste Management System in Japan

At present, Japan has a solid system for waste management and recycling. Japan, however, experienced problems on public health, certain removal of waste from living environment, shortages of landfill site, illegal dumping of waste, environmental protection, getting better awareness by inhabitants, effective use of natural resources, etc. These are all problems that today's developing countries are facing.

It is important to know the problems Japan encountered in the past, as well as the measures developed and technologies introduced to cope with these problems. Figure 3 show waste collection in Tokyo at the time.

(1) Public Health Improvement and Waste Cleaning Act

In Japan, at the beginning of modernization, waste was treated by waste generators themselves or by private waste treatment operators who collected waste and selected valuables to sell them for profit. Waste was often discarded by waste treatment operators on roadsides or vacant lots and piled up in unsanitary conditions. In addition, as a result of increasing contact between humans and waste, various infectious diseases spread and necessity for improvement of public health gained attention.

The Waste Cleaning Act was enacted in 1900 in order to improve public health. The act defined the collection and disposal of waste as the obligation of municipalities and placed waste treatment operators under the supervision of governmental administrations to establish waste administration system. The act described that waste should be incinerated if possible.

(2) Modernization of Waste Removal and Public Cleansing Act

Japan faced the need to deal with urban municipal waste whose amount continued to increase rapidly as a result of economic development and urban population concentration. It becomes more difficult to cope with the rapid increase in the amount of waste by using manual collection methods. Furthermore, transporting waste to incineration plants or landfill sites requires reloading from carts to automobiles, and since reloading operations were undertaken on the streets, these created public health problems.

Waste collection using cart
Source: One hundred years of waste management in Tokyo

Reloading operation on street
Source: Waste management in Tokyo shown with photograph

Figure 3 Waste Collection in Tokyo at the Time

In order to develop systems for the division of roles and collaboration among different entities in waste management, i.e., national and local government and consumers, and in order to efficiently solve problems of municipal waste, the Japanese government enacted the Public Cleansing Act in 1954, in addition to conventional system of waste collection and disposal by municipalities. This act also defined the obligation of national and prefectural government to provide financial and technological supports to municipalities as well as the obligation of inhabitants to cooperate with municipalities in collecting and disposing of waste.

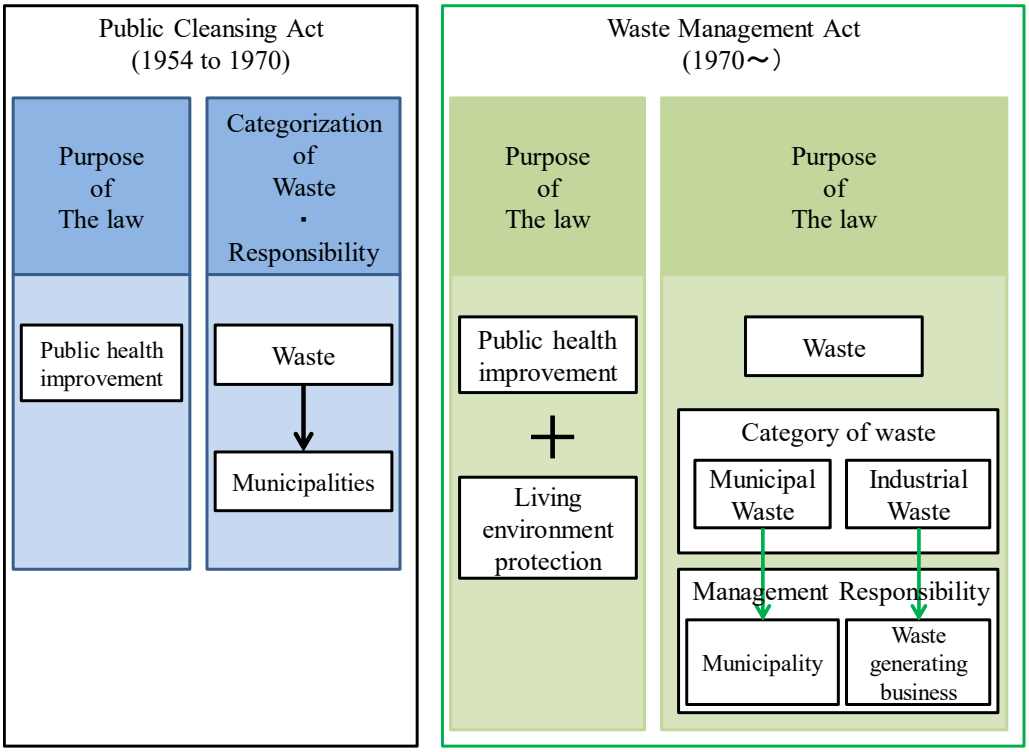
(3) High Economic Growth, Pollution Problems and Waste Management and Public Cleansing Act

As a result of high economic growth and income increase, as well as the widespread use of home appliances and emergence of supermarkets and convenience stores, marketing system and consumption behavior changed during the 1960s and 1970s. Due to such changes, an economy based on mass production and mass consumption developed, causing a rapid increase in the amount and kind of municipal waste.

Rapid industrialization resulting from high economic growth generated pollution by hazardous waste discharged from factories, such as organic mercury and cadmium, and seriously damaged the health of inhabitants in surrounding areas. Also, products made of plastic and other materials became widely used and were discarded in large amounts. Plastics do not deteriorate nor return to the soil even when they were buried underground.

In order to specify the responsibilities and standards in the management of all wastes, including industrial waste, and to develop basic systems for waste management, the government made extensive revisions to the Public Cleansing Act, and enacted the Waste Management Act in 1970. Distinguishing between two types of waste, i.e., industrial waste and municipal waste, the Waste Management Act defined the responsibility of municipalities to manage municipal waste as it had been done previously, while at the same time, newly defined responsibility of waste-generating business operators to manage industrial waste.

Purpose and categorization of waste in the Public Cleansing Act and Waste Management Act are illustrated as shown in Figure 4.



Source: History and current state of waste management Japan, MOEJ

Figure 4 Purpose of Categorization of Waste in the Laws

(4) Measures Implemented to Solve Problems; Promotion of Proper Waste Management

For the purpose of coping with the increase in amount of waste and promoting the proper management of hazardous waste, industrial waste which includes mercury and cadmium, the government strived to raise the general level of waste management by supporting the construction of waste management facilities in areas across Japan. In order to prevent pollution, increase incineration efficiency, and provide effective waste treatment and disposal, the government established the rules for sorting waste in the process of waste collection.

(5) War Against Waste; Tokyo Waste War

During Japan's rapid economic growth period, Tokyo has been confronted with deterioration of the living environment in areas around the landfill. This was due to the fact that large amounts of waste were landfilled without proper treatment. The construction of waste incineration facilities was bogged down by residents' opposition in surrounding areas. This situation was particularly serious in Koto Ward, which accepted the bulk of waste generated in the metropolitan area of Tokyo. In Koto Ward, the living environment of residents in area around the landfill was seriously compromised by foul odors and plagues of flies and mosquitoes from the landfills as well as by waste trucks that littered waste on the roads.

Under these conditions, Koto Ward adopted the resolution at the ward assembly meeting to oppose accepting waste from other wards. Also, opposition to an active movement against the construction of a waste incineration facility in the Suginami Ward, the residents of the Koto Ward interrupted the transportation of waste from Suginami Ward. Figure 5 show aspects of Tokyo Waste War.

Interruption of transportation of waste into Koto Ward
Source: One hundred years of waste management in Tokyo

Negotiations with resolution alliance against construction of incineration plant
Source: Waste management in Tokyo shown with photograph

Figure 5 Tokyo Waste War

The war against waste raised the awareness of citizens that waste is an important issue of daily life. As a result, people recognized the importance of government organizations and inhabitants working together to promote waste management and strategies implemented to promote the development of waste management facilities that are friendly to the surrounding environment.

(6) Construction of Incineration Plants that are Friendly to Surrounding Environment

The latest technologies to control pollution were introduced into waste management facilities and operation states in detail are shown in the area and public. Inhabitants really recognized that contaminants included in the exhaust gas and wastewater were well controlled; and waste management facilities are safe enough. Consequently, the waste management facilities including waste incineration plants gradually obtained the trust of local inhabitants. Then, waste incineration facilities were able to be built in proximity to residential and commercial facilities. The photos on the promotion of environmentally friendly waste incineration plants in Japan are shown in Figure 6 and typical example of pollution control state for exhaust gas from incineration plant is shown in Table 1.

Exhaust gas state indication board placed at the entrance

Facility management meeting inviting the representative inhabitants

Municipal incineration plant constructed in residential area

Inhabitants enjoying cherry-blossom viewing at the garden of an incineration plant

Source: Photograph provided by the Waste Management Authority of 23 cities of Tokyo

Figure 6 Promotion of Environmentally Friendly Waste Incineration Plants

Table 1 Typical Example of Pollution Control State for Exhaust Gas from Incineration Plant

Kind of contaminant	Cause of generation	Emission standard Removal methods	Possible control level
Dust	Particulates among flue gas	0.04～0.1 g/m^{3}N Removal by dust collection (bag filter)	0.01 g/m^{3}N or less
HCL	Combustion of matters contain Cl (plastics, salt etc.)	700 mg/m^{3}N Removal by alkali agent such as lime	10～30 ppm or less
SO_X	Combustion of sulfur component in waste and/or petroleum	(Depend on area) Same as HCl	30 ppm or less
NO_X	Combustion of N2 component Reaction of O_2 and N_2 in air	250 ppm Decomposition by urea or ammonia	60～80 ppm (non-catalyst) 50 ppm or less (catalyst)
Dioxins	Imperfect combustion Chemical reaction between Cl and organic matters	ng-TEG/m^{3}N Combustion control, adsorption etc.	0.1 ng-TEQ/m^{3}N or less

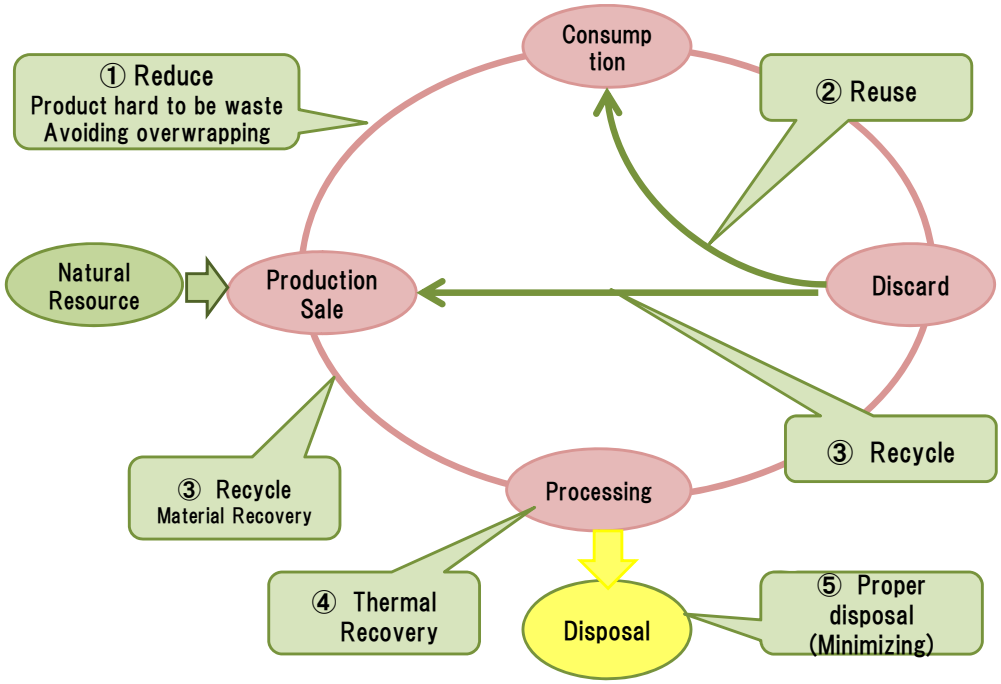
Source: JICA Survey Team

(7) Era of the Establishment of Sound Material Society

There had been significant progress in the proper management of waste in the 1980s. However, some problems were still left unsolved, including increase in waste generation and the resulting shortage of landfill. In order to provide comprehensive solutions to such problems, the government shifted the focus of its policies to reducing waste generation itself.

Furthermore, in order to move away from the current economic system based on mass production, mass consumption and mass disposal, and to promote the establishment of sound material-cycle society designed to ensure the implementation of the 3Rs, i.e., reduce, reuse and recycle, and proper waste management, the government established the Basic Act for Establishing a Sound Material-Cycle Society, so-called "Basic Recycling Act" in 2000.

This law provides a clear vision for a sound material-cycle society, which is designed to reduce natural resource consumption as well as environmental impact. It also presents basic principles for the establishment of a sound material-cycle society including determining legally the order of priority for resource recycling and waste management as follows: 1. generation reduction, 2. reuse, 3. recycling, 4. thermal recovery, and 5. proper disposal. This concept is illustrated in Figure 7.



Source: JICA Survey Team

Figure 7 Concept of 3Rs Policy

Appendix 9

Comparison of Waste Treatment Options

Appendix 9. Comparison of Waste Treatment Options

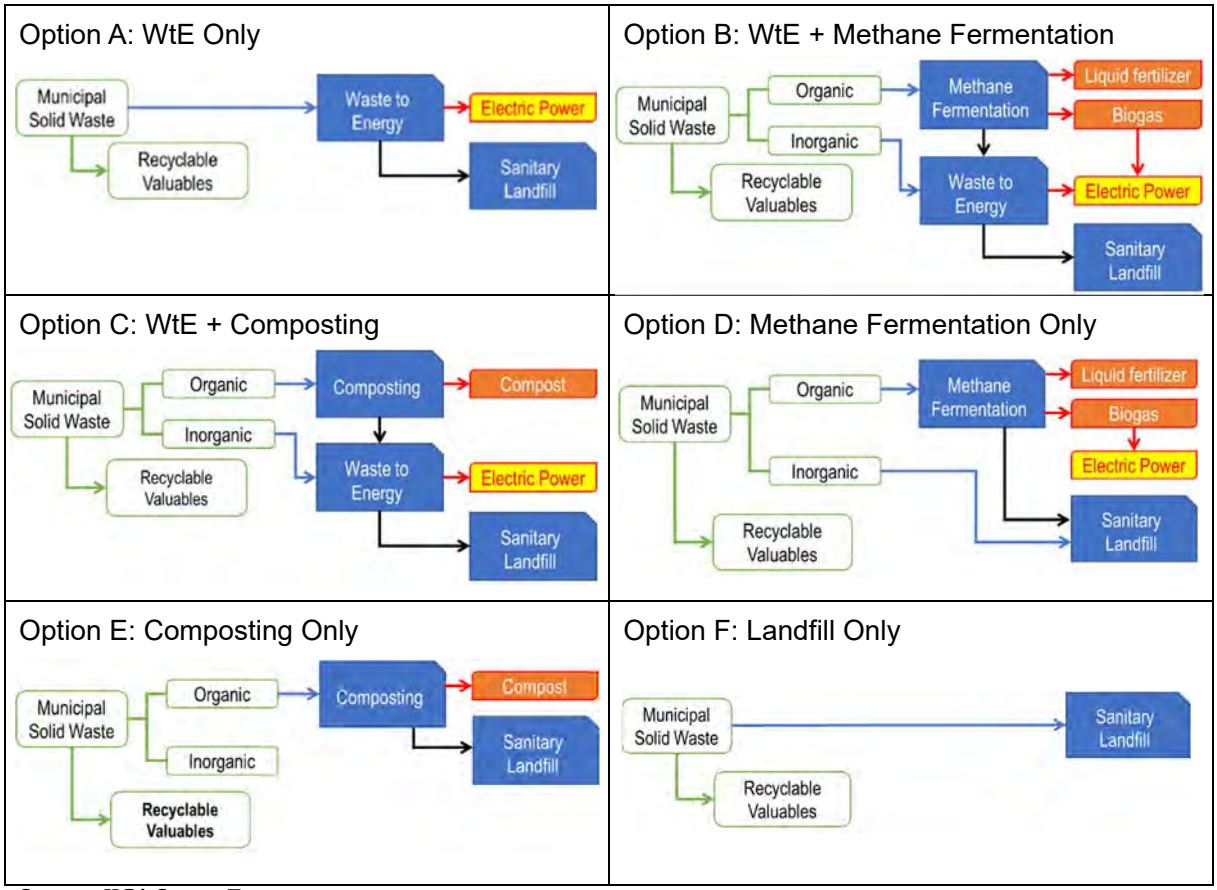
1. Introduction

Upon consideration on assistance scenarios for SWM in the three target cities, the JICA Survey Team introduced general comparison among the alternative technologies.

It is proposed to compare the advantages and disadvantages of the alternatives such as a waste to energy (WtE) plant, a methane fermentation plant, a composting plant, a sanitary landfill site and combination of these facilities (shown in Figure 1.1), from the environmental, financial, and social view points as shown in Table 1.1.

According to the National Waste Management Strategy of Ukraine which was approved in November 2017, waste cannot be disposed of at landfill sites or incinerated without waste volume reduction through reuse and recycling. Thus, reuse and recovery of recyclables before intermediate treatment and final disposal is a general condition in the comparison.

The calculation of project costs and facility capacities was conducted based on many assumptions and default values, thus it can be used for relative comparison purpose.



Source: JICA Survey Team

Figure 1.1 Proposed Comparison of Options

Table 1.1 Comparison Methods

Category	Item	Method
Financial Aspect	Approximate cost	Estimation of the capital cost (CAPEX) and operation cost (OPEX) based on experiences in Japan.
Environmental Aspect	Greenhouse gas emission	Estimation of the emission amount by using ver. 1 and 2 of JICA's supporting tool for climate change measures Methane fermentation, Composting: Ver. 2.0 (March 2014) WtE (Incineration), Landfill: Ver. 1.0 (June 2011)
	Volume of final disposal	Final disposal volume can be considered as a parameter of environmental load. It can be identified based on a material flow.
Social Aspect	Social acceptability	Qualitative verification on the introduction of source: separation, the required land area, the impact on the existing waste pickers as well as the contribution to the power supply.

Source: JICA Survey Team

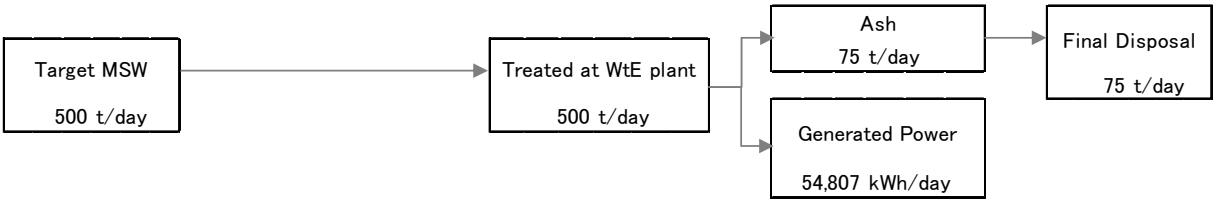
2. Material Flow and Design Capacity of Facilities in Each Option

Target waste volume for calculation of design capacity of facilities in each option was tentatively set at 500 t-waste per day. Any other conditions for the calculation are shown as follows:

i) Operation periods of the facilities: 15 years
ii) Waste composition data: Survey data in Kyiv in 2010

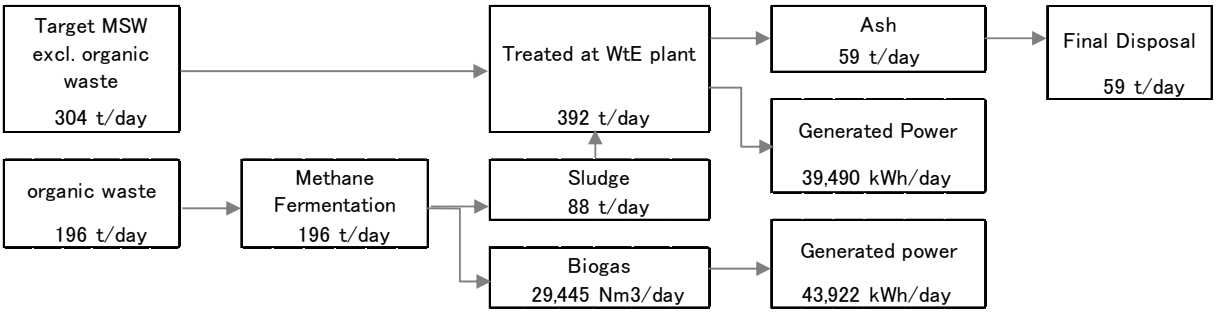
Based on the above methods and conditions, material flows and design capacities were calculated as follows:

The material flows are shown in Figure 2.1 to Figure 2.6:



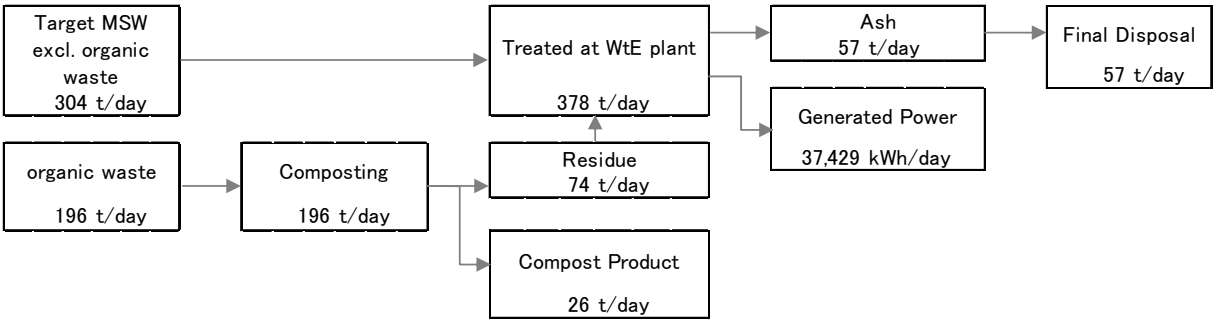
Source: JICA Survey Team

Figure 2.1 Material Flow of Option A: WtE Only



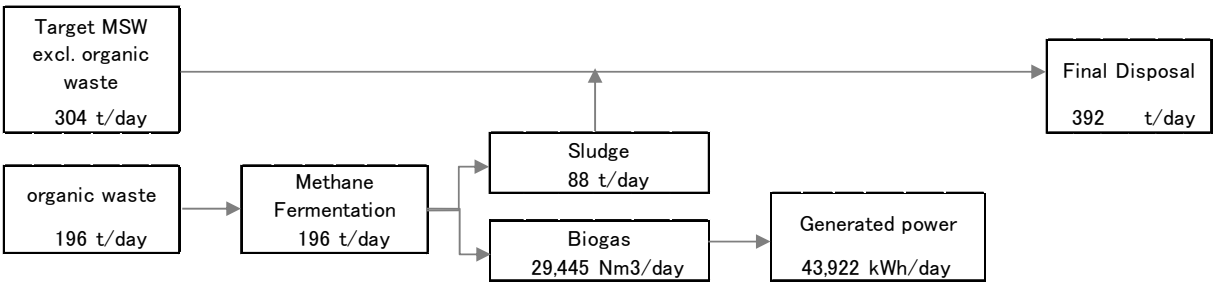
Source: JICA Survey Team

Figure 2.2 Material Flow of Option B: WtE + Methane Fermentation



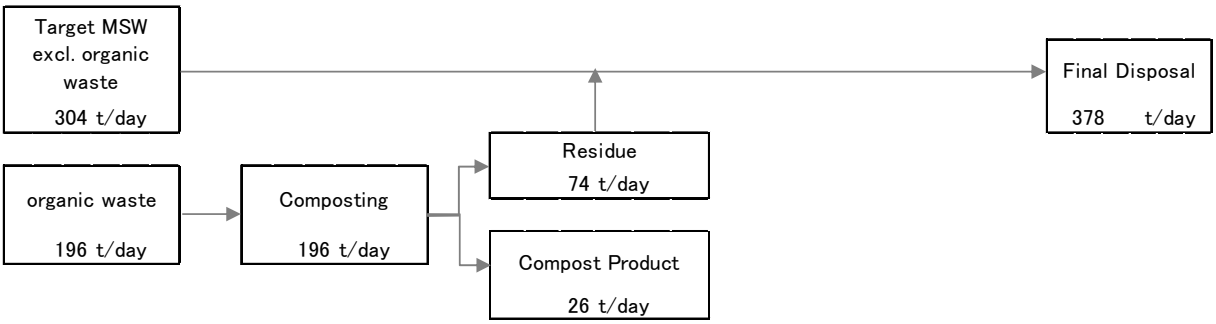
Source: JICA Survey Team

Figure 2.3 Material Flow of Option C: WtE + Composting



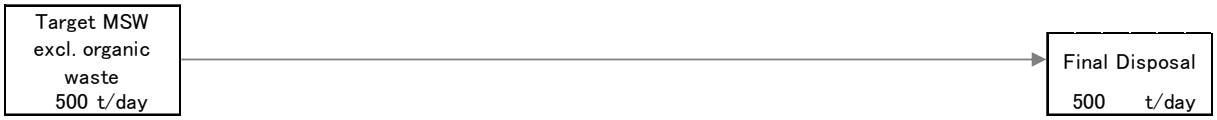
Source: JICA Survey Team

Figure 2.4 Material Flow of Option D: Methane Fermentation Only



Source: JICA Survey Team

Figure 2.5 Material Flow of Option E: Composting Only



Source: JICA Survey Team

Figure 2.6 Material Flow of Option F: Landfill Only

Based on the material flows, design capacities, which are set considering occupancy rates of the facilities in each option were calculated as shown in Table 2.1:

Table 2.1 Design Capacities of Facilities

Type of Facility	Unit	Design Capacity					
		A	B	C	D	E	F
WtE plant[1]	t/day	680	540	520			
Landfill site[2]	m^2	44,000	35,000	34,000	398,000	381,000	508,000
	m^3/15yrs	289,859	227,262	218,850	2,652,587	2,537,335	3,383,103
Methane fermentation plant	t/day		240		240		
Composting plant	t/day			250		250	

Note: 1) In cases of B and C, the design capacities of WtE plants include residues from the methane fermentation plant and the composting plant.
2) The design capacity of landfill site includes soil cover volume.
Source: JICA Survey Team

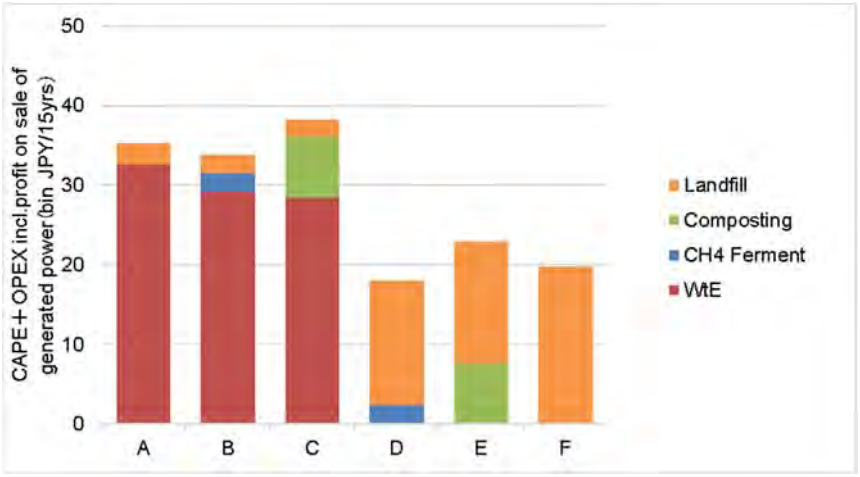
3. Financial Aspect

Based on the calculated design capacities, CAPEX, OPEX and profit on sale of generated power were calculated as shown in Table 3.1 and Figure 3.1.

Table 3.1 Calculated CAPEX, OPEX and Profit on Sale of Generated Power

Option	Type of Facility	i. CAPEX	ii. OPEX[1]	iii. Profit on sale of generated power[2]	iii. Total Cost (= i + ii + iii)
		bln JPY	bln JPY/15yrs	bln JPY/15yrs	bln JPY/15yrs
A	WtE plant	22.4	15.3	-5.1	32.6
	Landfill site	1.4	1.3	0.0	2.7
	Total	23.8	16.6	-5.1	**35.3**
B	WtE plant	18.9	13.9	-3.7	29.2
	Methane fermentation plant	6.7	5.0	-9.4	2.4
	Landfill site	1.2	1.1	0.0	2.3
	Total	26.8	20.1	-13.1	**33.8**
C	WtE plant	18.4	13.5	-3.5	28.4
	Composting plant[3]	4.4	3.3	0.0	7.7
	Landfill site	1.1	1.0	0.0	2.2
	Total	24.0	17.8	-3.5	**38.2**
D	Methane fermentation plant	6.7	5.0	-9.4	2.4
	Landfill site	10.7	5.1	0.0	15.8
	Total	17.4	10.1	-9.4	**18.1**
E	Composting plant[3]	4.4	3.3	0.0	7.7
	Landfill site	10.3	5.0	0.0	15.2
	Total	14.7	8.2	0.0	**22.9**
F	Landfill site	13.5	6.2	0.0	**19.8**

Note: 1) OPEX includes cost for electricity, labor and repair. OPEX of the landfill site includes cost for leachate treatment after its closure as well.
2) Minus means profit in this table. Unit rates for sale of power generated from WtE plants and methane fermentation plants are set at 19 JPY/kW and 39 JPY/kW respectively.
3) It was assumed the compost product will not generate financial sales proceed.
Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.1 Calculated CAPEX and OPEX including Profit on Sale of Generated Power

Comparing A, D and E with F respectively, the results indicate the WtE and composting is more expensive than sanitary landfill and methane fermentation is cheaper than sanitary landfill.

4. Environmental Aspects

4.1. GHG Emission

Volumes of GHGs emission reduction in all the options were calculated by utilizing JICA Climate Finance Impact Tool (JICA Climate FIT) for Mitigation[1]. JICA Climate FIT was developed in 2011 and revised in 2014 in order to evaluate GHGs emission reduction as a tool to examine if JICA' should implement a project.

4.1.1. Calculation method

The outline of calculation method is as shown below.

4.1.1.1. Volume of GHGs emission reduction through implementation of the projects

Volume of GHGs emission reduction through implementation of the projects are calculated as a gap between GHGs emission volumes of with and without the project options. The options with and without the project are defined as below:

Table 4.1 Definition of baseline and project scenario

Baseline (option without the project)	To continue current SWM system which is to dispose of waste at landfill site under anaerobic condition without any intermediate treatment.
Project scenario (option with the project)	To conduct intermediate treatment such as incineration, methane fermentation, composting before final disposal at landfill site as shown in Figure 1.1.

Source: JICA Survey Team

The formula calculating the volume of GHGs emission reduction is as follow:

$$ER_y = BE_y - PE_y$$

In which:

ER_y : Volume of GHGs emission reduction in the project scenario in a year of "y" (t-CO_2/y)

BE_y : Volume of GHGs emission in baseline in a year of "y" (t-CO_2/y)

PE_y : Volume of GHGs emission in the project scenario in a year of "y" (t-CO_2/y)

[1] https://www.jica.go.jp/activities/issues/climate/mitigation_j.html

4.1.1.2. Volume of GHGs emission in baseline

The volume of GHGs emission in baseline is calculated as total of GHGs emission volume converted from methane generated from waste disposed at a landfill site.

The formula calculating the volume of GHGs emission in baseline is as follow:

$$BE_y = MB_y - MD_{reg,y}$$

In which:

MB_y : GHGs emission volume converted from volume of methane generated at landfill sites in baseline in a year of "y" (t-CO_2/y)

$MD_{reg,y}$: volume of GHGs emission reduced by methane recovery from flaring according to regulations or standard in the country reduction in a year of "y" (t-CO_2/y)

4.1.1.3. Volume of GHGs emission in project scenario

The volume of GHGs emission by generation of methane and carbon dioxide at WtE plant, methane fermentation plant, composting plant and sanitary landfill sites is calculated by using the following formula. GHGs emission volume by energy generation at conventional power plants of the same amount of energy generated in the project can be deducted.

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{i,y} + PE_{a,y} + PE_{c,y} + PE_{l,y} + PE_{w,y} - PE_{EN,y}$$

In which:

$PE_{EC,y}$: GHSs emission volume by electricity consumption in the project in a year of "y" (t-CO_2/y)

$PE_{FC,y}$: GHSs emission volume by fuel consumption in the project in a year of "y" (t-CO_2/y)

$PE_{i,y}$: GHSs emission volume by incineration of waste in the project in a year of "y" (t-CO_2/y)

$PE_{a,y}$: GHSs emission volume by methane fermentation of waste in the project in a year of "y" (t-CO_2/y)

$PE_{c,y}$: GHSs emission volume by composting of waste in the project in a year of "y" (t-CO_2/y)

$PE_{l,y}$: GHSs emission volume by disposal of waste at landfill sites in the project in a year of "y" (t-CO_2/y)

$PE_{w,y}$: GHSs emission volume by treatment of wastewater including leachate in the project in a year of "y" (t-CO_2/y)

$PE_{EN,y}$: GHGs emission volume in energy generation of the same amount of energy generated in the project in a year of "y" (t-CO_2/y)

4.1.2. Others

4.1.2.1. Project boundary

The boundary of calculation of GHGs emission defined as within the project site where intermediate treatment and disposal at landfill sites will be conducted.

4.1.2.2. Leakage

Leakage in waste management in the calculation would be emission by increased traffic volume, emission from incineration residues and emission by end users of produced compost. However, the volumes of these emission are assumed to be quite small so they were not considered in calculation.

4.1.3. Calculation results

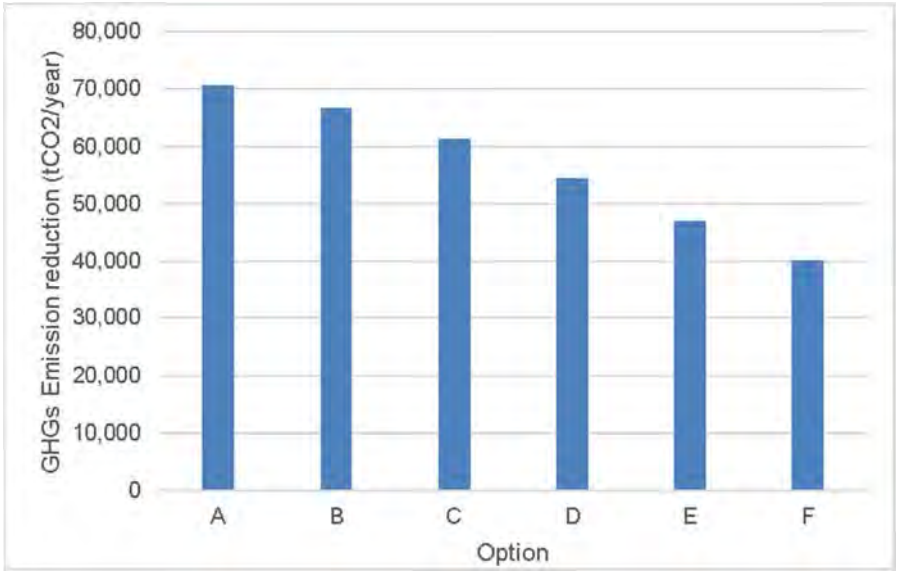
The calculation results are as shown in Table 4.2 and Figure 4.1. The results indicate that WtE, methane fermentation, composting and sanitary landfill are efficient for GHGs emission reduction, in that order.

Table 4.2 Volume of GHGs emission reduction in each option

Unit: t-CO_2/year

No.	Item	Option A	Option B	Option C	Option D	Option E	Option F
1	GHGs emission in baseline	73,122					
2	GHGs emission in project scenario	2,428	6,300	11,707	18,591	26,073	32,907
3	GHGs emission reduction (=1-2)	70,694	66,822	61,415	54,531	47,049	40,215
4	Reduction rate	97%	91%	84%	75%	64%	55%

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1 Calculated GHGs Emission Reduction

4.1.3.1. Final disposal volumes and areas of landfill sites

Final disposal volumes at landfill sites and areas of landfill sites, which is parameters for general environmental impact and change of natural landscape respectively, in all the options are as shown in Table 4.3.

Regarding final disposal volume, in the cases of options A, B and C which includes incineration of waste, its reduction through intermediate treatment is significant and it will be 10 -15 % comparing to the option F that all waste is disposed at landfill sites.

Regarding areas of landfill sites, according to final disposal volume, in the cases of options A-E, the areas of landfill sites can be reduced through incineration and recycling of organic waste, which means change of natural landscapes can be reduced.

Table 4.3 Final disposal volumes and areas of landfill sites

Items	Unit	Option A	Option B	Option C	Option D	Option E	Option F
Final disposal volume	Ton	75	59	57	392	378	500
Design capacity of landfill site[1]	m^3/15yrs	289,859	227,262	218,850	2,652,587	2,537,335	3,383,103
Area of landfill site	m^2/15yrs	44,000	35,000	34,000	398,000	381,000	508,000

Note: 1) The design capacity of landfill site includes soil cover volume.
Source: JICA Survey Team

4.2. Other environmental aspects

Other environmental aspects apart from GHGs emission reduction and final disposal volume in all the options were evaluated qualitatively and the evaluation results are as shown in Table 4.4.

Table 4.4 Results of qualitative evaluation on other environmental aspects

Items	Qualitative evaluation
Leachate	In the cases of options A, B and C, reduction of final disposal volume leads reduction of leachate generated at the landfill sites. In addition, prevention of disposal of organic waste at landfill sites leads reduction of polluting load of water quality parameters such as BOD and nitrogen/phosphorous compounds as well. In the cases of options D and E as well, final disposal volume can be reduced through recycling of organic waste. It leads reduction of polluting load of water quality parameters and reduction of polluting load of water quality parameters though their reduction volumes are much less than the options A-C.
Odor and injurious insects	In the cases of options A-C, odor and injurious insects inside and around the landfill sites can be minimized through incineration process. In the cases of options D-E as well, the odor and injurious insects can be reduced through recycling of organic waste. Daily soil cover also leads reduction of the odor and injurious insects especially in the option F.
Air pollution	In the cases of options A-C that all or a part of waste will be incinerated, they may enhance air pollution such as dioxins. However, proper gas treatment equipment and operation such as dust collectors, incineration at a high temperature and gas quenching treatment can minimize the air pollution.

Source: JICA Survey Team

Table 4.5 Summary of evaluation results of other environmental impacts

Environmental impact	Option A	Option B	Option C	Option D	Option E	Option F
Leachate	◎ Possible to reduce drastically	◎ Possible to reduce drastically	◎ Possible to reduce drastically	○ Possible to reduce	○ Possible to reduce	― No change
Odor/injurious insects	◎ Possible to reduce drastically	◎ Possible to reduce drastically	◎ Possible to reduce drastically	○ Possible to reduce	○ Possible to reduce	○ Possible to reduce
Air pollution (GHGs emission is not considered here)	△ Possible to minimize air pollution through proper treatment	△ Possible to minimize air pollution through proper treatment	△ Possible to minimize air pollution through proper treatment	― No change	― No change	― No change

Legends: ◎/×: Major positive/negative impact, ○/△: Positive/negative impact, -:No impact
Source: JICA Survey Team

5. Social acceptability

Social acceptability of all the options such as feasibility of separate collection, impact to livelihood of waste pickers and contribution to stable power supply were evaluated qualitatively.

5.1. Separate collection

According to the new national waste management strategy, municipal waste will not be able to be incinerated without any recovery of recyclables as shown in Figure 1.1. In the cases of options B-E, in addition to the recovery of recyclables, separation of organic waste, such as food waste and green waste,

by source separation or mechanical sorting is one of conditions for proper operation of methane fermentation and composting facilities.

The source separation is very rare in the three target cities though private companies are conducting it at some of housing complexes. Also in Japan, only some towns and villages conduct source separation of organic matters from household waste. It seems to be difficult to conduct source separation of household organic waste in big cities with a population of more than a million.

On the other hand, in EU member countries, source separation into three kinds of waste such as packaging waste, papers and other waste including organic waste is conducted and organic waste is sorted and recycled at mechanical and biological treatment facilities.

5.2. Contribution to stable power supply

In the cases of options A-C, the WtE plants can be power supply plants (heat supply plants) with power generation facilities (or heat recovery facilities). Though power generation capacities of WtE plants are not very big, there are over 1,000 WtE plants with power generation in Japan. Most of incineration plants with daily capacity of over 100 ton are equipped with power generation facilities and use generated power within the plants and sell the rest to power companies. When big earthquakes happened, it supplied power to the surrounding areas.

5.3. Securement of land

Generally, it is very difficult to secure land for a SWM facility as people consider SWM facilities as troublesome. Moreover, a waste final disposal site requires a large land and it is not easy to secure it.

The WtE plants can reduce waste volume and the land of final disposal site as well. As shown in Table 5.1, the areas of final disposal sites can be reduced up to around 10 % through incineration process.

5.4. Livelihood of waste pickers

There are more or less waste pickers at the No. 5 landfill site in Kyiv City, the Right Bank Complex in Dnipro City and the Dergachi landfill site in Kharkiv City. At most in Dnipro City, there are approximately 100 waste pickers in Dnipro City. Waste pickers are often affected by SWM projects.

In the cases of options A-C, installation of the WtE plants will affect the recyclable collection of waste pickers, which means it will affect livelihoods of the waste pickers.

As a measure on the impact to the waste pickers, in the cases of options B and C, if sorting facilities will be installed as pretreatment in the methane fermentation plant and the composting plant, the waste pickers can be employed as sorting operators. However, as it will not be able to provide them enough employment, the local governments will have to provide other job opportunities.

In the cases of options D-F that all waste or waste apart from organic waste will be disposed at landfill sites, some recyclables will come to landfill sites so that it will not affect the livelihoods of waste pickers.

Table 5.1 Comparison of Social Acceptability of all the options

Items	Option A	Option B	Option C	Option D	Option E	Option F
Separation of organic waste	○ No change	× Separation is needed.	× Separation is needed.	× Separation is needed.	× Separation is needed.	○ No change
Impact on Livelihoods of waste pickers	× Directly affected. Compensation of alternative jobs is necessary.	△ Directly affected. Possible to employ partially at new plants though it will be affected.	△ Directly affected. Possible to employ partially at new plants though it will be affected.	○ No change	○ No change	○ No change
Contribution to stable power supply	○ Generate power stably	○ Generate power stably	○ Generate power stably	○ Generate power stably	× No power generation	× No power generation (power

						generation from landfill gas can be an option)
Securement of land	○ Land will be much smaller than option F.	○ Land will be much smaller than option F.	○ Land will be much smaller than option F.	△ A huge land is necessary. (bit smaller than option F)	△ A huge land is necessary. (bit smaller than option F)	× A huge land is necessary.

Legends: ◎/×: Major positive/negative impact, ○/△: Positive/negative impact, -:No impact
Source: JICA Survey Team

6. Comparison results of waste treatment options

All the above results of the waste treatment options were summarized in Table 6.1.

Table 6.1 Summary of comparison results of waste treatment options

Items		Option A	Option B	Option C	Option D	Option E	Option F
Financial	Project cost (bln JPY)	40.9	48.3	40.5	31.4	25.6	23.3
Environmental	GHG emission reduction (t-CO2/yr)	70,694	66,822	61,415	54,531	47,049	40,215
	Change of natural landscape	◎	◎	◎	○	○	―
	Leachate	◎	◎	◎	○	○	―
	Odor/injurious insects	◎	◎	◎	○	○	○
	Air pollution	△	△	△	―	―	―
Social	Separation of organic waste	○	×	×	×	×	○
	Contribution to stable power supply	○	○	○	○	×	―
	Securement of land	○	○	○	×	×	―
	Impact on Livelihoods of waste pickers	×	△	△	△	△	―

Legends: ◎/×: Major positive/negative impact, ○/△: Positive/negative impact, -:No impact
Source: JICA Survey Team

Evaluation results of each waste treatment option is as shown in Table 6.2:

Table 6.2 Evaluation results of each waste treatment option

Option	Evaluation
Option A: WtE only	▪ The total project cost including CAPEX and OPEX for 15 years is the second highest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the biggest (97%). Final disposal volume at landfill sites can be drastically reduced from 500 ton/day to 75 ton/day. ▪ The option A has many advantages such as reduction of odor/injurious insects and change of natural landscape. ▪ Regarding social acceptability, the option A has some advantages such as unnecessity of separation of organic waste, stable power supply and reduction of the area of final disposal site. However, it will affect livelihoods of waste pickers so that compensation for them will be necessary.
Option B: WtE + Methane fermentation	▪ The total project cost including CAPEX and OPEX for 15 years is the highest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the second biggest (91%). Final disposal volume at landfill sites can be drastically reduced from 500 ton/day to 59 ton/day. ▪ The option B has many advantages such as reduction of odor/injurious insects and change of natural landscape. ▪ Regarding social acceptability, separation of organic waste such as source separation and MBT is necessary. In the case source separation will be installed to SWM system, cooperation of citizen is essential. ▪ The option B has two other advantages of stable power supply and reduction of the area of final disposal site. ▪ The option B will affect livelihoods of waste pickers so that compensation for them will be necessary. There is some possibility to employ the waste pickers at SWM facilities.
Option C: WtE + Composting Only	▪ The total project cost including CAPEX and OPEX for 15 years is the third highest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the third biggest (84%). Final disposal volume at landfill sites can be reduced the most drastically from 500 ton/day to 57 ton/day. ▪ The option C has many advantages such as reduction of odor/injurious insects and change of natural landscape. ▪ Regarding social acceptability, separation of organic waste such as source separation and MBT is necessary. In the case source separation will be installed to SWM system, cooperation of citizen is essential. ▪ The option C has two other advantages of stable power supply and reduction of the area of final disposal site. ▪ The option C will affect livelihoods of waste pickers so that compensation for them will be necessary. There is some possibility to employ the waste pickers at SWM facilities.
Option D: Methane fermentation Only	▪ The total project cost including CAPEX and OPEX for 15 years is the third lowest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the fourth biggest (75%), which is much less than the options A-C including WtE plants though. ▪ Final disposal volume at landfill sites can be reduced from 500 ton/day to 392 ton/day. ▪ The option D has another advantage of reduction of change of natural landscape, which is smaller than the options A-C though. ▪ Regarding social acceptability, separation of organic waste such as source separation and MBT is necessary. In the case source separation will be installed to SWM system, cooperation of citizen is essential. ▪ The option D has two other advantages of stable power supply and reduction of the area of final disposal site, which are smaller than the option A-C though. ▪ The option D will not affect livelihoods of waste pickers.

Option	Evaluation
Option E: Composting Only	▪ The total project cost including CAPEX and OPEX for 15 years is the second lowest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the fifth biggest (64%), which is much less than the options A-C including WtE plants though. Final disposal volume at landfill sites can be reduced from 500 ton/day to 387 ton/day. ▪ The option E has another advantage of reduction of change of natural landscape, which is smaller than the options A-C though. ▪ Regarding social acceptability, separation of organic waste such as source separation and MBT is necessary. In the case source separation will be installed to SWM system, cooperation of citizen is essential. ▪ The option E has an advantage of reduction of the area of final disposal site, which are smaller than the option A-C though. ▪ The option E will not affect livelihoods of waste pickers.
Option F: Landfill Only	▪ The total project cost including CAPEX and OPEX for 15 years is the lowest among the six options. ▪ Regarding environmental aspect, GHG emission reduction is the smallest (55%). Final disposal volume at landfill sites cannot be reduced from the current status. ▪ The option F has another advantage of reduction of change of natural landscape, which is smaller than the options A-C. ▪ Regarding social acceptability, separation of organic waste such as source separation and MBT is necessary. In the case source separation will be installed to SWM system, cooperation of citizen is essential. ▪ The area of final disposal site cannot be reduced so that the final disposal site will make big environmental and social impacts though change of natural landscape. ▪ Regarding social acceptability, the option F has some advantages such as unnecessity of separation of organic waste. ▪ The option F will not affect livelihoods of waste pickers.

Source: JICA Survey Team

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Appendix 10

Photos

Appendix 10. Photos

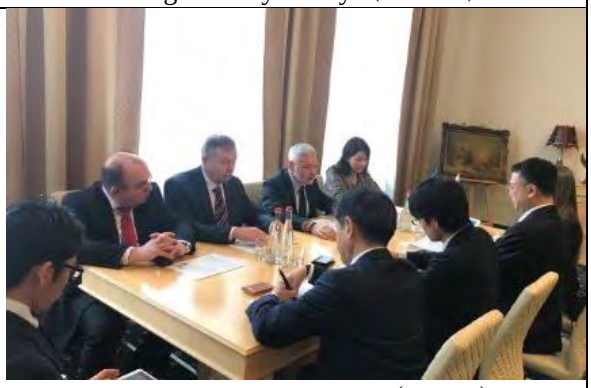
First Field Survey (22 February – 15 April)

Kick-off meeting

Meeting with Kyiv Oblast（23-Feb.）

Meeting with Kyiv City（23-Feb.）

Meeting with Kharkiv Oblast（2-Mar.）



Meeting with Kharkiv City（1-Mar.）

Meeting with Dnipropetrovsk Oblast（27-Feb.）

Meeting with Dnipro City（27-Feb.）

Meeting with MENR (22-Feb.)

Meeting with MRDCHCS (22-Feb.)

Meeting with MEDT（26-Feb.）

Meeting with GIZ（23-Feb.）

Meeting with EBRD（26-Feb.）

Kyiv

Landfill No.5（8-Mar.）

Landfill No.6（8-Mar.）

Energia Incineration Plant（13-Mar.）

Meeting with Kyiv Communal Service
（14-Mar.）

Pressed PET Bottles at Eko Stok（12-Apr.）

Prastic Bags at Eko Stok（12-Apr.）

Kharkiv

Bohodukhiv City Landfill（2-Mar.）

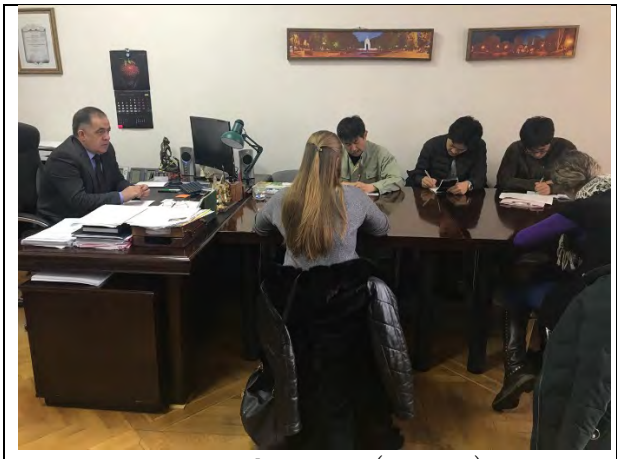
Sorting facility of Bohodukhiv City Landfill (2-Mar.)

Dergachi Landfill（3-Mar.）

Truck scale of Dergachi Landfill (3-Mar.)

Meeting with Kharkiv City（26-Mar.）

Meeting with Kharkiv Oblast（28-Mar.）



Meeting with KVBO（27-Mar.）

Collection vehicle of KVBO（27-Mar.）

Waste Collection of Kharkiv City（27-Mar.）

Dergachi Landfill（27-Mar.）

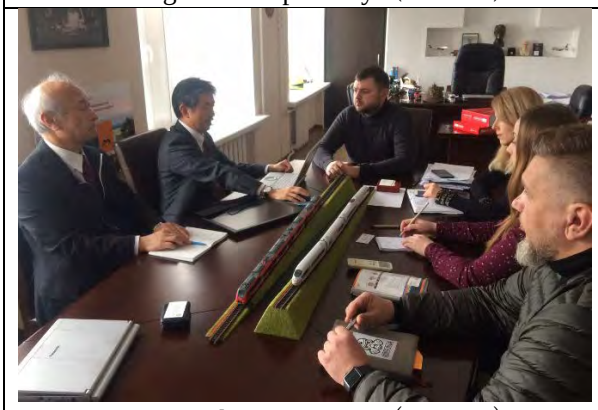
Dnipro

Zhovti Vody City Landfill（28-Feb.）

Pravoberezhny Landfill（27-Feb.）

Meeting with Dnipro City（19-Mar.）

Meeting with Dnipro City（22-Mar.）



Meeting with Dnipro City（23-Mar.）

Meeting with Dnipropetrovsk Oblast (22-Mar.)

Meeting with Eco Dnipro（20-Mar.）

Right Bank Landfill（20-Mar.）

Waste Composition Survey

Pravoberezhny Landfill（23-Mar.）

Dergachi Landfill（29-Mar.）

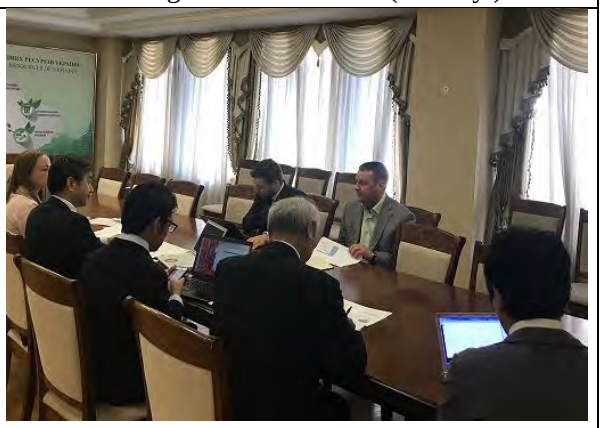
Second Field Survey (9 May – 6 June)

Kyiv

Meeting with Kyiv City (10-May.)

Meeting with MRDCHCS (11-May.)

Meeting with Kyiv Oblast (15-May)

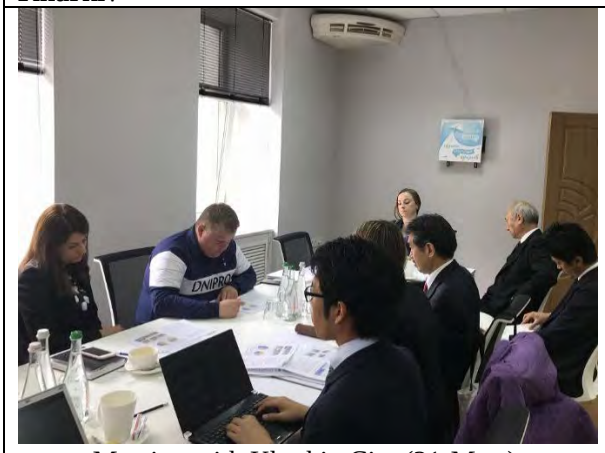


Meeting with MENR (16-May)

Landfill No.5 (16-May.)

Energia Incineration Plant（31-May.）

Kharkiv



Meeting with Kharkiv City (21-May.)

Dergachi Landfill（22-May.）

Dnipro

Meeting with Dnipro City (23-May)

Meeting with EcoDnipro City (24-May)

Meeting with Dnipro City Mayor (25-May)

Waste Composition Survey

Landfill No.5 (15-May.)

Landfill No.5 (15-May.)

Solid Waste Management Sminar

SWM Seminar (1-Jun.)

SWM Seminar (1-Jun.)

Third Field Survey (15 July – 1 August)

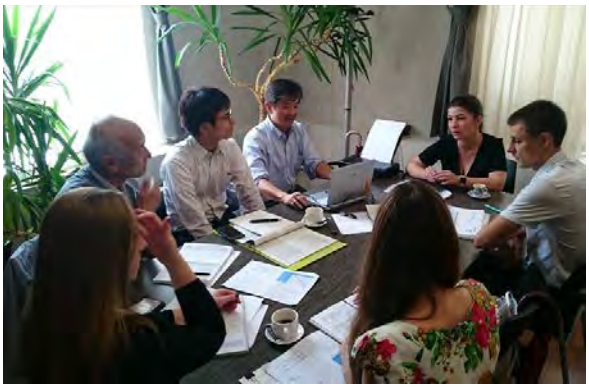
Kyiv

Energia Incineration Plant（16-Jul.）

Meeting with Kyiv（16-Jul.）

Meeting with MRDCHCS（17-Jul.）

Meeting with MENR（17-Jul.）



Meeting with Kyiv Oblast（18-Jul.）

Meeting with MEDT（17-Jul.）

Obukhivmiskvtorresursy （25-Jul.）

Trash Can of Kyiv City （29-Jul.）

Waste Collection of Kyiv City （28-Jul.）

Kharkiv

Dergachi Landfill（23-Jul.）

Meeting with Kharkiv City （23-Jul.）

Meeting with Kharkiv Oblast（24-Jul.）

Dnipro

Meeting with Dnipro City（19-Jul.）

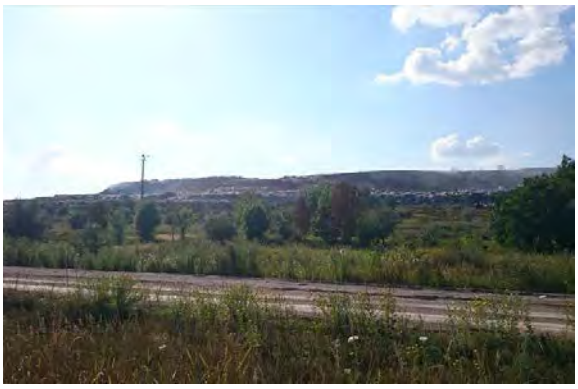
Meeting with Dnipropetrovsk Oblast（19-Jul.）

Meeting with Dnipro City Mayor（20-Jul.）
Source: Dnipro City Website

Right Bank Landfill （20-Jul.）

Damping Site （20-Jul.）

Closed Waste Incineration Plant （20-Jul.）



Left Bank landfill （21-Jul.）