Fiscal 2006 Project Consigned by the Ministry of Environment

Fiscal 2006 CDM/JI Project Study

Study into Utilization of Methane Gas at a Landfill Site in Zhitomir, Ukraine

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Shimizu Corporation

Summary

1. Background of the Project

The Study entailed implementation of a feasibility study on a project to conduct power generation and gas combustion using landfill gas (LFG) comprising mainly methane gas generated from Zhitomir Landfill Site in Zhitomir, Ukraine, and to link this to realization of a JI project in the future.

Zhitomir, which is located approximately 130 km west of Kiev, the capital of Ukraine, has a population of approximately 280,000 and is the capital city of Zhitomir Province. Zhitomir Landfill Site, which is owned by the city, is located approximately 7 km from the city center. The landfill site covers an area of around 19 ha and is divided into eight sections, which are being successively filled. On part of the site, bulldozers regularly implement earth.

In the Study, a plan for introducing gas collection pipes, gas treatment equipment and gas engine power generating equipment, etc. to the project site of Zhitomir Landfill Site was compiled, and feasibility as a private sector project was assessed from the viewpoints of project effect and profitability, etc. In order to increase the feasibility of realization as a CDM project, the Study was conducted on the assumption that flare stack treatment is combined with a power generating system.

Since the project will contribute to prevention of global warming and improvement of the global environment, Zhitomir Municipal Government is very keen to see its realization. Moreover, since Ukraine has hardly any experience of technology utilizing

renewable energy, the project technology will contribute to the sustainable development of Ukraine.

Ukraine ratified the Kyoto Protocol in 2004. Its DNA is the Ministry of the Environmental Protection and the approval procedures and scheme for JI projects are already in place.

2. Contents of the Project Plan

The project proposes to install landfill gas (LFG) collection pipes at Zhitomir Landfill Site, and to collect and treat LFG before utilizing it for power generation in a gas engine generator (GEG). The generated power will be sold to the local grid. Meanwhile, LFG that cannot be used in the GEG will be combusted and destroyed via flare stacks.

Since the power generated by this system will enable power stations within the grid to reduce consumption of fossil fuels, the project can be expected to have an effect in terms of energy saving and reduction of greenhouse gas emissions. Moreover, concerning the LFG that cannot be used in the GEG, since methane will be converted to carbon dioxide as a result of combustion and destruction in the flare stack, the greenhouse gas reduction effect will be further boosted.

Figure 1 shows a schematic of the overall project system.

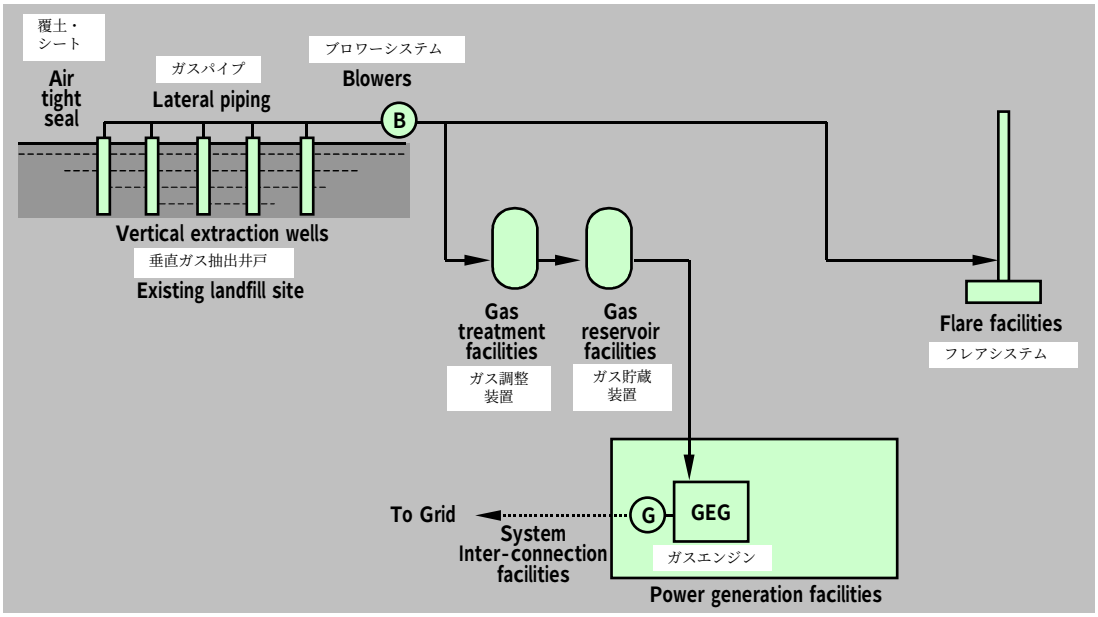

Figure 1 Schematic of the Overall System

As the method for calculating the generated amount of methane gas ($Q_{y,x}$) on the landfill

site, the First Order Decay Model (corresponding to Equation 3 in the Guideline) from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual CHAPTER 6 WASTE) is used in its advanced forms (Equation 4 & Equation 5 in the Guidelines). The 2006 IPCC Guidelines for Inventories have been disclosed, and these have been revised in order to forecast the generated amount of LFG more realistically and accurately. In the project, it is planned to directly measure the amount of greenhouse gas emission reductions based on the collected and used amount of LFG at the time of project implementation. Now, calculations only provide the forecast amount of emission reductions. Moreover, since the conventional calculation method gives more conservative calculation results, the conventional method shall be used. The formula is indicated below.

$$Q_{y,x}=k * R_x * L_0 * e^{-k(y-x)}$$

$Q_{y,x}$	The amount of methane gas (Nm3/y) currently generated (year y) base on the amount of solid waste carried in year x（R_x）
k	The methane generation rate (1/y)
R_x	The amount of solid waste carried in in year x（Mg/y）
y	The current year（y）
L_0	The methane generation potential (Nm^3/Mg, where Mg is the amount of solid waste)

Figure 2 shows the results of trial calculation of the generated and collected amounts of methane gas. Incidentally, the collected amount in 2008 is low because it is assumed that the collection system only operates for six months in that year.

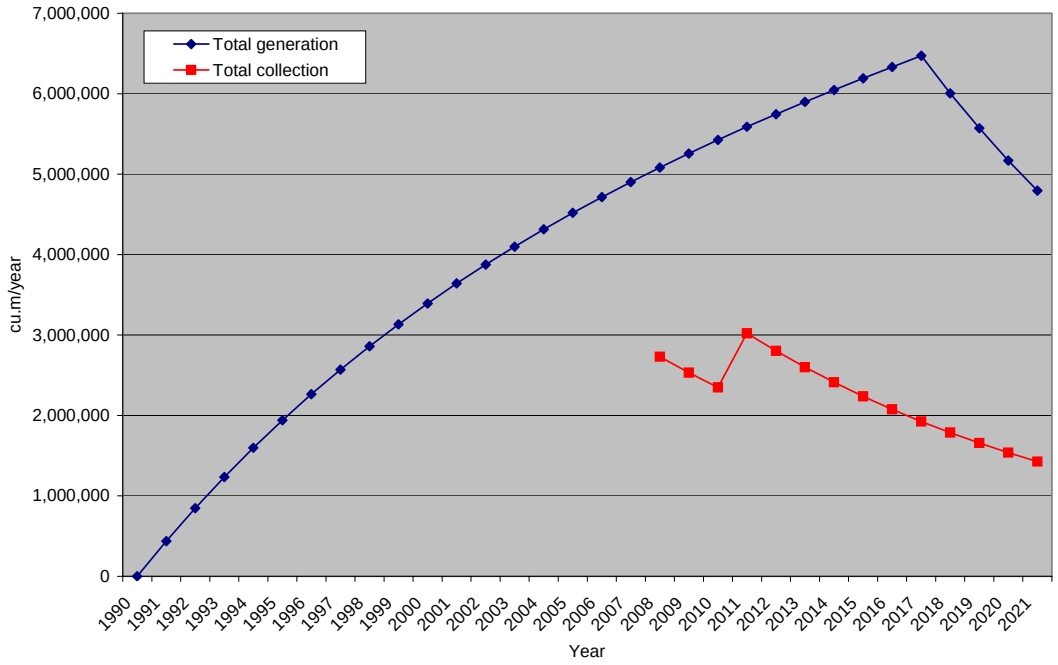

Figure 2 Results of Estimating the Generated and Collected Amounts of Methane Gas

It is expected to install a gas engine generator (GEG) with capacity of 500kW. Part of the electricity generated in the GEG will be used inside the plant for operating blowers, etc., while excess power will be sold to the power grid. Whenever the gas engine is stopped or when there is excess methane gas, all the gas will be destroyed in the flare stack. Figure 3 indicates the forecast amounts of methane gas used in the gas engine and the flare.

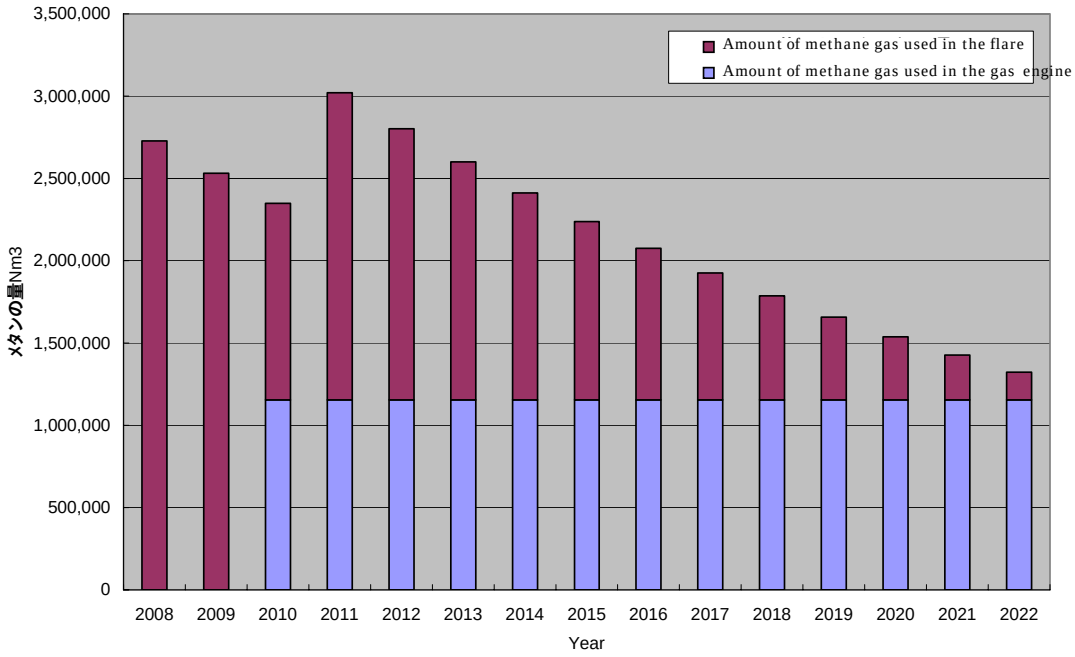

Figure 3 Purposes of Use of Recovered Methane Gas

3. Project Implementation Plan

The participants on the Japan side will conduct the initial project investment (ordering of construction works), while Zhitomir Municipal Government will be responsible for all other aspects of project operation (monitoring, operation and maintenance of instruments, accounting work, ERU management, subcontracting, personnel affairs, reporting, etc.).

Although the project is rather small in scale, when considered from the viewpoint of CO2 credit acquisition, it may be better to adopt the pay-on-delivery approach for averting project risk. However, in order to resolve the shortage of funds in the initial stage, it will be necessary to initially pay an amount equivalent to the amount of carbon credits. Doing so will be extremely beneficial for the project funding plan. Moreover, in order to realize the project at an early point, it is better to implement it based on direct investment for the total necessary funds (without specifying the method of fund raising in particular).

Project profitability is greatly affected by the economic value of ERUs. If ERUs have no economic value, project profitability is low even before funds are raised and realization becomes near impossible. On the other hand, if it is assumed that ERUs do have economic value, assuming that the project period is 15 years and price of ERU is

US$9.33/t-CO2 (equivalent to 7 EURO/tCO2), the IRR (after tax) will be 13.55%, indicating that sufficient profits can be secured. Advertisement for Japanese participants other than Shimizu Corporation will take place from now, but it is thought that numerous corporations will be willing to invest in such a project.

Table 1 shows the project implementation schedule. It is planned to advance procedures with a view to securing approval from the governments of Japan and Ukraine during the first half of fiscal 2007. At the same time, it is scheduled to install the SPC and conduct detailed design, to start the construction works from the second half of 2007, and to start the project from January 2008. The Project implementation period is scheduled for 15 years.

Table 1 Project Implementation Schedule

Work Item	2006	2007	2008	2009	2010	2011		2022
FS implementation								
PIN submission		Feb						
Receiving of LEO from Government of Ukraine		April						
PDD preparation of EIA implementation		April-June						
IE determination		June						
Receiving of LOA from Government of Ukraine		August						
SPC establishment and start of detailed design		June						
Start of construction works		August						
Start of credit period			Jan		Credit period: 15 years			

4. Baseline Setting

The project is a JI undertaking, however, it was examined using baseline methodology approved by the CDM Executive Board.

“ACM0001/Version 4 Consolidated baseline methodology for landfill gas project activities” and “ACM0001/Version 4 Consolidated monitoring methodology for landfill gas project activities” have been selected for application to the project. The latest version as of January 2007 is Version 5, however, since this is a JI undertaking, Version

4 was adopted.

Meanwhile, the project is as described below.

① Currently, LFG collection is not carried out on the landfill site in Zhitomir and all LFG is released into the atmosphere. (Baseline)

② The project proposes to collect LFG on the existing landfill disposal site and to flare the captured gas.

③ The captured gas will be used to produce energy (electricity), and emission reductions will be claimed for displacing energy generation from other sources.

Therefore, since the project falls under applicability of (a) and (c) under ACM0001, this methodology can be applied.

Also, according to ACM0001, the Tool for Demonstration of Additionality is used to demonstrate the fact that the project is additional to the baseline, which is set as maintenance of the status quo.

Moreover, in ACM0001, since emission reductions in the case of project implementation are directly measured in the monitoring plan, there is no measurement of baseline emissions and project emissions. Accordingly, based on ACM0001, emission reductions are directly measured.

Concerning the grid emission coefficient ($CEF_{electricity,y}$), referring to the Operational Guidelines for Project Design Documents of Joint Implementation Projects, Volume 1: General Guidelines, Version 2.3, Ministry of Economic Affairs of the Netherlands May 2004 that is officially approved by the Government of Ukraine, this is set between 0.490~0.695 tCO2/MWh.

Table 2 shows the results of calculating the greenhouse gas emission reductions in the project. Aggregate reductions over the credit period (2008~2022) are calculated as 513,593 t-CO_2.

Table 2 Results of Calculating Emissions and Emission Reductions

Year	Project Emissions	Baseline Emissions	Leakage	Emission Reductions
	t-CO_2e	t-CO_2e	t-CO_2e	t-CO_2e
2008	35,781	76,520	0	40,739
2009	41,354	79,143	0	37,789
2010	46,536	84,218	0	37,682
2011	38,924	86,608	0	47,684
2012	44,561	88,922	0	44,361
2013	49,892	91,170	0	41,278

2014	54,940	93,350	0	38,410
2015	59,727	95,476	0	35,749
2016	64,272	97,546	0	33,273
2017	68,596	99,568	0	30,973
2018	63,638	92,472	0	28,834
2019	59,038	85,888	0	26,850
2020	54,771	79,772	0	25,001
2021	50,811	74,094	0	23,283
2022	47,138	68,826	0	21,688
Total	779,978	1,293,571	0	513,593

5. Monitoring Plan, etc.

Monitoring items in the project have been decided based on ACM0001.
Figure 4 shows the monitoring plan in schematic form.

※ ID numbers correspond to the monitoring items.

The sold amount of electric energy measured in this monitoring plan (ID9) is the amount obtained after subtracting electricity used in the system from the amount of electric energy generated in the GEG.

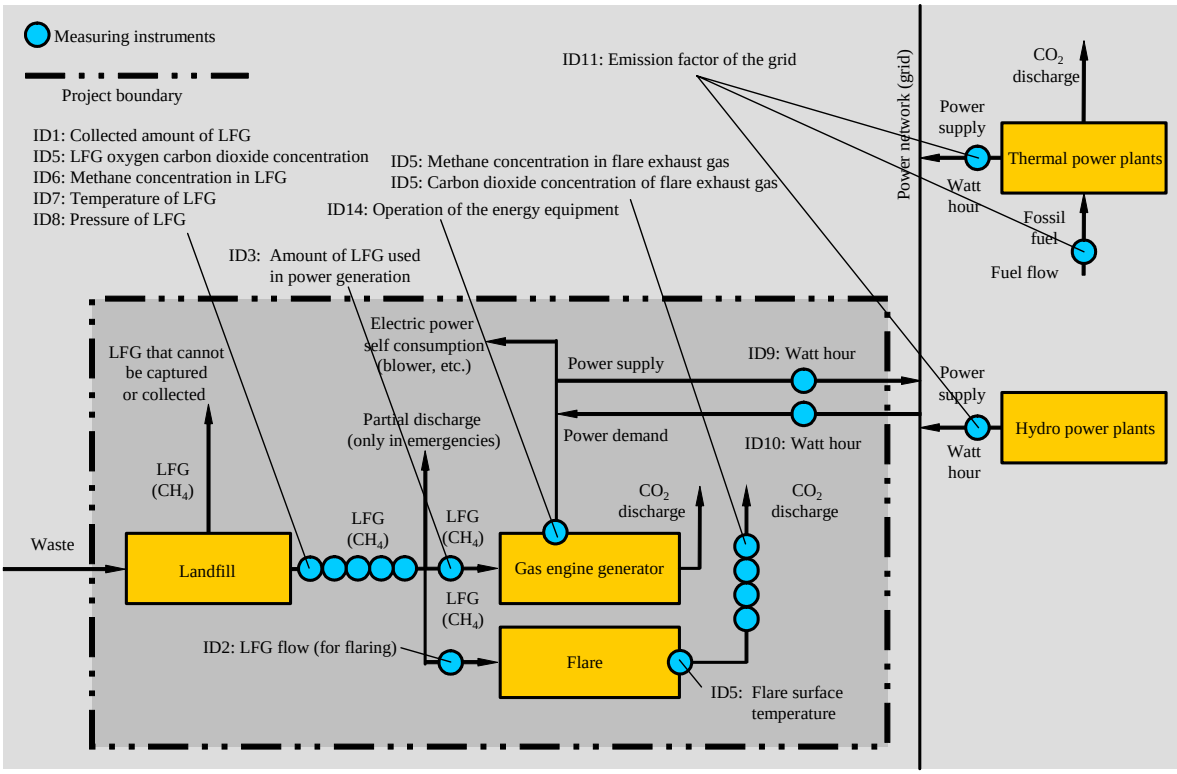

Figure 4 Monitoring Plan Schematic

6. Profitability

Project profitability is assessed according to the investment payback period (PBP) and the internal rate of return (IRR). The construction cost is approximately 3,050,173 US$ (1,787,543 US$ at the start of construction, plus 924,354 US$ after two years and 338,276 US$ after three years), and the running cost is approximately 38,122 US$ (210,000 JD) per year for operation and 344,665 US$ per year for maintenance (from the third year onwards).
As for taxation, corporate profit tax is 20% of ordinary profit.
Plant and equipment depreciation was calculated assuming a depreciation rate of 90%.
The power tariff was set at 5.0 US$cent/kWh based on the existing data. This is the price at which the power generator sells electric power to the power distribution company.
The exchange rate used in the calculations was, 1US$ = 116.00 yen.
Finally, concerning the project implementation schedule, assuming the project facilities commence operation from 2008, it is assumed the project credit period will be 15 years from 2008 to 2022.

Concerning the investment payback period, as is shown in Table 3, the number of years from the start of the project (start of construction) to the time when aggregate project balance enters the black was calculated for the case where ERUs have no economic value and the two cases where the economic value of ERUs is 5 US$/t-$CO_2$ and 9.33 US$/t-$CO_2$ (7 EURO/tCO2) respectively.

Table 3 Investment Payback Period in Each Case

Economic Value of ERUs		Investment Payback Period
Case where ERUs have no economic value	0 US$/t$CO_2$	Irrecoverable (Irrecoverable)
Cases where ERUs have economic value	5 US$/t$CO_2$	11 years (10 years)
	9.33 US$/t$CO_2$ (equivalent to 7EURO/tCO_2)	7 years (7 years)

※ Figures in parentheses indicate pretax values.

As for the internal rate of return (IRR), as is shown in Table 4, comparative examination was carried out for three different cases, i.e. the case where ERUs have no economic value and the two cases where the economic value of ERUs is 5 US$/t-$CO_2$ and

9.33 US$/t-CO2 (7EURO/tCO2) respectively. Since this assessment of project profitability based on IRR is sought as an indicator for determining the propriety of investment, the project IRR not taking into account interest and loan repayments was used.

The project IRR is negative in the case where ERUs have no economic value, however, since an IRR (after tax) of 13.55% can be expected when the economic value of ERUs is 9.33 US$/t-CO2 (7EURO/tCO2), the project is an attractive proposition for investment.

Table 4 Internal Rate of Return (IRR) in Each Case

Economic Value of ERUs		IRR
Case where ERUs have no economic value	0 US$/$tCO_2$	Minus (Minus)
Cases where ERUs have economic value	5 US$/$tCO_2$	6.73 (7.66)
	9.33 US$/$tCO_2$ (equivalent to 7 EURO/tCO_2)	13.55 (14.79)

※ Figures in parentheses indicate pretax values.

As was mentioned earlier, the initial cost of the project is approximately 3,050,173 US$. On the other hand, the total reduction in greenhouse gas emissions over the project credit period (2008-2022) is 513,593 t-CO_2.

The cost of reducing greenhouse gas emissions was calculated by dividing CO_2 emissions over the credit period (2008~2022) by the initial cost. Table 5 shows the results.

Table 5 CO_2 Reduction Cost

Item	Amount
GHG Emission Reduction (t- CO_2)	513,593
Cost (1000 US$)	3,050,173
CO_2 Reduction Cost (US$/$tCO_2$)	Approx. 5.9

7. Conclusion and Future Work

The F/S conducted examination of the project to collect LFG from the landfill disposal site in Zhitomir and use this to generate electricity in a gas engine, in order to reduce atmospheric emissions of methane and, using the generated power to replace electricity from grid power stations, to reduce CO2 emissions at power stations.

The Government of Ukraine has already completed the JI project approval scheme including the JI project approval procedure, and a number of projects have already acquired LOE, while a few are now in the approval application stage and are likely to be

approved soon. There is a strong possibility that the project will also be approved.
Zhitomir City Municipality, the project counterpart, welcomes implementation of this CDM project from the viewpoints of environmental improvement and acceptance of overseas investment, etc., and it gave immense cooperation in the course of the FS.
In the project plan, from the viewpoint of securing profitability, etc., it is envisaged that a gas engine generator of 500 kW (0.5 MW) will be installed and acquisition of carbon credits will be aimed for from 2008. As a result, it was concluded that the project can be sufficiently profitable so long as it is approved by the government as a JI undertaking and the market price of carbon credits is 9.33 US$/t-CO2 or higher.
It is hoped that the LOE is readily acquired, determination is conducted and approval is secured from the governments of Japan and Ukraine. At the same time, effort will be made to promptly compile a more detailed equipment plan and bind a contract for project implementation with a view to realizing the earliest possible implementation. .

The consolidated methodology can be applied to projects for the collection and utilization of methane gas from landfill sites, and this is extremely advantageous from the viewpoint of certainly and quickly realizing the project in readiness for the initial commitment period from 2008.
Meanwhile, when it comes to forming LFG projects, unlike chlorofluorocarbon destruction and N2O destruction projects, it is essential to conduct detailed examination in the survey stage because numerous factors such as the following have an impact:

- Weather conditions in the host country;
- Shape of the landfill site;
- Composition of solid waste depending on lifestyles; and
- Waste collection system

Based on detailed investigation of such elements, it is possible to gauge the effect and profitability of the project.
Moreover, interpretations of LFG projects differ according to the host country, and it is sometimes difficult to coordinate the opinions of central government agencies and local governments (counterparts) regarding project realization. As competition to acquire projects heats up between countries, this coordination of views is the most important theme in the project development stage. In this case, the host country is enthusiastic about realizing the project under Japanese support and it holds the FS in high regard.

Through this study, it was possible to examine a promising JI project as well as gauge

the latest trends in Ukraine, which has high potential for JI and GIS, and advertise policies of the Government of Japan. It will be necessary to immediately actualize the project in order to reinforce relations with Ukraine, and to continue developing projects and linking these to realizing the objectives of Japan in Central and Eastern Europe.