PROGRAM OF NATIONAL CDM/JI STRATEGY STUDIES
NSS PROGRAM

THE NATIONAL STRATEGY OF UKRAINE FOR JOINT IMPLEMENTATION AND EMISSIONS TRADING

PROJECT PIPELINE

(APPENDIX TO MAIN REPORT)

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MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES OF UKRAINE

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1. BACKGROUND

In order to help Ukraine to seize potential benefits from GHG emission reduction projects to be implemented in the near future, the chapter reviews existing potential JI projects and identifies new ones. This includes a brief description of each project, a preliminary analysis of GHG emissions reduced by each project, and the related costs for each project in compliance with JI methodology. The selected pilot project pipeline represents a wide variety of possible ventures in different sectors of the Ukrainian economy. The pipeline has been prepared in such a way that it can be used for AIJ pilot phase and for future JI projects under the Kyoto Protocol.

2. OBJECTIVES

The study has three main objectives:

- Identification and review of existing projects that meet JI requirements
- Identification and assessment of new possible pilot projects for JI
- Selection of pilot pipeline projects covering the various sectors of the Ukrainian economy

3. PRELIMINARY CRITERIA FOR PROJECT SELECTION

The following criteria are used for project selection:

- Quality of information
- Willingness of project owners to cooperate
- Compatibility with and supportiveness of national environment and development priorities and strategies
- Real, measurable, and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities
- Good prospective economic state of the company
- Total amount of investment not less than USD 500,000
- Replicability potential
- Proven, conventional technology

4. SCOPE OF SERVICES

National consultants, in close cooperation with foreign consultants and a project coordinator, completed the following subtasks:

5. Information on the project "NSS for Ukraine", including offers of cooperation, has been sent to potential users of information regarding CO_2 emission reduction projects. Primarily, the information has been communicated to key authorities in Ukraine, including the State Committee for Energy Conservation, the Ministry of Fuel and Energy, the Ministry of Industrial Policy, the Ministry of Economy, the Ministry of Ecology and Natural Resources, the Ministry of Transport, the State Committee for Forestry, and several other relevant organizations.
6. A national model for financial analysis and calculation of GHG emission reduction has been developed in close cooperation with the Swiss expert team. The model enables to obtain calculation results in compliance with the UNFCCC Uniform Reporting Format.
7. 30 projects with significant GHG emission reduction potential in different sectors of the Ukrainian economy have been pre-selected (see Appendix).
8. Financial analysis and GHG emission reduction estimation have been carried out for all 30 pre-selected projects. The financial analysis was performed using the specially developed national model, and the results were verified by using the "PROFORM" model, developed by the Lawrence Berkley National Laboratory (USA). Both models gave almost identical project IRR indices.

5. GENERAL ASSUMPTIONS FOR FINANCIAL ANALYSIS AND GHG EMISSION REDUCTION CALCULATIONS

Potential JI projects are described using a simplified version of the UNFCCC Uniform Reporting Format for Activities Implemented Jointly (URF).

Estimates of GHG emissions were developed following the IPCC methodology [1]. IPCC emission factors for fuel combustion for Ukraine are shown in Appendix B.

For JI projects involving substitution or reduced consumption of grid electricity, two separate baseline[106] emission factors were applied:

- The first emission factor is **819.7g CO_2 per kWh**. This is the average emission factor for thermal power plants in Ukraine in 1990, which operate on coal, natural gas and fuel oil.
- The second emission factor is **350 g CO_2 per kWh**. This represents best available new technology using natural gas.[107]

[106] The baseline denotes the reference case without the project, against which GHG emission reductions are calculated.

The two values serve to demonstrate the sensitivity of the projects' GHG impacts with regard to the baseline emission factor for grid electricity. The values are conservative in comparison with those recommended by the Dutch ERUPT Programme - 1010 g/kWh for electricity-producing projects and 1224 g/kWh for electricity-saving projects, respectively (for year 2000).[108]

Financial efficiency analysis of potential JI projects was performed for the following three scenarios:

- The enterprise does not receive any compensation for the achieved emission reduction (Scenario A)
- The enterprise, together with the investor in the JI project, receives a compensation of $18.3 per ton of carbon emission reduced ($5.0 per ton of CO2) (Scenario B)
- As above, with $36.7 per ton of carbon ($10.0 per ton of CO2) (Scenario C).

Each of these scenarios was analyzed for three different values of the cost of capital (discount rate): 10%, 20%, and 30%. The cost of capital for an enterprise corresponds to the rate of return that would be achieved investing this capital in the best possible alternative, and the procedure of discounting project costs and benefits accounts for the loss of this return if the project, rather than the best alternative is implemented. In general terms, the cost of capital reflects the annual interest paid by banks on deposited funds. In Ukraine, the hypothesis of a stable 10% discount rate in the cost/benefit analysis in dollars over a 20-year period is reasonably conservative. Calculations of financial efficiency with higher values of discount rate were performed to account for increased risk of investment in Ukrainian enterprises from the viewpoint of potential external investors.

Financial efficiency was analyzed based on the following two main criteria, which are the most commonly used in the international practice of investment evaluation:

- Net Present Value (NPV)
- Internal Rate of Return (IRR)

NPV reflects the present (discounted) net financial benefits of the project over the whole period of its life cycle. A positive value of NPV serves as criterion of project's financial acceptability.

IRR reflects the maximum discount rate at which a project repays its cost. An IRR that exceeds the cost of capital suggests project's financial viability.

Due to the limited information available concerning possible equity financing it is assumed that all necessary funds for project implementation will be sourced from foreign JI investors.

[107] Assumption: Natural-gas fired combined cycle plant with efficiency of 57% and 56.1 g CO_2/MJ natural gas.

[108] ERUPT Guidelines, Volume 2a: "Baseline Studies, Monitoring and Reporting", Version 2.0, October 2001, p.32.

The actual structure of financing will be a subject of negotiations between project owners and potential JI investors.

6. LIST OF PROPOSED POTENTIAL JI PROJECTS IN UKRAINE

National experts have considered a list of the potential JI projects in the context of their eligibility for the JI mechanism and with account to the completeness and reliability of initial data. The consideration has allowed to offer the following projects for the final selection (Table 1).

TABLE 1. LIST OF PROPOSED POTENTIAL JI PROJECT IN UKRAINE

#	*Sector*	*Category*	*Title of the project*	*Investment, thousand USD*	*CO_2 reduction over project life time, t*		*Cost of emission avoided[109], USD per t CO_2 eq.*		*Incremental costs of project[110], thousand USD*	*IRR[111], %*	*Comments, risks, sensitivity*
					819g CO_2/kWh [112]	*350g CO_2/kWh [113]*	*819g CO_2/kWh*	*350g CO_2/kWh*			
1	Energy sector (coal)	Gas capture	Skochinsky mine methane capture and utilization	51,895	2,196,621		-6.92		-5,476	26.0/ 29.7/ 33.4	Key element: a ready market to accept the gas that is produced and willingness-ability of consumers to pay competitive for the gas with cash. The project has strong compliance with national economic development, socio-economic as well as with environment priorities and strategies. (e.g., safety in coal mining). Methane emissions in the baseline and project case are relatively uncertain.
2	Power sector	Energy efficiency	Installation of new steam turbines in existing boiler station at Tyre plant "Dniproshina" (12 MW)	5,610	990,659	360,323	-2.23	-6.13	-538	22.5/ 24.2/ 27.1	Good risk rating, well-tested technology, absent of necessity to sell electricity to a grid
3	Power sector	Energy efficiency	Kachanov associated gas capture and utilization (Poltava region)	3,000	589,680	252,000	4.7	11.1	681	13.8/ 16.2/ 19.3	Anticipated amount of associated gas for a long-term period may be a critical issue. Insufficient data basis
4	Power sector	Renewable energy	Installation of Additional Wind Power at Novoazovsk (Donetsk oblast) and Tarkhankut (Autonomous Republic of the Crimea) Wind Plants	14,000	621,523	265,608	38.6	90.3	4,158	7.0/ 7.8/ 8.8	The project meets the requirement of additionality due to the positive value of incremental costs of the project. There is a minor risk that preferential electricity tariff regimes will not exist for a long time, and governmental support for wind power will be lower

[109] Cost per t CO_2 reduction = (NPV of baseline - NPV of project) / discounted GHG effect project case net of GHG effect baseline

[110] NPV of baseline minus NPV of project at 20% of discount rate

[111] IRR present without ERU credits / with ERU credits $5 per t CO_2 for 350 g CO_2 emissions per kWh / with ERU credits $5 per t CO_2 for 819 g CO_2 emissions per kWh

[112] Specific average national emission of 819.7 g CO_2 per kWh for thermal power plant in Ukraine for 1990 base year

[113] Specific emission of 350 g CO_2 per kWh for the best available electricity production technology using natural gas

#	*Sector*	*Category*	*Title of the project*	*Investment, thousand USD*	*CO_2 reduction over project life time, t*		*Cost of emission avoided*[109]*, USD per t CO_2 eq.*		*Incremental costs of project*[110]*, thousand USD*	*IRR*[111]*, %*	*Comments, risks, sensitivity*
					819g CO_2/kWh[112]	*350g CO_2/kWh*[113]	*819g CO_2/kWh*	*350g CO_2/kWh*			
5	Power sector	Energy efficiency	Co-generation system on coke gas at Avdeevka coke plant (16 MW)	13,000	1,583,500	676,710	-9.4	-22.0	-4,894	30.7/ 32.7/ 35.3	The most sensitive element: the project will be a pilot for the usage of coke gas by gas turbine in the Ukraine
6	Industry	Energy efficiency	Heat recovery for ventilation of main production building (Rosava tyre plant)	3 401	344 441	341 848	5.9	5.9	491	15.7/ 18.8/ 18.8	The project meets the requirement of additionality due to the positive value of incremental costs of the project. Good risk rating, well-tested technology
7	Households	Fugitive gas capture	Implementation of 1.5 MW_e power plant operating on landfill gas at Lugansk landfill	2 250	1 337 280	1 224 720	3.8	4.2	1 243	3.3/ 20.0/ 21.3	The project meets the requirement of additionality due to the positive value of incremental costs of the project. Major risk: the volume of captured and utilized landfill gas will be lower than anticipated
8	Agriculture	Renewable energy	Implementation of 280 kW_e+560 kW_{th} CHP biogas plant in pig breeding farm	1 039	267 651	246 640	6.1	6.6	398	9.2/ 16.2/ 16.7	The project meets the requirement of additionality due to the positive value of the incremental costs of the project. Conservative estimate of CH_4 emission reduction. Sharp drop of livestock due to the extension of sickness or bad harvest may impact the amount of manure
9	Industry	Industrial processes	Modernization of smelter to improve operating efficiency at the "Zaporizhzhiya Aluminium Enterprise"	200 000	9 984 817	6 980 229	6.7	9.5	16 162	17.8/ 18.8/ 19.2	The project proposed by the firm with very good reputation. This project has a variety of non-greenhouse benefits. Minor risk: deterioration of the world market of aluminium conjuncture
10	Households	Energy efficiency	Installation of new energy efficiency pumps on Dniprovska Waterworks	3 647	1 117 558	477 589	-5.3	-12.4	-1 447	30.2/ 33.5/ 37.9	Good risk rating, well-tested technology. A big social importance of the project
			Installation of new energy efficient pumps on Desnianska Waterworks	9 777	2 564 959	1 096 136	-3.6	-8.4	-2 234	25.9/ 28.8/ 32.6	

#	Sector	Category	Title of the project	Investment, thousand USD	CO_2 reduction over project life time, t		Cost of emission avoided [109], USD per t CO_2 eq.		Incremen-tal costs of project[110], thousand USD	IRR[111], %	Comments, risks, sensitivity
					819g CO_2/kWh [112]	350g CO_2/kWh [113]	819g CO_2/kWh	350g CO_2/kWh			
11	Households	Energy efficiency	Installation Gas Turbine Combined Cycle at Ivano-Frankivsk CHP	36 872	4 540 086	474 924	8.6	82.6	9 555	12.6/ 12.9/ 15.7	The project meets the requirement of additionality due to the positive value of incremental costs of the project. Good risk rating, well-tested technology.
12	Households	Energy efficiency	District heating system rehabilitation in Vinnitsa city	49 700	5 200 610		31.1		17 068	9.2/ 11.2/ 11.2	The project meets the requirement of additionality due to the positive value of incremental costs of the project. Good risk rating, well-tested technology. Insufficient data basis
13	Forestry	Afforestation	Afforestation in Kharkiv region	470	282 300		18.3		431	<0/ 6.7/ 9.2	The project proposed by the firm with very good reputation on environmental issues. The project has been approved by the Ukrainian State Committee of Forestry. ERU sales substantially increase financial viability (IRR) of project.
14	Households	Renewable Energy	Utilizing wood waste as an alternative fuel for heating in Ivano-Frankivsk region, replacing coal	3 179	411 305	427 017	14.10	13.6	1 411	7.2/ 11.5/ 11.3	High additionality due to insufficient project profitability without ERU revenues. About 20% of the indicated GHG savings correspond to methane emission reductions resulting from reduced coal mining. Estimate of GHG emission reduction is conservative because methane emissions from decaying wood are not accounted for. Risk: Reliability of wood waste supply to be studied in more detail

7. BRIEF DESCRIPTION OF PROJECTS

7.1. SKOCHINSKY MINE METHANE CAPTURE AND UTILIZATION

A Description of the Project

A.1 Title of the Project: " Skochinsky Mine Methane Capture and Utilization "

A.2 Participants/actors

Item	Participant 1	Participant 2
Name of organization	Skochinsky mine	Partnership for Energy and Environmental Reform (PEER)
Function within project	Project owner	Project consultant and facilitator
Street		9 Khmelnitskogo Street, suite 6
Post code	83084	01030
City	Donetsk	Kiev
Country	Ukraine	Ukraine
Contact person	------------------------	------------------------
Surname	Miminoshvili	Triplett
First & middle name	Valery Veniaminovich	Jerry
Job title	Mine Director	President
Direct tel	+(380 62) 272-4390	(+380 44) 234-2303
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Direct E-mail		trip@public.ua.net aef@public.ua.net

A.3 Project

Item	Please fill in if applicable
General description of JI project	The project consists of capturing Coal Bed Methane (CBM), thereby reducing Methane emissions from coal mining. The bulk of the methane will be sold to consumers within the existing system of natural gas transportation, and the minor proportion can be used at mine's own boiler-plants to substitute coal. The project will entail three phases: pilot project, evaluation, and the full-scale development program. The pilot project phase will consist of the drilling and completion of five standard wells and one gob well. An evaluation phase will follow the pilot phase to access the results of the drilling and to allow time for the decision to continue into the development program. The project assumes a full year to complete the pilot phase and the evaluation period. The full-scale development program consists of the drilling and completion of four holes per month over a three-year period. Selected coal seams and sandstones in the standard coalbed methane wells will be hydraulically stimulated to provide an avenue for the gas and water to flow from the formation to the well bore. The gob wells will produce gas from the relaxed fractured coal seams and sandstones resulting from the longwall mining operations. Skochinsky Mine, located within the boundaries of the city of Donetsk, is one of the 241 underground coal mines present in Ukraine. This mine was selected for evaluation based on its methane reserves, the specific methane content of its coal seams, its annual coal production, and its projected economic life. The Skochinsky Mine includes a reserve area of 80 square kilometers that contains approximately 45 billion cubic meters of methane. The mine reserve area contains thirty coal seams that have an aggregate thickness of 9.25 meters and the methane content of the coal seams ranges from 16 to 25 cubic meters/ton of coal. During 1999, the mine produced about 785,000 raw tons of coal from one seam that ranged in thickness from 1.10 to 1.95 meters.

General description of project baseline (reference scenario)	It is assumed that methane, released during underground coal mining, is emitted into the atmosphere through the degasification and ventilation system. The amount of this methane is determined based on IPCC methodology for underground coal mining. Please refer to Section E for more details.
Type of project **Exact location**	Exhaust gas capture Donetsk, Ukraine
Project starting date **Project life**	To be determined 12 years, excluding 1-year pilot project phase
Stage of project	Business Plan is completed
Technical data	The full-scale development program consists of the drilling and completion of four holes per month over a three-year period for a total of 144 wells. The drilling program will include 124 standard wells and 20 gob wells. Selected coal seams and sandstone of the standard coalbed methane wells will be hydraulically stimulated, fractured, to provide an avenue for the gas and water to flow from the point of generation to the well bore. The gob wells will not be hydraulically stimulated, as they will release gas from the fractured coal seams and sandstone. In the selected area for drilling, the wells will encounter 30 coal seams and 4 layers of sandstone. The drilling area has an average gas content of over 20 cubic meters per ton of coal in the coal seams and a minimum of 0.8 cubic meters of gas per cubic meter of sandstone.
Main project risks	The primary risks in a CBM project are the lack of resources and low gas production. In addition, regulations for disposal of produced water, restraints on the acquisition of land surface rights, and poor market conditions for natural gas can adversely affect projects. In addition, the implementation of a project in a country with economy in transition contains its own risks involving legal and tax issues. Some of these factors are addressed below. • Resource: The Skochinsky Mine coal seam depth and thickness are known from coring and mining. The gas content has been determined from a long history of mining and gas emission measurements. There is a high degree of confidence in the accuracy of the resource estimate but even with some degree of error, the resource density is extremely high. • Gas production rate: High and sustained rates of gas flow after the termination of the mining activity indicate potential for good permeability. However, the only definitive way to determine permeability and other production characteristics is to drill and evaluate wells. It is assumed that the best available technology will be employed by experienced personnel to design and complete the project. The combination of high resource density and the potential for satisfactory permeability gives a high degree of confidence that commercial production can be achieved. • Water Disposal: Problems with wastewater disposal can be an impediment to CBM/CMM development projects. Wastewater produced from the operations will be discharged into local streams. There is an adequate stream system in or near the project area to receive the wastewater produced from the project. There should be no regulatory problems since the water quality will be the same, or similar, as the wastewater that the coal mine discharges. • Acquisition of drill sites and rights-of-way: Demographics and land in the project area are suitable for the planned scope of the project. The method to obtain the right to use the surface for drilling and production activities is unclear and needs further investigation. Minor risk: Approval risk relates not to obtaining necessary approval of a project as JI from appropriate governmental entity (national JI office).

A.4 Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	51,895,300	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	8,271,320	0
1.3. Revenues p.a.	USD (2000 prices)	19,053,371	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	2,196,621	4,393,242
1.5. Discount rate	%	20	
1.6. Project life	years	12	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	5,476,078	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	2,196,621
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	790,891
2.3. Incremental costs of project [5]	USD (2000 prices)	-5,476,078
2.4. Cost per t CO_2 [6]	USD / t CO_2	-6.92

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.
[2] All revenues and costs (incl. income tax) are aggregated and discounted over project life.
[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.
[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.
[5] Calculated as NPV of baseline minus NPV of project.
[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis
SCENARIO A
SCENARIO B
SCENARIO C

ERU cost, \$/tonne CO_2

0
5.0
10.0

IRR with ERU credits (%)

26.0
29.7
33.4

NPV at 10% with ERU credits (thousand USD)

23 532
29 127
34 722

NPV at 20% with ERU credits (thousand USD)

5 476
8 771
12 067

NPV at 30% with ERU credits (thousand USD)

-2 289
-132
2 026

Investment per tonne of avoided emissions	USD/t CO_2 eq.	23.63

Describe how costs are determined; specify key assumptions:

All of the assumptions that have been used in developing the project are based on similar projects and then modified to adjust to the conditions that are expected to be encountered in Ukraine. All of the operating and equipment costs are those in effect as of January 1, 2000 and all of the financial projections are based on a constant USD basis.

The project includes a Pilot Project Phase, an Evaluation Phase, and a Development Phase. Each Phase will be implemented maximizing project cash flow, and is modeled on development projects that have been successfully implemented in other countries.

The project envisages the bulk of the methane to be sold to consumers through the existing system of natural gas transportation, and a minor proportion to be used at the mine's own boiler-plants to substitute coal, so that in the future the mined methane will fuel electric power generation for the mine's own purposes.

The development costs for each standard well are estimated to be USD 331,000 and for each gob well to be USD 231,000:

- Total investments account for USD 51.9M
- Costs for Pilot Project Phase account for USD 6.2M
- Methane's price is at USD 50 per 1,000 m^3

Average volume of mined methane is 87.7M m^3 per year

Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Methane	271	549	748	672	519	425	359	309	271	234	145	69

Financial analysis has been carried out taking into account tax benefits (over the first three years there is tax exemption, over the following years the tax rate is at 15% - half of the current rate) envisaged for special economic zones, which include the city of Donetsk. This situation has been assumed to be maintained over the first 6 years after the pilot phase has been completed.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

In 1999, the Cabinet of Ministers of Ukraine drafted a National Energy Program for the period 2000-2010. This program includes a set of goals for the energy sector to achieve a more balanced supply/demand situation through a combination of alternative energy sources and energy efficiency programs. One of the goals is to have eight billion cubic meters of CBM, including CMM, produced per year by the year 2010.

Capturing and utilizing CMM in Ukraine can significantly reduce the amount of greenhouse gas that coalmines presently emit into the atmosphere. During 1999, the Ukrainian coalmines generated approximately 2,060 million cubic meters of methane. Through degasification systems, the mines captured approximately 257 million cubic meters of methane (13% of the total generated) and used only 79 million cubic meters of the captured methane; thus emitting approximately 1,981 million cubic meters of methane into the atmosphere. Not only that this is a waste of a vitally needed energy resource but CMM emissions also contribute to the greenhouse gas effect.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of air pollutions by switching from coal to methane.

Local social/cultural benefits:

- Improving coal mine safety, productivity and coal mine employee health.
- Reduce the number of accidents and fatalities that Ukrainian mines are presently experiencing (In 1999, Ukraine coalmines experienced 289 fatalities, or 3.6 deaths per one million raw tonnes of coal produced. This grave statistic is one of the worst in the world. Many of the fatalities are the result of outbursts caused by high gas pressures and from explosions caused by the ignition of high levels of methane. Pre-mining degasification of the coal reserves, with the drilling of vertical wells and utilizing enhanced underground degasification system, would greatly reduce the accident and fatality rates in Ukrainian coal mines.)
- In addition, removal of the methane from the mines will increase productivity by reducing the number of mine slowdowns or shutdowns due to high methane levels.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Promotion of coal bed methane utilization systems;
- This project may also act as a catalyst to the formation of similar projects at other coal mines;
- Creation of an alternative energy source that would mitigate Ukraine's dependency on imported fuel, primarily natural gas from Russia and other CIS countries.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project, environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest is the lack of access to investment capital due to low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurance and shortage of own financial resources. The methodology for estimating methane emissions from underground coal mining consists of two steps. The first step involves estimating methane emissions from underground mines, and the second involves estimating emissions from post-mining activities. CH_4 emissions were calculated in accordance to the IPCC methodology [1] and with accountance for national emissions factors, which are used for the national GHG inventory in the Ukraine. The emission factor is of great importance, which can be confirmed by the results of the inventory of methane emissions from underground coal mining according to the data of measurements made in the Ukraine by thecompany Partnership for Energy and Environmental Reform.

Emissions factors

Activities	*Emission factors*
Underground coal mining	16.51 kg $??_4$ / ton of coal
Post-mining	1.34 kg $??_4$ / ton of coal

Coal mining forecast for Skochinsky Mine for project baseline scenario

Year	***2003***	***2004***	***2005***	***2006***	**…**	***2014***
Coal mining, t	820,000	900,000	1,000,000	1,000,000		1,000,000
? H_4 emission, t	14,637	16,065	17,880	17,880		17,850
? O_2 equivalent emission, t	307,377	337,932	337,480	375,365		374,850

E.2 Estimated emissions with the JI project

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

Methane emissions in the JI project case depend on the efficiency of the degasification system. Typical efficiency of the degasification system is 50%[114] (fraction of the gas drained). Methane emissions from coal mining in the JI project scenario are therefore estimated to be 50% lower than in the baseline case.

GHG emissions for Skochinsky Mine in the JI project case

Year	*2003*	*2004*	*2005*	*2006*	…	*2014*
Efficiency of the degasification system	0.5	0.5	0.5	0.5	…	0.5
? H_4 emissions, t	7 319	8 033	8 925	8 925	…	8 925
? O_2 equivalent emissions, t	153 689	168 683	187 425	187 425	…	187 425

E.2 Summary Table: Projected Emission Reduction

	GHG	***Unit***	***Emission per year***	***Total emission over project life***
A) Project baseline scenario	CO_2	t	-	-
	CH_4	t	17,434	209,202
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	366,104	4,393,242
B) JI project scenario	CO_2	t	-	-
	CH_4	t	8,717	104,601
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	183,052	2,196,621
C) Effect (B-A)	CO_2	t	-	-
	CH_4	t	- 8,717	- 104,601
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	- 183,052	- 2,196,626

7.2. REPLACING EXISTING BOILER HOUSE ON NEW STEAM TURBINE CO-GENERATION PLANT AT TIRE PLANT "DNIPROSHINA"

A Description of the Project

A.1 Title of the Project: "Installation of new steam turbins in existing boiler station at Tire Plant "Dniproshina" "

A.2 Participants/actors

Item	**Participant 1**	**Participant 2**
Name of organization	JSC "Dniproshina"	JSC "DneprVNIPIenergoprom"
Function within project	Owner	Designer
Street	24 Krotova str.	Barnaulskaya, 2 ?
Post code	49600	49000
City	Dnipropetrivsk	Dnipropetrivsk
Country	Ukraine	Ukraine
Contact person	---------------------------	------------------------

[114] IPCC Good Practice Guidance (2000, page 2.73) indicates a typical efficiency range of 30-50%

Surname	Saychenko	Pojairybko
First & middle name	Alexander Vladimirovich	Alexander Evgenievich
Job title	Deputy Chief	Chief engineer
Direct tel	(+380 562) 98-67-41	(+38 0562) 34-12-93
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Direct E-mail	shine&dneproshina.dp.ua	dneprom@email.dp.ua

A.3 Project

Item	Please fill in if applicable
General description of JI project	The project idea is utilization of heat losses for electricity production, thereby reducing GHG emissions from fossil fuel savings at thermal power plants. The enterprise will consume this electricity for its own needs and so substitute grid electricity. JSC "Dniproshina" is a large user of heat and electricity. The enterprise generates heat from process steam and hot water proceeding from its own boiler. Although the company has a considerable energy potential at its boiler facility, it purchases electric energy at high tariffs from the grid without having any possibility to influence them. The process steam produced by its own boilers has initial parameters that exceed the level required for production. Positive pressure has to be released by throttle valves, but its energy potential is not utilized. The realization of the excess potential of electricity production by steam turbines, maintaining the existing level of heat supply, would make it possible to increase the energy efficiency of the technological process, since the existing consumption of fuel would not increase significantly. As a result, additional costs of electricity generation would be approximately 3 times lower than the production cost of electricity at the electric power plants of the grid. Based on the analysis of operation of the JSC "Dniproshina" boiler facility, including the status of the existing main power-generating equipment, the necessity to meet production steam loads and the existing problems of energy supply to the enterprise, the project envisions the creation of a new energy source, operating at the existing boiler facility.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that, without significant investment, a status quo scenario would be maintained. It is assumed that, without the implementation of this project, the existing equipment would not be replaced, during its technical life, with new equipment. Energy savings are calculated under the assumption of constant energy demand, and using energy efficiency data of the new equipment.
Type of project	Energy efficiency
Exact location	Dnipropetrivsk, Ukraine
Project starting date	To be determined
Project life	20 years (operation time of equipment installed)
Stage of project	Pre-feasibility study is completed
Technical data	It is proposed to incorporate two 6 MW backpressure turbines (P-6-3.4/1.0 and PR6-3.4/1.5/0.5-1) of the Kaluga Turbine Plant in the existingboiler house. Annual load of steam turbines is 6508 hours. Annual electricity production is 67.2 mln. kWh. Natural Gas consumption for electricity production will increase by 2.9 million m^3.
Main project risks	Major risks: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Off take and sales risk: relates to the possibility of future lower production load of the enterprise and consequent failure to generate the expected quantity of ERUs.

A.4 Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	5,610,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	469,140	2,184,000
1.3. Energy savings p.a.	USD (2000 prices)	1,714,860	-
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	110,077	1,100,736
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	537,690	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	990,659
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	241,205
2.3. Incremental costs of project [5]	USD (2000 prices)	-537,690
2.4. Cost per t CO_2 [6]	USD / t CO_2	-2.23

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project.

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	SCENARIO A	SCENARIO B	SCENARIO C
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	22.5	27.1	31.6
NPV at 10% with carbon credits (thousand USD)	4,842	6,759	8,676
NPV at 20% with carbon credits (thousand USD)	538	1,543	2,548
NPV at 30% with carbon credits (thousand USD)	-1,039	-407	224

Investment per ton of avoided emissions	USD/t CO_2 eq.	5.7

1.Costs, Revenues and GHG Effects: Comparison between Baseline and Proje ct (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	5,610,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	469,140	2,184,000
1.3. Energy Saving p.a.	USD (2000 prices)	1,714,860	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	110,077	470,400
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	537,690	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life. [3]	t CO_2 equivalent	360,323
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	87,731
2.3. Incremental costs of project [5]	USD (2000 prices)	-537,690
2.4. Cost per t CO_2 [6]	USD / t CO_2	-6.13

Results of Financial Analysis based on ProForm Model

Financial Analysis	SCENARIO A	SCENARIO B	SCENARIO C
ERU Cost, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	22.5	24.2	25.8
NPV at 10% with carbon credits (thousand USD)	4,842	5,539	6,236
NPV at 20% with carbon credits (thousand USD)	538	903	1,269
NPV at 30% with carbon credits (thousand USD)	-1,039	-809	-579

Investment per ton of avoided emissions	USD/t CO_2 eq.	15.6

Describe how costs are determined; specify key assumptions:

The main items within project investment costs are the following (at present all amounts are estimated by the company's engineering staff and should be verified):

- Cost of project design and engineering work is about USD 100,000.
- Equipment cost is USD 2,600,000. The company plans to install turbines and electric generators produced by Kaluga turbine plant, as the preliminary market investigation showed that they are significantly cheaper than similar equipment of ABB or turbine of JSC "Turboatom" (Kharkov, Ukraine) with generators of "Electrotjazhmash" (Ukraine).
- Cost of construction/installation and start-up expenses is about USD 2,400,000.

- Contingency is 10% of total initial investment for new equipment: USD 510,000.

Therefore, the total project investment amounts to about USD 5,610,000.

Estimation of operation and maintenance costs amounts to USD 305,000 per year, including additional natural gas consumption USD 164,000 (or 2.9 mln. m^3 per year) and maintenance of new equipment.

Future fuel and electricity prices are assumed to remain constant and equal to their current level (price of natural gas is USD 56.6 per thousand m^3 and electricity tariff is USD 0.035 per kWh). Annual electricity production is 67.2 mln kWh.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage.

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts including improvement of the local environmental situation by reducing air pollutant emissions (due to reduction of heat production in the energy system). Negative effects are not expected. The proposed project is therefore compatible with national economic developments as well as with socio-economic and environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction air pollution.

Local social/cultural benefits:

- Providing reliable electricity to the plant (its productive operation could be maintained without suffering from blackouts and shortages);
- Better skilled personnel.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- The implementation of the GHG reduction measures will reduce the energy intensity of the tyres produced by Dneproshina;
- Increased profitability/efficiency of tyre plant Dneproshina;
- Less use of primary energy.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest problems are the lack of access to investment capital due to the low interest of the Ukrainian commercial banks in project financing, high costs of debt financing, difficulties in obtaining guarantees/insurances and shortages of their own financial resources.

The plant management has known about advantages of the project for a long time but still can not find appropriate financial possibilities for its implementation.

The project baseline was built in accordance with a status quo scenario. It is assumed that without significant investment the status quo scenario will be maintained. No energy savings would have been made without the project.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	67 200

Emission factor, g CO_2/kWh	819
CO_2 emissions from electricity, t	55 037
Natural gas, thousand m^3	0
Total CO_2 emissions, t	55 037

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.
GHG emission reductions in the JI project scenario will result from the replacement of current electricity consumption from grid and was estimated an with allowance for decrease in power generation at thermal power plants, which operate on coal, natural gas and fuel oil. Natural Gas consumption for electricity production will increase by 2,900 thousand m^3 in project case.

Energy consumption and CO_2 emissions per year

Name	**JI project scenario**
Electricity, thousand kWh	0
Natural gas, thousand m3	2 900
Natural gas, TJ	98.6
Emission factors, CO2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	5 504
Total CO_2 emission, t	5 504

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	55,037	1,100,736
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	55,037	1,100,736
B) JI project scenario	CO_2	t	5,504	110,077
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	5,504	110,077
C) Effect (B-A)	CO_2	t	-49,533	-990,659
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-49,174	-990,659

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	23,520	470,400
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	23,520	470,400
B) JI project scenario	CO_2	t	5,504	110,077
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	5,504	110,077
C) Effect (B-A)	CO_2	t	-180,116	-360,323
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-180,116	-360,323

7.3. KACHANOV ASSOCIATED GAS CAPTURE AND UTILIZATION

A Description of the Project

A.1 Title of the Project: "Kachanov associated Gas Capture and Utilization"

A.2 Participants/actors

Item	**Participant 1**	**Participant 2**
Name of organization	Kachanivskyi Gas-Processing Plant	International Center for Scientific Culture – World Laboratory, Ukrainian Branch
Function within project	Gas production/Project owner	Project partner
Street	The village of Kachanove, Gadyats'kyi rayon. Glyns'ko-Rozbyshevs'ke manufacture of the Kachanivs'kyi Gas-Processing Plant	32a, Turgenevska Str.
Post code		252054
City	Poltavs'ka oblast	Kiev
Country	Ukraine	Ukraine
Contact person	-------------------------	--------
Surname	Savchenko	Buravlev
First & middle name	Grigoriy Ivanovych	Yevguen Pavlovych
Job title	Director	Deputy Director
Direct tel	(+380 0535) 420574	(+380 44) 243-7332
Direct fax	(+380 0535) 420574	(+380 44) 243-7332
Direct E-mail		ubwlab@ukr.net

A.3 Project:

Item	**Please fill in if applicable**
General description of JI project	The project idea is the utilization of associated gas for electricity production, thereby reducing GHG emissions from fossil fuel savings at thermal power plants. The enterprise will consume this electricity for its own needs and so substitute grid electricity.

	this electricity for its own needs and so substitute grid electricity. The installation of a power generating facility with an overall capacity of 6 MW, fueled with gas originated from oil refinery processes, will give 36 thousand MWh of electricity per year. Currently the associated gas is flared without useful utilization. The associated gas mainly consists of CH_4 (methane, ~80%) while the rest is Propane, Butane etc.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that without significant investment, a status quo scenario would be maintained. It is assumed that without the implementation of this project, the existing equipment would not be replaced with new equipment during its technical life. Energy savings are calculated assuming a constant energy demand and using energy efficiency data of the new equipment.
Type of project	Energy efficiency
Exact location	Poltava Region
Project starting date	To be determined
Project life	20 years
Stage of project	Pre-feasibility study is completed
Technical data	Electricity capacity is 6 MW; Load factor is 68.5%; Electricity production is 36 thousand MWh per year.
Main project risks	Major risks: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Unstable level of income from electricity sellings due to the absence of long term power purchase agreements. Minor risk: • Technology risk: relates to technical design of the project, which may not generate the expected credit amount.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3,000 000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	216,000	792,000
1.3. Revenues p.a.	USD (2000 prices)	792,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	0	589,680
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-681,212	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	589,680
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	143,575

2.3. Incremental costs of project [5]	USD (2000 prices)	681,212
2.4. Cost per t CO_2 [6]	USD / tCO_2	4.7

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	13.8	19.3	24.5
NPV at 10% with carbon credits (thousand USD)	742	1,883	3,024
NPV at 20% with carbon credits (thousand USD)	-681	-83	515
NPV at 30% with carbon credits (thousand USD)	-1,165	-788	-412

Investment per ton avoided emissions	USD/t CO_2 eq.	5.1

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	216,000	792,000
1.3. Revenues p.a.	USD (2000 prices)	792,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	0	252,000
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-681,212	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	252,000
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	61,357
2.3. Incremental costs of project [5]	USD (2000 prices)	681,212
2.4. Cost per t CO_2 [6]	USD / tCO_2	11.1

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	13.8	16.2	18.5
NPV at 10% with carbon credits (thousand USD)	742	1,229	1,717
NPV at 20% with carbon credits (thousand USD)	-681	-426	-170
NPV at 30% with carbon credits (thousand USD)	-1,165	1,004	-843

Investment per ton avoided emissions	USD/t CO_2 eq.	11.9

Describe how costs are determined; specify key assumptions:

The main items of the project investment are the following:

- Total investment for the installation of gas-diesel power generators is USD 3M, or USD 500 per kW of electric capacity installed;
- Operation and maintenance costs make up USD 0.006 per kWh of energy produced, or USD 216 thousand per year for estimated 36 GWh of annual power generation;
- Sales price of 1 kWh is USD 0.022.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts and includs improvements of the local environmental situation by reducing air pollutant emissions (due to the reduction of heat production in the energy system). Negative effects are not expected. Therefore the proposed project is compatible with national economic development, socio-economic and environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduced air pollution from coal-based power production.

Local social/cultural benefits:

- By providing reliable electricity to the plant, its productive operation could be maintained without suffering from blackouts and shortages;
- Better skilled personnel.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Increased profitability/efficiency of Kachanivs'kyi Gas-Processing Plant;
- Less use of primary energy;
- Employment creation, during the construction phase of the project.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of this problems are the lack of access to the investment capital due to low interest of the Ukrainian commercial banks in project financing, high costs of debt financing, difficulties in obtaining guarantees/insurances and shortages of their own financial resources.

The plant management has known about advantages of the project for a long time but still can not find appropriate financial possibilities for its implementation.

The project baseline was built in accordance to a status quo scenario. It is assumed that without significant investment a status quo scenario will be maintained. No energy savings would have been made without the project.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh:

Name	*Project baseline scenario*
Electricity, thousand kWh	36 000
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	29 484

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh:

Name	*Project baseline scenario*
Electricity, thousand kWh	36 000
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	12 600

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

GHG emission reductions in the JI project scenario will result from the replacement of the current electricity consumption of the grid and was estimated with allowance for a decrease in the power generation of thermal power plants, which operate on coal, natural gas and fuel oil.

The installation of a power generating facility fuelled with associated gas from gas cleaning process, will give 36 thousand MWh of electricity per year. Currently the associated gas is flared without useful utilization. Therefore there will be no additional GHG emission from associated gas combustion.

E.2 Summary Table: Projected Emission Reductions (819 g CO2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	29,484*	589,680
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	29,484	589,680
B) JI project scenario	CO_2	t	0	0
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	0	0
C) Effect (B-A)	CO_2	t	-29,484	-589,680
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-29,484	-589,680

**Baseline scenario and JI project scenarios do not include GHG emissions from associated gas combustion because they are the same.*

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	-12,600	252,000
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	12,600	252,000
B) JI project scenario	CO_2	t	0	0
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	0	0
C) Effect (B-A)	CO_2	t	-12,000	-252,000
	CH_4	T		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-12,000	-252,000

7.4. Installation of Additional Generating Capacity at Novoazovsk (Donetsk oblast) and Tarkhankut (Autonomous Republic of the Crimea) Wind Plants

A Description of the Project

A.1 Title of the Project: "Installation of Additional Generating Capacity at Novoazovsk (Donetsk oblast) and Tarkhankut (Autonomous Republic of the Crimea) Wind Plants"

A.2 Participants/actors

Item	**Participant 1**	**Participant 2**	**Participant 3**
Name of organization	"Windenergo Ltd."	Novoazovsk WP	Tarkhankut WP
Function within project	Project owner		
Street	91 Levanevsky Str.		
Post code	04112		
City	Kiev	Donetsk oblast	Autonomous Republic of the Crimea
Country	Ukraine	Ukraine	Ukraine
Contact person			
Surname	Dulnev	Zhabskiy	Oleisker
First & middle name	Lev Solomonovich	Yuri Viktorovich	Igor Vikorovich
Job title	Deputy Director General	Director General	Head
Direct tel	+380 44 219-39-96	+380 62 382-6601	+380 6569 60079
Direct fax	+380 44 219-39-95	+380 62 382-6601	+380 6569 60079
Direct E-mail	windene@alfacom.net	vetroenergoprom@dn.farlep.net	isso@evpatoria.crimea.ua

A.3 Project:

Item	**Please fill in if applicable**
General description of JI project	The project will reduce GHG emissions by using renewable energy for electricity production. The electricity will be sold to the grid. The projects plan is to install 20 wind turbines with a capacity of 600 kW each, with 10 wind plants to be installed at Novoazovsk and 10 at Tarkhankut. Novoazovsk and Tarkhankut wind plants are state property. Till 1994 the responsible authority for wind power in the Ukraine was the Ministry of Energy. After that (since 1994) the wind plants are operated by the Intergovernmental Coordination Council. The size of Novoazovsk and Tarkhankut wind plants are shown in the table below.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that, without significant investment, a status quo scenario would be maintained. This project is assumed to reduce GHG emission from the generation of 31.62 GWh of electricity per year at Ukrainian thermal power plants.
Type of project	Renewable energy
Exact location	Donetsk oblast, Autonomous Republic of the Crimea
Project starting date	To be determined
Project life	25 years
Stage of project	Pre-feasibility study is completed
Technical data	This project entails setting up the production of wind turbines in Ukraine by assembling components made by Fuhrländer AG (Germany) and Turbowinds (Belgium). This project will allow the increase in capacity of each wind plant by 6 MW Electricity generation will consist of 31.62 GWh per year Load factor is 30% (2,635 hours per year)
Main project risks	• Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Off take and sales risk: relates to the possibility of future lower production load of the enterprise and consequent failure to generate the expected quantity of ERUs. • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Technology risk: relates to technical design of a project, which may not bring the expected credit amount. • Knowledge risk: lack of local technical knowledge about a JI technology. • Cost risk: high transaction cost compared to project cost and achievable amount of ERUs.

Schedule for Wind Turbine Commissioning at Novoazovsk Wind farm

Commissioning Date	Number of Wind Turbines (pieces)	Installed Capacity (MW)
30.12.1998	12	1,29
28.12.1999	15	1,61
29.09.2000	15	1,61
29.09.2000	15	1,61
27.12.2000	10	1,08
27.12.2000	10	1,08
16.07.2001	20	2,15
17.08.2001	20	2,15
20.11.2001	17	1,83
Total	**134**	**14,41**

The projected installed capacity of Novoazovsk Wind farm is 50 MW

Tarkhankut Wind farm

Commissioning Date	Number of Wind Turbines (pieces)	Installed Capacity (MW)
30.11.2001	21	2,26

The projected installed capacity of Tarkhankut Wind farm is 70 MW

A.4 Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	14,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	268,000	0
1.3. Revenues p.a.	USD (2000 prices)	1,411,715	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent		621,523
1.5. Discount rate	%	20	
1.6. Project life	Years	25	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 4,158,363	0

2. Incremental Project Costs and Effects

	Units	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	621,523
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	107,745
2.3. Incremental costs of project [5]	USD (2000 prices)	4,158,363
2.4. Cost per t CO_2 [6]	USD / t CO_2	38.6

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	7.0	8.8	10.4
NPV at 10% discount rate with carbon credits (thousand USD)	-1,697	-732	232
NPV at 20% discount rate with carbon credits (thousand USD)	-4,158	-3,709	-3,260
NPV at 30% discount rate with carbon credits (thousand USD)	-4,734	-4,473	-4,212

Investment per ton of avoided emissions	USD/t CO_2 eq.	22.5

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Units	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	14,000,000	-
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	268,000	-
1.3. Revenues p.a.	USD (2000 prices)	1,411,715	
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	-	265,608
1.5. Discount rate	%	20	
1.6. Project life	Years	25	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 4,158,363	-

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	265,608
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	46,045
2.3. Incremental costs of project [5]	USD (2000 prices)	4,158,363
2.4. Cost per t CO_2 [6]	USD / t CO_2	90.3

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	7	7.8	8.5
NPV at 10% discount rate with carbon credits (thousand USD)	-1,697	-1,285	-873
NPV at 20% discount rate with carbon credits (thousand USD)	-4,158	-3,967	-3,775
NPV at 30% discount rate with carbon credits (thousand USD)	-4,734	-4,622	-4,511

Investment per ton of avoided emissions	USD/t CO_2 eq.	52.7

Describe how costs are determined; specify key assumptions

The implementation of the program needs an investment of USD 14M over a period of 3 years.

The costs of operation and maintenance represent yearly 2% of the investment

The costs are divided as follows:

- First stage: Installation of 2 MW wind turbines. Cost: USD 4M.
- Second stage: Installation of 5 MW wind turbines. Cost: USD 5M.
- Third stage: Installation of 5 MW wind turbines. Cost: USD 5M.

In the calculations, tariffs for electricity generated by the wind plants were assumed to be set at a level sufficient to break-even in seven years. For this project, the tariff during the first seven years of operations will equal USD 0.095 per kWh and, starting from the eighth year to the thirtieth year, it will be USD 0.03 per kWh.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The Comprehensive Program of Wind Plants Construction developed in fulfillment of Decree of the President of Ukraine No. 159 of March 2, 1996 and approved by Resolution of the Cabinet of Ministers of Ukraine No. 137 of February 3, 1997, plans the increase of energy generation by the use of such renewable source of energy as wind energy (The project is legally supported by the Laws of Ukraine "On the Power Sector" and "On Taxation of Enterprises' Profit").

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits include the following emissions reduction:

- Carbon dioxide – 23,430 t/yr.;
- Sulfur oxide – 112.0 t/yr.;
- Nitric oxide – 44.2 t/yr.;
- Dust – 2.8 t/yr.;
- Carbon monoxide – 14.2 t/yr.;

Local social/cultural benefits:

- better skilled personnel

Local economic benefits, including transfer of environmentally sound technology and know-how:

- Increase in job opportunity,
- Less use of primary energy.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of number financial barriers for its implementation. Main of them are the lack of access to investment capital due to low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurance and shortage of own financial resources.

The practice of implementing these projects and prediction of funds attraction show that under no circumstances it will be impossible to achieve the planned installed capacity at these wind power plants by 2012 without attraction of foreign financial resources such as those under the JI mechanism

Project baseline was built in accordance with an assumption that power generation will continue at thermal power plants, which operate on coal, natural gas and fuel oil.

Energy consumption and CO_2 emission for Option: 819 g CO_2/kWh

Years of project baseline scenario	*1*	*2*	*3*	…	*25*
Electricity, thousand kWh	10 540	21 080	31 620	…	31 620
Emission factor, gCO_2/kWh	819	819	819	…	819
Total CO_2 emission, t	8 632	17 265	25 897	…	25 897

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Years of project baseline scenario	*1*	*2*	*3*	…	*25*
Electricity, thousand kWh	10 540	21 080	31 620	…	31 620
Emission factor, gCO_2/kWh	350	350	350	…	350
Total CO_2 emission, t	3 689	7 378	11 067	…	11 067

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.
Evidently, there will be no GHG emission in JI project scenario.

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	24,861	621,523
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	24,861	621,523
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	-24,861	-621,523
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-24,861	-621,523

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	10,624	265,608
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	10,624	265,608
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	-10,624	-265,608
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-10,624	-265,608

7.5. CO-GENERATION SYSTEM ON COKE GAS (AVDEEVKA COKE CHEMICAL PLANT)

Note: The pre-feasibility study is available in both Ukrainian and English.

A Description of Project

A.1 Title of Project: "Co-generation System on coke gas (Avdeevka Coke Chemical Plant)"

A.2 Participants/actors

Item	Participant 1	Participant 2	Participant 3
Name of organization	Avdeevka Coke Chemical Plant	Pacific Northwest National Laboratory	Agency for Rational Energy Use and Ecology
Function within project	Project owner	Design organization	National consultant
Street	Avdeevka town	PO Box 999	1 Labo rotorny str., P.O. Box 48
Post code	343871	99352	252133
City	Donesk oblast	Richland, WA	Kiev
Country	Ukraine	USA	Ukraine
Contact person	-------------------------	-------------------------	-------------------------
Surname First & middle name Job title Direct tel	Derevitsky Vasyl Ivanovich Chairman (+380 622) 90-35-90	Parker Steven A. (+509) 375-63-66	Raptsun Mykola Vitalyovich President (+ 380 44) 268-80-88
Direct fax	(+380 622) 99-84-02	(+509) 375-36-14	(+ 380 44) 268-84-51
Direct E-mail	postmaster@ogekoks.donetsk.ua.	Sa_parker@pnl.gov	arena@arena.viaduk.net

A.3 Project

Item	Please fill in if applicable
General description of JI project	The project idea is installation of gas turbine system on currently useless flared coke gas, thereby reducing electricity consumption by plant and, consequently, GHG emissions from fossil fuel saving. The current boiler uses coke gas as a fuel and the steam turbine plant is in relatively poor condition and will likely need replacement within the next five years. A gas-fired cogeneration system, the likely preferred option, is evaluated in more detail to determine the adequacy of coke oven gas (COG) supply and the cost-effectiveness of an investment in this type of technology. Except for periodic outages, the Avdeevka Coke Chemical Plant operates continuously–24 hours per day, 7 days per week, 52 weeks per year. The plant consumes large quantities of steam and electricity to produce coke and COG as a by-product. Steam needs are currently met via a combination of distributed and central generation using part of the COG as the energy source. Unused COG is either vented or flared. Electricity needs are currently met via a combination of steam turbine self-generation and purchases from the local electric power company. Processed steam and electricity demand are relatively constant from month to month, while steam demand for heating the plant and steam demand by external customers varies seasonally with the weather. Even though the amount of COG is limited, enough COG is available for the Avdeevka plant to generate most of the electricity and all the steam it needs. Cogeneration significantly increases the amount of steam and electricity that can be produced from a fixed amount of fuel compared to generating each separately. With free fuel and a relatively high annual average load factor, self-generation of electricity should be less expensive than purchasing electricity from an external supplier, even though the external supplier (that is, the local electric utility) is able to aggregate loads and benefit from equipment economies-of-scale. Among the cogeneration system options, a gas turbine system (i.e., a gas-fired combustion turbine coupled with a heat recovery steam generator [HRSG]) is likely the best option for the Avdeevka plant because gas turbines are more efficient and no more costly than steam turbines for the generating capacities applicable to the plant. Monthly, data of COG supply availability for cogeneration, steam demand, electricity demand, and ambient-temperature at the Avdeevka plant were combined with combustion turbine performance data provided by ABB to determine if adequate COG was available to meet the plant's steam and electricity loads.

General description of project baseline (reference scenario)	Project baseline was built under the assumption that, without a significant investment, a status quo scenario would be maintained. It is assumed that, without the implementation of this project, the existing equipment would not be replaced, during its technical life, with new equipment. Energy savings are calculated assuming a constant energy demand and using energy efficiency data for the new equipment.
Type of project	Energy efficiency
Exact location	Avdeevka town, Donetsk region, Ukraine
Project starting date	To be determined
Project life	13 years (technical life of installed equipment)
Stage of project	Feasibility study is completed
Technical data	Gas Turbine Performance *Combustion Turbine Performance at Full-Load and ISO Conditions (ABB Specifications)* Output, kW 16,595 Heat Rate, kJ/kWh 11,513 Heat Rate, kcal/kWh 2,750 Fuel Flow, kg/s 1.432 Exhaust Temperature, °C 377 Exhaust Flow, kg/s 92.5 Electricity production p.a., thousand kWh 138,104
Main project risks	Major risks: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Off take and sales risk: relates to the possibility of lower production load of the enterprise and consequent failure to generate the expected quantity of ERUs. Minor risks: • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Technology risk: relates to technical design of a project, which may not generate the expected credit amount. • Operation risk: lack of local skills in the operation of a cogeneration system on coke gas.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	13,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	552,000	0
1.3. Revenues p.a.	USD (2000 prices)	5,971,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	0	1,583,500
1.5. Discount rate	%	20	
1.6. Project life	Years	13	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	4,893,932	0

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	1,583,500
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	521,488
2.3. Incremental costs of project [5]	USD (2000 prices)	-4,893,932
2.4. Cost per t CO_2 [6]	USD / t CO_2	-9.4

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project.

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	30.7	35.3	39.8
NPV at 10% with carbon credits (thousand USD)	15,595	19,382	23,170
NPV at 20% with carbon credits (thousand USD)	4,894	7,067	9,240
NPV at 30% with carbon credits (thousand USD)	229	1,642	3,056

Investment per ton avoided emissions	USD/t CO_2 eq.	8.2

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	13,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	552,000	0
1.3. Energy savings p.a.	USD (2000 prices)	5,971,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	88,806	676,710
1.5. Discount rate	%	20	
1.6. Project life	Years	13	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	4,893,932	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	676,710
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	222,858
2.3. Incremental costs of project [5]	USD (2000 prices)	-4,893,932
2.4. Cost per t CO_2 [6]	USD / t CO_2	-22.0

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	30.7	32.7	34.7
NPV at 10% with carbon credits (thousand USD)	15,595	17,214	18,832
NPV at 20% with carbon credits (thousand USD)	4,894	5,823	6,751
NPV at 30% with carbon credits (thousand USD)	229	833	1,437

Investment per ton avoided emissions	USD/t CO_2 eq.	19.2

Describe how costs are determined; specify key assumptions:

Cogeneration System Costs

Estimated equipment purchase costs for a single ABB cogeneration unit, with component estimates provided for the turbine-generator and the HRSG, are shown below. Additional costs will be incurred to install these components and to purchase and install ancillary components, as well as for site preparation, design, construction management, training, and start-up services.

Cogeneration System Estimates, million USD

Turbine-generator purchase	5.8
HSRG purchase	1.5
Ancillaries, installation, services	3.95
Installed gas compressor	2.0
Total (rounded)	13

Operation and maintenance costs estimated 0.004 USD/kWh.
Electricity price for Avdeevka Coke Chemical Plant is 0.037 USD/kWh.
Annual electricity production by gas turbine is 138.1 mln. kWh.

Annual heat by production HRSB is 724 thousand GJ. Production cost on existing boiler station is 1.2 USD/GJ.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies

The project contributes to fulfilling the Ukrainian Energy and Environmental Policies

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of local air pollution.

Local social/cultural benefits:

- By providing reliable electricity to the plant, its productive operation could be maintained without suffering from blackouts and shortages;
- Better skilled personnel.

Local economic benefits, including transfer of environmentally sound technology and know-how:

- Promotion of coke gas utilization system for electricity and heat production;
- Less use of primary energy;
- The implementation of the GHG reduction measures will reduce the energy intensity of the coke produced by Avdeevka coke plant;
- Increased profitability/efficiency of Avdeevka coke plant.

E Benefits related to the Mitigation of Climate Change, and environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of these are the lack of access to investment capital, which is due to the low interest of the Ukrainian commercial banks in project financing, the high costs of debt financing, the difficulties in obtaining guarantees/insurances and shortages of their own financial resources.
The plant management has known about advantages of the project for a long time but still can not find appropriate financial possibilities for its implementation.
GHG emissions reductions (resulting from replacement of current electricity consumption from grid) are estimated with allowance for decrease in power generation at thermal power plants in Ukraine, which operate on coal, natural gas and fuel oil. No energy savings would have been made without the project.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	138 104
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	113 107

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	138 104
Emission factor, g CO_2/kWh	350
CO_2 emissions from electricity, t	48 336

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

GHG emissions reduction in JI project scenario will result from the replacement of the current electricity consumption from grid and was estimated with allowance for decrease in power generation at thermal power plants, which operate on coal, natural gas and fuel oil.
The Installation of a power generating facility fuelled with coke gas, will give 138 thousand MWh of electricity per year. Currently the coke gas is flared without useful utilization. Therefore there will be no additional GHG emission from coke gas combustion.

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	79,175	1,583,500
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	79,175	1,583,500
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	-79,175	-1,583,500
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-79,175	-1,583,500

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	33,835	676,710
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	33,835	676,710
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	-33,835	- 676,710
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-33,835	- 676,710

7.6. HEAT RECOVERY FROM VENTILATION OF MAIN PRODUCTION BUILDING AT TIRE PLANT "ROSAVA"

A Description of Project

A.1 Title of Project: "Heat recovery for ventilation of main production building at tyre plant "ROSAVA"

A.2 Participants/actors

Item	Participant 1	Participant 2
Name of organization	Close Join Stock Company "Rosava"	Tysak Engineering
Function within project	Project owner	Design organization
Street	91, Levanevskogo Str	29 Flint Rd
Post code	256400	01720
City	Bila Tserkva, Kiev oblast	Acton, MA
Country	Ukraine	USA
Contact person	---------------------------	---------------------------------
Surname	Tuluk	Popelka
First & middle name	Viktor Timofeevich	Andrew
Job title	Technical Director	Vice president
Direct tel	(+380 263) 73-903	(+978) 635 9336
Direct fax	(+380 263) 37-33	(+978) 263 0444
Direct E-mail	snab&srosava.kiev.ua	APopelka@aol. com

A.3 Project

Item	**Please fill in if applicable**
General description of JI project	The project idea is to install a new high-efficiency ventilation system in main production building at JSC "ROSAVA". Thereby, the electricity and heat consumption will be reduced, which will – consequently – lead to the saving of GHG emissions from fossil fuels. The proposed heat recovery for the ventilation of the main production building consists of the installation of a total of 63 heat recovery heat wheels for recuperation of the waste heat from the exhaust air, which is used for preheating the outdoor air, which enters the system, and secondly the installation of additional improvements to the ventilation units, which are necessary. The main production building of the Rosava plant is a typical, large floor, open space industrial building with large access gates, arched roof with roof window vents, and relatively poorly insulated shell. The approximate volume of air within this structure is 1.8M cubic meters. The processing of rubber resin, vulcanization of tires, and other technological processes produce significant amount of pollutants, and industrial type ventilation is required in order to for keeping the indoor air quality within acceptable limits. Therefore, in addition to heating and cooling the structure, a significant amount of outdoor air must be conditioned and introduced into the building and subsequently exhausted into the atmosphere.
General description of project baseline (reference scenario)	The existingventilation equipment in the main production building has exhausted its service life. Its mere replacement would not lead to energy savings, and its cost is USD 300,000.
Type of project	Energy efficiency
Exact location	Bila Tserkva, Kiev oblast
Project starting date	To be determined
Project life	20 years (technical life of installed equipment)
Stage of project	Feasibility study is completed
Technical data	Energy saving will be accomplished by recuperating 76% of efficient heat during the heating season. The system does not have mechanical, electric or absorption cooling. The evaporative

	cooling does not produce sufficient temperature difference to make heat recovery worthy. Electricity saving will be accomplished also by reducing the pumping power currently required for the nozzle spray array. The proposed Celdek evaporative system (made by Munters, Sweden) requires only water to be supplied at low head pressure to the distribution manifold above the Celldek material. Water then flows over the Celdek by gravity. It is assumed that the distributed local exhaust fans have total electricity consumption of more than the same nominal air volume central centrifugal blower. Total heat saving represents 67,931 Gcal per year, and the resulting electricity consumption saving represents 276,518 kWh. The total monetary saving, assuming USD 0.039 per kWh and USD 9.72 per Gcal, represents USD 671,075 annually. The annual cost of additional maintenance of the wheel was not considered in the calculation, as it is typically part of the overall ventilation system maintenance.
Main project risks	Major risk: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). Minor risk: • Knowledge risk: lack of local technical knowledge about a JI technology.

A.4 Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	***JI Project***	***Baseline***
1.1. Total investment	USD (2000 prices) [1]	3,401,000	300,000
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	928,441	1,567,032
1.3. Revenues p.a.	USD (2000 prices)	-	-
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	456,691	801,132
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 6,088,142	- 5,597,133

2. Incremental Project Costs and Effects

	Unit	***Incremental Effects and Costs of JI Project***
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	344,441
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	83,864
2.3. Incremental costs of project [5]	USD (2000 prices)	491,009
2.4. Cost per t CO_2 [6]	USD / tCO_2	5.9

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project.

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	15.7	18.8	21.8
NPV at 10% discount rate with ERU credits, thousand USD	1,173	1,840	2,506
NPV at 20% discount rate with ERU credits, thousand USD	-491	-142	208
NPV at 30% discount rate with ERU credits, thousand USD	-1,070	-850	-631

Investment per ton of avoided emissions	USD/t CO_2 eq.	9.0

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3,401,000	300,000
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	928,441	1,567,032
1.3. Revenues p.a.	USD (2000 prices)	-	-
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	426,195	768,043
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 6,088,872	- 5,597,133

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	341,848
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	83,233
2.3. Incremental costs of project [5]	USD (2000 prices)	491,009
2.4. Cost per t CO_2 [6]	USD / tCO_2	5.9

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	15.7	18.8	21.7
NPV at 10% discount rate with ERU credits, thousand USD	1,173	1,835	2,496
NPV at 20% discount rate with ERU credits, thousand USD	-491	-144	203
NPV at 30% discount rate with ERU credits, thousand USD	-1,070	-852	-634

Investment per ton of avoided emissions	USD/t CO_2 eq.	9.1

Describe how costs are determined; specify key assumptions:

Material and labor schedule for heat recovery system installation

Description	*Material Cost, USD*	*Labor cost, USD*	*Shipping & Handing, USD*	*Taxes & Fees, USD*	*Total Cost, USD*
Heat recovery unit TE-70	1,393,653	278,731	840	139,365	1,812,588
Return air ductwork	532,210	106,442	26,611	0	665,263
Enclosure& frame	222,300	88,920	11,115	0	322,335
Exhaust blowers	226,800	90,720	11,340	0	328,860
Celldek evaporation system	99,000	39,600	4,950	9,900	153,450
Controls	76,680	30,672	3,834	7,668	118,854
Total costs					**3,401,350**

Installation of a heat recovery system for the air ventilation units produces substantial operational cost savings (heat, cooling, electricity). For new installations, or sites considering installation of a cooling system, it also reduces the size of cooling station equipment, as a substantial part of the cooling energy is recuperated.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts including improvement of the local environment by reducing air pollutant emissions (due to decreased need of energy generated from heat plants). Negative effects are not expected. Proposed project is therefore compatible with national economic development, socio-economic and environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of local air pollution.

Local social/cultural benefits:

- Improved working conditions, increased motivation;
- Better indoor climate in buildings;
- Creates a healthier environemnt for the workers.

Local economic benefits, including transfer of environmentally sound technology and know-how:

- Promotion modern high-efficiency environmentally sound technology;
- The implementation of the GHG reduction measures will reduce the energy intensity of the tyres produced by Rosava;
- Increased profitability/efficiency of tyre plant Rosava.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.
The additionality of this financially feasible project can be explained by the existence of the number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital due to the low interest of the Ukrainian commercial banks in project financing, the high costs of debt financing, the difficulties in obtaining guarantees/insurances as well as the shortage of own financial resources.
The Project baseline was built in accordance with a status quo scenario for ventilation system in the main production building at JSC "ROSAVA". It is assumed that without significant investment a status quo scenario will be maintained. No energy savings would have been made without the project.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	3 528
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	2 889
Natural gas, TJ	665.8
Emission factors, CO_2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	37 167

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	3 528
Emission factor, g CO_2/kWh	350
CO_2 emissions from electricity, t	1 138
Natural gas, TJ	665.8
Emission factors, CO_2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	37 167

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.
GHG emissions reduction in the JI project scenario will result from the electricity saving and was estimated with allowance for decrease in the power generation at thermal power plants, which operate on coal, natural gas and fuel oil. Heat energy savings will be accomplished by 76% efficient heat recovery during the heating season. Bila Tserkva CHP is heat energy supplier of Rosava. Bila Tserkva CHP used n atural gas for heat production. Average efficiency of heat generation at Bila Tserkva CHP is 92%.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*JI project scenario*
Electricity, thousand kWh	3 251
Emission factor, g CO_2/kWh	819
CO_2 emissions from electricity, t	2 663
Natural gas, TJ	361.4
Emission factor, CO_2 t/TJ	55.8195
CO_2 emissions from Natural Gas combustion, t	20 172

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Name	*JI project scenario*
Electricity, thousand kWh	3 251
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	1 138
Natural gas, TJ	361.4
Emission factor, CO_2 t/TJ	55.8195
CO_2 emissions from Natural Gas combustion, t	20 172

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	***Unit***	***Emission per year***	***Total emission over project life***
A) Project baseline scenario	CO_2	t	40,057	801,132
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	40,057	801,132
B) JI project scenario	CO_2	t	22,835	456,691
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	22,835	456,691
C) Effect (B-A)	CO_2	t	-17,222	-344,441
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-17,222	-344,441

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	38,402	768,043
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	38,402	768,043
B) JI project scenario	CO_2	t	21,310	426,195
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	21,310	426,195
C) Effect (B-A)	CO_2	t	-17,092	-341,848
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-17,092	-341,848

7.7. Implementation of 1.5 MW_E power plant operating on landfill gas at Lugansk landfill

A Description of Project

A.1 Title of Project: "Implementation of 1.5 MW_e power plant operating on landfill gas at Lugansk landfill"

A.2 Participants/actors:

Item	Participant 1	Participant 2
Name of organization	Close Joint Stock Company "Protos"	Scientific Engineering Center "Biomass"
Function within project	Project owner	National consultant
Street	96, Lomonosov str.	P/o box 964
Post code	91016	03067
City	Lugansk	Kiev
Country	Ukraine	Ukraine
Contact person	Director	Director
Surname	Belik	Geletukha
First & middle name	Anatoliy K.	Georgiy Georgiyevich
Job title	Director	Director
Direct tel	(+ 380 642) 490-988, 490-941	(+380 44) 446-94-62
Direct fax	(+ 380 642) 490-988	(+380 44) 484-81-51
Direct E-mail		geletukha@biomass.kiev.ua

A.3 Project:

Item	Please fill in if applicable
General description of JI project	The project will reduce methane emissions by capturing and using landfill gas for electricity production. The electricity will be sold to the grid, displacing power from fossil fuel-fired power stations and associated CO_2 emissions. "Protos" is a company responsible for collection, transportation and disposal of municipal solid wastes (MSW) at the Lugansk landfill (region center, population of about 500,000). "Protos" is a Close Joint Stock Company working independently on commercial basis. The landfill is

	located near the city of Lugansk, its area is 8 hectares, its depth is 20-25 m, and its capacity is about 1.5M m^3. It is 90% full, and it contains 1.6M tons of MSW. Now the landfill is being enlarged. The project envisions the installation of a 1.5 MW power plant at the Lugansk landfill. The plant will fulfill the landfill demand of heat and electricity, and will provide the opportunity to sell most of the produced electricity to the grid. Such project is profitable for the Lugansk landfill, as the Ukrainian price of electricity for power producers is about USD 0.021 per kWh and, according to calculations, the production cost of electricity generated by a 1.5 MW power plant operating on LFG is about USD 0.016 per kWh. It is expected that electrisity prices will grow. Implementation of power plant on the landfill results in production of 12 GWh/year of electricity.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that, without this investment, a status quo scenario would be maintained. It is assumed that this project will reduce GHG emissions from generation of 12 thousand MWh of electricity at Ukrainian therm al power plants.
Type of project	Renewable energy
Exact location	Lugansk, Ukraine
Project starting date	To be determined
Project life	20 years (operation time of landfill)
Stage of project	Pre-feasibility study is completed
Technical data	Parameters • Volume of landfill — 2M m^3 • Landfill gas yield, million m^3/year — 8 • Heating value of landfill gas, MJ/m^3 — 18 • Installed capacity of landfill gas, MJ/ m^3 — 2 ^{x}750 • Electricity production, MWh/year — 12,000
Main project risks	Major risks: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Off take and sales risk: relates to the possibility of future lower production load of the enterprise and consequent failure to generate the expected quantity of ERUs. • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Technology risk: relates to technical design of a project, which may not generate the expected credit amount. Minor risks: • Knowledge risk: lack of local technical knowledge about a JI technology. • Cost risk: high transaction cost compared to project cost and achievable amount of ERUs.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	2,250,000	
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	77,750	
1.3. Revenues p.a.	USD (2000 prices)	252,000	
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	760,620	2,097,900
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 1,243,071	-

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	1,337,280
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	325,600
2.3. Incremental costs of project [5]	USD (2000 prices)	1,243,071
2.4. Cost per t CO_2 [6]	USD / tCO_2	3.8

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project.

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	3.3	21.3	36.6
NPV at 10% discount rate with ERU credits, thousand USD	-840	1,747	4,335
NPV at 20% discount rate with ERU credits, thousand USD	-1,243	114	1,470
NPV at 30% discount rate with ERU credits, thousand USD	-1,334	-481	372

Investment per ton of avoided emissions	USD/t CO_2 eq.	1.7

Option A: Diesel Generator "Man"

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	2,250,000	
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	77,750	
1.3. Revenues p.a.	USD (2000 prices)	760,000	
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	760,620	1,985,340
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 1,243,071	-

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	1,224,720
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	298,194
2.3. Incremental costs of project [5]	USD (2000 prices)	1,243,071
2.4. Cost per t CO_2 [6]	USD / tCO_2	4.2

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	3.3	20.0	34.0
NPV at 10% discount rate with ERU credits, thousand USD	-840	2,967	5,375
NPV at 20% discount rate with ERU credits, thousand USD	-1,243	0	1,242
NPV at 30% discount rate with ERU credits, thousand USD	-1,334	-553	228

Investment per ton of avoided emissions	USD/t CO_2 eq.	1.8

Describe how costs are determined; specify key assumptions:
The main items of the project investment costs are the following:

Capital costs, million USD	2.250
Operation time, years	20
O&M costs, thousand USD/year	77.8
Fuel cost, USD/t	0
Prime cost of electricity, USD/kWh	0.016
Market cost of electricity, USD/kWh	0.021

Total financial investment for the project is about USD 2,250,000 and based at typical range in 1.55-2.25 million USD/MW for such projects[115].

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts including improvement of the local environment by reducing air pollutant emissions (due to decreased need of energy generated from heat plants) and creation of new jobs. Negative effects are not expected. The proposed project is therefore compatible with national economic development, socio-economic and environment priorities and strategies. Landfill gas is defined as "alternative fuel" according to the Law of Ukraine "On alternative types of liquid and gas fuel" (N 1391-XIV of 01/14/2000), and administrative support is promised to projects on LFG plants implementation.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Stop to the LFG dispersion in the air around nearby buildings
- Significant reduction of greenhouse gasses

[115] Lars Mikkel Johannessen 1999: Guidance Note on Recuperation of Landfill Gas from Municipal Solid Waste

- Reduction of hazardous gasses emission

Local social/cultural benefits:

- Creation of at least 10 new jobs
- better skilled personnel

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Project created a source of employment for people;
- Promotion of landfill gas utilization systems;
- This project may also act as a catalyst to the formation of similar projects at other landfills in Ukraine;
- Production of 12 GWh/year of electricity.

E Benefits related to the Mitigation of Climate Change, and environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The reason why the current project would not be undertaken without being a JI project is the lack of financial resources in the renewable energy sector of the Ukraine. There aren't any major changes in this situation, as in general the country's economy is unlikely to grow in such a way that it would create a sufficient reserve for a more extensive support of the renewable energy sector over the next 15 years.
In practice, the project would not have a chance for being implemented without using the Joint Implementation mechanism. Currently there aren't any existing LFG recovery and utilization project. Methane is simply generated in anaerobic conditions and released in the air. Currently the Ukrainian law hasn't got any requirements concerning landfill methane. The implementation of the collection and utilization system will be the first example in the Ukraine with a great demonstration effect.

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

CO_2 emission reductions: The reduction of CO_2 that will take place due to the reduction of fossil fuel combustion at the thermal power plant with a electricity production of 12,000 MWh/year.

CH_4 emission reductions: It is assumed that the LFG recovery system can cover approximately 80 percent of the waste in place. The average efficiency of the LFG extraction wells/collectors is assumed to be approximately 75 percent over the life of the landfill. The on-line availability of a LFG collection system is assumed to be 99 percent. Based on the figures outlined above, the LFG recovery rate for a utilization project in Ukraine is estimated to be 60 percent of the total LFG generation rate. The estimate range is consistent with the findings reported by the USEPA, which reports that LFG recovery can range from approximately 60 to 85 percent.

The annual recovery of LFG is estimated with 5 m^3 per tonnes of waste and per year over a period of 20 years (100 m^3 in total). The methane content in LFG is about 50%. These values are consistent with the World Bank recommendations (see Lars Mikkel Johannessen 1999: Guidance Note on Recuperation of Landfill Gas from Municipal Solid Waste Landfills).

Reduction ??$_4$ emissions through biogas utilization from municipal solid waste

Volume of Lugansk landfill, m^3	2 000 000
Average density of wastes, t/m^3	0.8
Annual recovery of LFG, m^3/t (wastes)	5
Recovery of LFG at Lugansk landfill, m^3/year	8 000 000
? ?$_4$ utilization (thousand m^3/year)	8 000 x 0.5 = 4 000
? ?$_4$ utilization (t/year)	2 716*
? ?$_4$ utilization over project life (t)	54 320
Emissions avoided in CO_2 equivalent over project life (tonne)	1 140 720**

* Specific weight of CH_4 is assumed to be equal to 679 g/m^3

** Global warming potential for CH_4 equals 21

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	Unit	Emission per year	Total emission over project life
A) Project baseline scenario	CO_2	T	9,828	196,560
	CH_4	T	4,527	90,540
	N_2O	T		
	Other	T		
	Total	t CO_2 eq.	104,895	2,097,900
B) JI project scenario	CO_2	T	-	-
	CH_4	T	1,811	36,220
	N_2O	T		
	Other	T		
	Total	t CO_2 eq.	38,031	760,620
C) Effect (B-A)	CO_2	T	-9,828	- 196,560
	CH_4	T	-2,716	-54,320
	N_2O	T		
	Other	T		
	Total	t CO_2 eq.	-66,864	- 1,337,280

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	Unit	Emission per year	Total emission over project life
A) Project baseline scenario	CO_2	t	4,200	84,000
	CH_4	t	4,527	90,540
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	99,267	1,985,340
B) JI project scenario	CO_2	t	-	-
	CH_4	t	1,811	36,220
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	38,931	760,620
C) Effect (B-A)	CO_2	t	-4,200	-84,000
	CH_4	t	-2,716	-54,320
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-61,236	-1,224,720

About 15M t of MSW annually are generated in Ukraine. Most MSW is disposed of at landfills (more than 90%). About 140 landfills, out of the total number of 655 landfills, can be considered as suitable for extraction, collection and utilization of landfill gas. Based on this number, the potential of landfill gas available for energy production amounts to about 400M m^3/year, which is equivalent to 0.3M tce/year. This shows that Ukraine presents good conditions for duplication of this project.

7.8. IMPLEMENTATION OF 280 kW_E+560 kW_{TH} CHP BIOGAS PLANT ON PIG BREEDING FARM

A Description of Project

A.1 Title of Project: "Implementation of 280 kW_e+560 kW_{th} CHP biogas plant in pig breeding farm"

A.2 Participants/actors

Item	Participant 1	Participant 2	Participant 3
Name of organization	Agricultural Enterprise “Aurora” Ltd.	Scientific Engineering Center “Biomass”	UKRNIIAGROPROEKT
Function within project	Project owner	National consultant	Design organization
Street	v. Pridneprovskoe, Nikopol district	P/o Box 964	2, Solomenska sq.
Post code	255780	03067	03680
City	Dnepropetrovskregion	Kiev	Kiev
Country	Ukraine	Ukraine	Ukraine
Contact person	-------------------------	-------------------------	-------------------------
Surname	Pomazansky	Geletukha	Smirnov
First & middle name	Andriy	Georgiy Georgiyevich	Oleg Pavlovich
Job title	Director	Director	Deputy Director
Direct tel	(+ 380 5662) 780 50	(+380 44) 446-94-62	(+ 380 44) 276 20 51
Direct fax	(+380 5662)780 53	(+380 44) 484-81-51	(+ 380 44) 276 20 51
Direct E-mail		geletukha@biomass.kiev.ua	

A.3 Project:

Item	**Please fill in if applicable**
General description of JI project	The project will reduce GHG emissions by using renewable energy for heat and electricity production. The heat will be used for its own needs and electricity will be partly sold to consumers. A pig-breeding farm is part of the agricultural enterprise "Aurora" Ltd. The farm is located next to the town of Nikopol in the Dnepropetrovsk region. The pig-breeding farm consists of two departments: Reproduction department and Fattening department, which are located one next to the other. Total capacity the farm is 30,000 pigs, but it is holding about 19,000 pigs now. The farm plans to increase the amount of pigs up to 30,000 in the near future. The proposed project consists of demonstrating the viability of an economically and environmentally sound system of pig manure processing in a medium-sized private pig-breeding farm in the Dnepropetrovsk region. The pig manure will be converted by means of a Combined Heat and Power (CHP) anaerobic digestion system with total digesters volume of 3,000 m^3, producing up to 280 kW of electricity and 560 kW of heat. This biogas plant will be able to treat 130 t/day of manure wastes with dry solids content of approx. 8-9%. The residual fraction will be converted to high quality liquid fertilizer and solid digested manure in order to be applied at 5,000 ha of cultivating lands owned by the same company. The implementation of a biogas plant results in the production of 2,24 thousand MWh/year of electricity and the production of heat equivalent to 164,000 m3/year of natural gas. The biogas is converted in CHP units into heat and electricity. The electricity is used for own farm consumption and other company facility's needs during the year. During the winter the heat is used in the anaerobic digester (40%) as well as for space heating of pig farm reproduction department (60%). During the summer month the heat can partly be used for hot water supply (10-30%). The base line heat supply only takes the winter consumption of heat into account.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that, without significant investment, a status quo scenario would be maintained. It is assumed that, without the implementation of this project, the existing equipment would not be replaced, during its technical life, with new equipment. Energy savings are calculated assuming a constant energy demand, and using energy efficiency data for the new equipment.
Type of project	Renewable energy
Exact location	v. Pridneprovskoe, Nikopol district, Dnepropetrovsk region, Ukraine
Project starting date	To be determined
Project life	20 years (technical life of installed equipment)
Stage of project	Pre-feasibility study is completed
Technical data	Parameters — digesters volume of 3,000 m^3 Capital costs, thousand USD — 1,039 O&M costs, thousand USD/year — 13.6 Savings [(a)], thousand. USD/year: Electricity — 51.5 Heat — 9.8 Minerals (N, P, K) — 94.7 Total — 142.5
Main project risks	Major risks: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Technology risk: relates to technical design of a project, which may not

	generate the expected credit amount. Minor risks: • Knowledge risk: lack of local technical knowledge about a JI technology. • Cost risk: high transaction cost compared to project cost and achievable amount of ERUs.

a) Not including savings of ecological penalties, which may be incurred by the existing manure management. A stricter ecological legislation is expected in Ukraine in the near future.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	1,039,000	
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	13,600	
1.3. Fuel energy cost p.a.	USD (2000 prices)	0	
Revenues p.a.	USD (2000 prices)	139,257	9,800
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	24,971	292,622
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-431,611	-33,691

** GHG emissions during JI project life*

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	267,651
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	65,167
2.3. Incremental costs of project [5]	USD (2000 prices)	397,919
2.4. Cost per t CO_2 [6]	USD / tCO_2	6.1

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project.

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	9.2	16.7	23.6
NPV at 10% discount rate with ERU credits, thousand USD	-52	466	984
NPV at 20% discount rate with ERU credits, thousand USD	-398	-126	145
NPV at 30% discount rate with ERU credits, thousand USD	-505	-334	-164

Investment per ton of avoided emissions	USD/t CO_2 eq.	3.9

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	1,039,000	
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	13,600	
1.3. Revenues p.a.	USD (2000 prices)	139,257	
Fuel energy cost p.a.	USD (2000 prices)		9,800
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	24,971	271,610
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-431,611	-33,691

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	246,640
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	60,052
2.3. Incremental costs of project [5]	USD (2000 prices)	397,919
2.4. Cost per t CO_2 [6]	USD / tCO_2	6.6

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, USD/ton CO_2	0	5.0	10.0
IRR with ERU credits, %	9.2	16.2	22.6
NPV at 10% discount rate with ERU credits, thousand USD	-52	425	902
NPV at 20% discount rate with ERU credits, thousand USD	-398	-148	103
NPV at 30% discount rate with ERU credits, thousand USD	-505	-348	-191

Investment per ton of avoided emissions	USD/t CO_2 eq.	4.2

Describe how costs are determined; specify key assumptions:

Total investment for the project is about USD 1,039,000 based on Dutch CHP unit manufacturer prices. It includes USD 867,000 for equipment and installation costs (USD 654,000 for equipment and USD 213,000 for installation). About 17% of total project costs (USD 173,000) are for design works, transportation of equipment, custom duties (5% of total project costs), and contingency (5% of total project costs).

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage.

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts, including improvement of the local environment by reducing air pollutant emissions (due to decreased need for external electricity production) and creation of new jobs. Negative effects are not expected. The proposed project is therefore compatible with national economic development, socio-economic and environment priorities and strategies. Biogas is defined as “alternative fuel” according to the Law of Ukraine “On alternative types of liquid and gas fuel” (N 1391-XIV of 01/14/2000) and administrative support is promised to projects of biogas plants implementation.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environemntal benefits:

- avoiding of underground water contamination;

Local social/cultural benefits:

- creation of at least 10 new jobs and better skilled personnel.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Creation of employment;
- Promotion of biogas utilisation systems;
- This project may also act as a catalyst to the formation of similar projects at other breeding farm, allowing more facilities to become increasingly self-sufficient in their power supply;
- Increased profitability of pig breeding farm,
- Electricity saving is USD 51,500 per year;
- Heat saving is USD 9,800 per year;
- Mineral fertilizers production USD 94,700 per year.

E Benefits related to the Mitigation of Climate Change, and environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital, which is due to the low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurances and do to shortages of own financial resources.

The installation of a waste processing plant, in particular an anaerobic digestion plant and manure de-watering and application equipment, anticipates the requirements of Ukrainian sanitary and environment authorities on cleaner production and discharge norms.

By Ukrainian norms it is prohibited to use pig excretions as fertilizer directly. Referring to these norms they should be stored at special storage ponds under anaerobic conditions for six months. In practice the usual storage time lasts two to three years. Therefore, 100% of pig excretions in Ukraine are collected in anaerobic ponds for at least six months. We assume that during six months or more storage ponds generate the same amount of methane, which is generated and used for energy in biogas plant.
In the project baseline scenario biogas utilization assums 1,46 million m^3 per year. The estimation of biogas utilization is based on local agricultural norms and recommendations of local experts (Scientific Engineering Center “Biomass”).

Pigs	*Amount, heads*	*Manure (recommended data), kg/ head*	*Total manure, kg/day*	*Dry matter, %*	*Dry matter, kg/day*
Mother	650	15,30	9 945	9.9	984.6
mother tested	220	8,80	1 936	10	193.6
Resting	500	8,80	4 400	9	396.0
Piglets 0-2 months	4 200	0,55	2 310	12	277.2
swine pigs	8 500	1,80	15 300	13.9	2 126.7
Fattening pigs	5 000	6,50	32 500	12.5	4 062.5
Total	19 070		66 391		8 040.6

8040.6 kg/day * K * 0.85 * 0.45 m^3/kg * 365 days/yr = **1 459 340 m^3** /year of biogas

- where k=1.3 used for taking into account multi component fodder;

- the factor 0.85 is the ratio of organic dry matter per total dry matter in manure;
- B_0 is the biogas building potential (0.450 m^3 biogas/kg organic dry matter).

The final 130 000 tonnes of manure was calculated from 66 391 tonnes taking into account the perational practice and the water adding norms for different types of pigs. It means that the real dry content can be approximately 7%. To work at a level of 8-9% the company has to improve its operational practice and has to reduce the amount of water during project implementation. The company believes that this is possible.
The ??$_4$ content in biogas is assumed to be 60%. This will be a CH_4 emisssion of 876 thousand m^3 per year or 595.08[116] tonnes per year.
The estimation of CH4 emissions made by the Scientific Center Biomass is conservative. According to the IPCC default methodology, CH4 emissions may be up to 1 mln. tonnes per year.
Emissions of CO_2 will take place due to the consumption of fossil fuels combustion at thermal power plants for the production of 2.24 thousand MWh/year of electricity as well as due to the annual use of natural gas (164 thousand m^3) for heat production.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	2.24
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	1 835
NATURAL GAS, THOUSAND M ^{3}	164
Natural gas, TJ	5 576
Emission factors, CO2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	311

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	2.24
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	784
NATURAL GAS, THOUSAND M ^{3}	164
Natural gas, TJ	5 576
Emission factors, CO_2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	311

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

In JI project scenario leaks out of the digester assumed approximately 10% of the methane produced in the lagoons. Thus ??$_4$ emission will be 87.6 thousand m^3 per year or 59.5 tonnes per year. There will be no other GHG emission in the JI project scenario.

[116] Specific weight of CH_4 is assumed to be equal to 679 g/m^3

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	2,146	42,916
	CH_4	t	595	11,891
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	14,631	292,622
B) JI project scenario	CO_2	t		
	CH_4	t	59	11,189
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	1,249	24,971
C) Effect (B-A)	CO_2	t	-2,146	-42,916
	CH_4	t	-535	-10,702
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-13,383	-267,651

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	1,095	21,905
	CH_4	t	595	11,891
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	13,581	271,610
B) JI project scenario	CO_2	t		
	CH_4	t	59	1,189
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	1,249	24,971
C) Effect (B-A)	CO_2	t	-1,095	-21,905
	CH_4	t	-535	-10,702
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-12,332	-246,640

The Ukrainian agricultural sector has a big potential for the implementation of anaerobic digestion biogas plants. Statistical data gathered in 2000 show that it would be possible to build 2,903 digesters with a volume of 1,000 m^3 each: 2,478 at cattle farms, 295 at pig breeding farms and 130 at poultry farms. The implementation of all these digesters would give an opportunity to install CHP units with total electric capacity of 325 MW and thermal capacity of 711 MW and replace 1.33M t?e of fossil fuels.

7.9. MODERNIZATION OF SMELTER TO IMPROVE OPERATING EFFICIENCY AT THE "ZAPOROZHYE ALUMINUM ENTERPRISE"

A Description of Project

A1 Title of Project: " Modernization of smelter to improve operating efficiency at the "Zaporozhye Aluminum Enterprise"""

A.2 Participants/actors

Item	Participant 1	Participant 2
Name of organization	Zaporozhye Aluminum Enterprise (ZALK)	Titanium Institute
Function within project	Project owner	Project developer
Street	15, Pivdenne Shose	180, Lenina prosp.
Post code	69002	69600
City	Zaporozhye	Zaporozhye
Country	Ukraine	Ukraine
Contact person	------------------------	------------------------
Surname	Fridman	Bondarenko
First & middle name	Mikhaylo Oleksandrovich	Volodymir Mikhaylovich
Job title	Deputy Chairman – Technical director	Chief engineer of a project
Direct tel	(+380 612) 12 28 70	(+380 612) 33 14 91
Direct fax	(+380 612) 12 27 57	(+380 612) 33 42 17
Direct E-mail	aho@zalk.com.ua	titan@titan.marka.net.ua

Item	Participant 3	Participant 4
Name of organization	Russian Aluminum –magnesium Institute	Kaiser Aluminum Technical Services, Inc.
Function within project	Project partner	Project developer
Street	86, Sredny per.	407 West Riverside ave., Suite 1150
Post code	199106	99201
City	Sankt-Peterburg	Spokane, WA
Country	Russian Federation	USA
Contact person	------------------------	------------------------
Surname	Nechiparenko	Prangerberg
First & middle name	Aleksandr Andreevich	Zigfrid
Job title	Chief engineer of a project	Expert
Direct tel	(+ 812) 320 55 32	(+ 509) 456 35 26
Direct fax	(+812) 320 55 32	(+ 509) 456 35 26
Direct E-mail	vami@vami.spb.ru	ninasieg@email.msn.com

A.3 Project:

Item	Please fill in if applicable
General description of JI project	The project aims to reduce GHG emissions by the conversion of Soderberg reduction cells to more efficient and environmental friendly pre-baked cells for aluminium production at "Zaporizhzhiya Aluminium Enterprise" (ZALK). The management of ZALK wishes to modernize the smelter in order to significantly reduce the level of emissions, improve working conditions, increase metal production and improve operating efficiency of the facility. The operation of a modern smelter features optimized cell and bus bar designs based on the simulation of heat, electrical, magnetic and hydrodynamic cell conditions, automated cell control and energy management systems, point feeding systems, pre-baked anodes, efficient cell hooding and dry gas scrubbing systems, optimized electrolyte chemistry, and optimized

	analytical and process control methods and practices. The design proposed for the modernization of the ZALK smelter is based on proprietary Kaiser Technology, which includes all the features listed above and has been specially developed for the cost effective conversion of Soderberg reduction cells to pre-baked cells. Kaiser's conversion technology is proven to provide high current efficiency, high cell productivity and lining performance, high metal quality, low energy and carbon consumption, reduced emissions and improved working conditions.
General description of project baseline (reference scenario)	**Present Situation.** The reduction plant at the ZALK consists of four lines with a total of eight cell rooms. Each cell room has two bays where the cells are arranged in two rows. There are 19 cells in each row and, in total, 608 cells are installed in four cell lines. The cells used at the ZALK are 66-kA HSS cells (Soderberg technology). 5-t bridge cranes perform all lifting operations in the cell rooms. Cell exhaustion gases go through an underground duct system to "wet scrubbers" located in the courtyards between the cell rooms. The wet scrubber system is not a compact facility, and blocks large sections of the courtyards between the cell rooms. The existing gas treatment centers are very energy consuming and produce a lot of waste. Metal, tapped from the cells, is transported in crucibles to the cast facility for further processing into finished products. The Soderberg technology used at ZALK has drawbacks due to low current efficiency, high consumption of electricity, high consumption of anode paste and other process materials and low efficiency of the cell hooding. In addition, the HSS Soderberg technology is considered an obsolete technology and creates serious problems when it comes to environmental protection and industrial hygiene.
Type of project	Industrial processes
Exact location	Zaporozhye, Ukraine
Project starting date	To be determined
Project life	20 years
Stage of project	Detailed Feasibility Study
Technical data	The principle technology for the ZALK is the Kaiser K150 reduction cell. This technology is based upon the Kaiser P-86 reduction cell that has operated successfully in Sweden for over 14 years. The Kaiser K150 technology provides a modern state-of-the-art reduction cell, which, equipped with dry scrubbing technology, provides environmental performance compliant with both the USA and European standards for environmental and industrial hygiene performance. No compromises in the high standards for environmental performance are suggested for the ZALK. The cell design selected was based on a number of criteria, the most important of which was the ability of the technology to fit within the confines of the existing cell room buildings. The next most critical factor was the potential of the technology for creating sufficient economic value and meeting threshold investment requirements. In the framework of the reconstruction project ZALK, KATSI and Tl made the following decisions: • To maintain Cell Rooms 1 - 7 and to replace HSS cells with prebake cells of KATSI design, installed side-by-side (54 cells in each cell room); • To extend Cell Rooms 1-7 and the casting facility by 1 bay (i.e. 11 m) towards the plant's central pipe bridge; • To divide the seven cell rooms into two cell lines with 190 and 188 cells per line respectively (total of 378 cells in two lines); • To dismantle and remove the wet gas scrubbers and other structures

	located in the courtyards; • To ensure natural cell room ventilation and cell bottom cooling according to the roof ventilators drawings, and to change the roof ventilator design in accordance with KATSI drawings; • To install one dry gas treatment center for Cell Rooms 1-3 and to install a second dry gas treatment center for Cell Rooms 4-7; • To locate all facilities for anode fabrication within the existing plant used for the electro thermal production of silumin and silicon; • To assemble anodes and cathodes in the existing buildings housing the casting operation and the welding shop; • To locate the bath processing plant with the transport conveyor next to the electro thermal plant water circulation unit; The projected smelter performance is given in Table 1.1. The technical data in this table, and elsewhere in this DFR, represent projections based on designs and performances that have been actually achieved. As part of the ongoing contractual arrangements that are to be formalized, Kaiser Aluminum Technical Services, Inc. (KATSI) will be required to provide technical support services during the initial plant operations to ensure the achievement of the performance objectives defined in this DFR.
Main project risks	Major risk: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). Minor risk: • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule.

Table 1.1 Existing and Projected Smelter Performance

Description	***Unit***	***Existing***	***Pre-baked***
Total Cells	number	608	378
Metal Output	kg/cell/day	477	1,147
Average Operating Cells	N.	568	375
Cell Voltage	Volts	4.87	4.27
Line Current	kA	67	150
Current Efficiency	%	88.7	95.0
DC Power Consumption	kg/kg Al	16.32	13.39
Al_2O_3 Alumina	kg/t Al	1.96	1.92
Net Anode Carbon Consumption	kg/t Al	540	400
AlF_3	kg/t Al	27	9
Cryolite	kg/t Al	30	2
Anode Current Density	A/cm^2	0.73	0.76
Cell Life	Days	1,600	3,000

Describe existing Work on the Project:

Kaiser Aluminum Technical Services, Inc. (KATSI) was commissioned by ZALK to carry out a Detailed Feasibility Study (DFS) of the conversion of the reduction plant. The Study was sponsored by the U.S. Trade and Development Agency (TDA) and intended to provide decision-quality information to ZALK management for planning the modernization of the smelter. This Detailed Feasibility Report (DFR) contains a description of the current situation at the smelter, an overview of the technology recommended by Kaiser with an estimate of capital and operating cost, project schedules, an economic evaluation, and a recommended action plan.

The Titanium Institute (TI), Zaporozhye, Ukraine, being the general designer for ZALK, performed the domestic part of the Study based on technologies and scope of work provided by KATSI for the reconstruction of the cell rooms and the construction of an anode fabricating facility.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Units	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	200,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	0	0
1.3. Energy savings Revenues p .a.	USD (2000 prices)	39,729,000 8,968,917	 0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	34,787,783	44,772,600
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-16,161,754	-

2. Incremental Project Costs and Effects

	Units	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	9,984,817
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	2,431,093
2.3. Incremental costs of project [5]	USD (2000 prices)	16,161,754
2.4. Cost per t CO_2 [6]	USD / t CO_2	6.65

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	17.8	19.2	20.5
NPV at 10% discount rate with carbon credits (thousand USD)	105,232	124,461	143,699
NPV at 20% discount rate with carbon credits (thousand USD)	-16,162	-6,080	4,007
NPV at 30% discount rate with carbon credits (thousand USD)	-59,248	-52,911	-46,571

Investment per ton of avoided emissions	USD/t CO_2 eq.	20

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	200,000,000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	-	-
a. Energy savings p.a. Revenues p.a.	USD (2000 prices)	39,729,000 8,968,917	-
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	19,313,771	26,294,000
1.5. Discount rate	%	20	
1.6. Project life	Years	21	

1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-16,161,754	-

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	6,980,229
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	1,699,539
2.3. Incremental costs of project [5]	USD (2000 prices)	16,161,754
2.4. Cost per t CO_2 [6]	USD / t CO_2	9.51

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Dioxide Carbon Price, USD/ton CO_2	0	5.0	10.0
IRR with carbon credits (%)	17.8	18.8	19.7
NPV at 10% discount rate with carbon credits (thousand USD)	105,232	118,741	132,258
NPV at 20% discount rate with carbon credits (thousand USD)	-16,162	-9,079	-1,992
NPV at 30% discount rate with carbon credits (thousand USD)	-59,248	-54,796	-50,342

Investment per ton of avoided emissions	USD/t CO_2 eq.	28.7

Describe how costs are determined; specify key assumptions:

Kaiser, jointly with the Titanium Institute, estimated project costs, including the foreign and domestic components of capital costs and non-capital expenditures. Kaiser's policy for the implementation of cost effective technological projects consists of the maximum utilization of local equipment and materials. Being aware of the recognized industrial, research and development capability of Ukrainian producers, Kaiser provided the Titanium Institute with design control specifications for estimating possible scope and cost of work to be performed by local contractors.

As a result of close cooperation, and valuable assistance from ZALK's management and specialists, Kaiser and the Titanium Institute jointly produced the estimate of capital and non-capital expenditures for the Project. This included direct costs, indirect costs and contingencies for each scenario.

The reduction plant conversion will require USD 145M, consisting of USD 95M for the domestic component (66%) and USD 50M for the imported component (34%) (1999 USD).

The construction of the dedicated anode plant will additionally require USD 54M, consisting of USD 16M for the domestic component (30%) and USD 38M for the imported component (70%) (1999 USD).

Thus, the total Project expenditure will amount to nearly USD 200M, consisting of USD 111M for the domestic component (56%) and USD 89M for the imported component (44%) (1999 USD).

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive secondary impacts not directly related to GHG abatement, including improvement of the local environmental situation by reducing air pollutant emissions (due to reduction of energy generated from local heat plants) and creation of new jobs. Negative secondary effects are not expected. The proposed project is therefore compatible with national economic development and socio-economic and environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

An important objective of the project is to meet or exceed the national pollution control requirements for solid waste, liquid effluent, gaseous, and particulate emissions. Responsible businesses operate in a manner protective of human health and an environment. Obsolete technologies with detrimental environmental impact will inevitably meet public and regulatory pressures. By implementing pre-baked technology, ZALK can successfully address its most urgent and long-term ecological concerns. The recommended technology is capable of efficiently addressing the ecological concerns of ZALK and the local community.

By replacing the Soderberg cells with Kaiser pre-baked cells, working conditions in the cell rooms improve immediately. In the cell rooms, tar emissions are practically eliminated using pre-baked anodes. Dust and fluoride emissions in the work areas are significantly reduced with the use of well-sealed pre-baked cells and modified alumina handling systems. Fluoride emissions to the atmosphere are significantly reduced through the application of a modern dry gas treatment system. Installing new gas treatment systems allows ZALK to bring the reduction plant emissions down to the international standards.

Smelter emissions are anticipated to improve significantly after the conversion to pre-baked technology as described in the following table:

Environmental Comparisons

Parameter	***Units***	***ZALK***	***K150***	***% Change***
Production	t per year	97,000	163,000	68%
Unit Basis				
Total fluoride usage	kg/t Al	63.0	9.0	-86%
Total fluoride emitted	kg/t Al	6.0	0.7	-89%
Dust emitted [inc. Si]	kg/t Al	77.3	22.7	-71%
Dust emitted Smelter	kg/t Al	30.9	2.4	-92%
Tar Emission	kg/t Al	7.3	0.06	-99%
Total Tonnage Basis				
Total fluoride usage	t per year	6,111	1,743	-71%
Total fluoride emitted	t per year	581	110	-81%
Dust emitted [inc. Si]	t per year	7,497	3,695	-51%
Dust emitted Smelter	t per year	3,000	397	-87%
Tar Emission	t per year	712	9	-99%

The smelter impact on the environment, after the implementation of the measures set forth in the Feasibility Study, is described in more detail in Appendix "C" of the feasibility study (Environmental Impact Statement).

Local social/cultural benefits:

- improved working conditions and better skilled personnel.

Local economic benefits, including transfer of environmentally sound technology and know-how:

The economic impact of the Project has been evaluated based on Kaiser's advanced aluminum reduction technology and by taking into consideration the following factors:

- Expansion in meatal production due to the increas in:
  - Cell amperage
  - Current efficiency
  - Cell life
- Cost savings as a result of:
  - Improved consumption factors (energy, carbon, bath etc.)
  - Reduction of direct labor cost per ton of metal
  - Reduction of variable overhead costs per ton of metal
  - Effect of operating leverage (fixed costs vs. variable costs)
- Higher realized prices due to improved metal purity
- Decrease in cell capital repair costs
- Reduced fines for harmful emissions and solid waste
- Positive impact of tax exemptions and deductions (i.e. VAT credit)
- Kaiser expertise in implementing low cost modernization projects

The overall economic impact was affected, to some extent, by the conservative assumptions made in regard to the ZALK future operating environment: falling long term aluminum price, higher alumina price for incremental metal production, increased raw material imports, etc.

Kaiser's proprietary reduction technology contributes to a substantial reduction in ZALK's manufacturing and operating costs, despite the negative effect of higher prices of purchased alumina needed to support the incremental metal production.

E Benefits related to the Mitigation of Climate Change, and environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The baseline scenario is based on the assumption that the current Soderberg technology of Aluminum production will be maintained.

The Soderberg technology used at ZALK has drawbacks due to low efficiency, high consumption of electricity, high consumption of anode paste and other process materials, and low efficiency of the cell hooding. In addition, the HSS Soderberg technology is considered an obsolete technology and creates serious problems when it comes to environmental protection and industrial hygiene.

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

CF4 and C2F6 calculations comply with IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Industrial Processes, Chapter 3, Corrigenda GPGAUM-Corr.2001.01, 15 June 2001, Table 3.10.

	Unit	*Project baseline scenario – Soderberg technology*	*JI project scenario – Pre-baked technologies*
Emission factor CF_4	kg CF_4/t Al	0.6	0.31
CF_4 emissions	t CF_4/year	60	31
CF_4 emissions avoided	t CF_4/year		29
CF_4 emissions avoided in CO_2 eq.	t CO_2 eq./year		**188,500**
Emission Factor C_2F_6	kg C_2F_6/t Al	0.06	0.04
C_2F_6 emissions	t C_2F_6/year	6	4
C_2F_6 emissions avoided	t C_2F_6/year		2
C_2F_6 emissions avoided in CO_2 eq.	t CO_2 eq./year		**18,400**
Total CO_2 emissions avoided (from CF_4 and C_2F_6)	t CO_2 eq./year		**206,900**
Electricity consumption	kWh/year	1,970,000,000	1,649,681,529
Options: 819 g CO_2 per kWh			
CO_2 emissions from electricity generation	t CO_2/year	1,613,430	1,352,089
Avoided CO_2 from electricity saving	t CO_2/year		**262,341**
Options: 350 g CO_2 per kWh			
CO_2 emissions from electricity generation		689,500	577,389
Avoided CO_2 from electricity saving (350 g CO2/kWh) g CO_2 per kWh)			**112,111**
CO_2 emission factor from anode	t CO_2/t Al	1.80	1.50
CO_2 emissions from anode	t CO_2/year	180,000	150,000
Avoided CO_2 from anode	t CO_2/year		**30,000**
Total CO_2 eq. emissions avoided (819 g CO2/kWh) g CO_2 per kWh**)**	**t CO_2 eq./year**		**499,241**
Total CO_2 eq. emissions avoided (350 g CO2/kWh) g CO_2 per kWh)	**t CO_2 eq./year**		**349,011**

Summary Table: Projected Emission Reductions for JI project scenario compared to project baseline scenario.

Options: 819 g CO_2 per kWh

GHG reduction component	*Unit*	*Emission reduction per year*	*Total reduction over project life*
Electricity saving	t CO_2	262,341	5,246,817
Avoided CO_2 from anode	t CO_2	30,000	600,000
CF_4 and C_2F_6 emissions reduction	t CO_2 eq.	206,900	4,138,000
Total GHG emissions reduction	**t CO_2 eq.**	**499,241**	**9,984,817**

Options: 350 g CO_2 per kWh

GHG reduction component	*Unit*	*Emission reduction per year*	*Total reduction over project life*
Electricity saving	t CO_2	112,111	2,242,229
Avoided CO_2 from anode	t CO_2	30,000	600,000
CF_4 and C_2F_6 emissions reduction	t CO_2 eq.	206,900	4,138,000
Total GHG emissions reduction	**t CO_2 eq.**	**349,011**	**6,980,229**

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital due to low interest of the Ukrainian commercial banks in project financing, the high costs of debt financing, the difficulties in obtaining guarantees/insurances as well as the shortage of their own financial resources.

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	1,793,430	35,868,600
	CH_4	t		
	N_2O	t		
	CF_4	t	60	1,200
	C_2F_6	t	6	120
	Other	t		
	Total	t CO_2 eq.	2,238,630	44,772,600
B) JI project scenario	CO_2	t	1,501,089	30,021,783
	CH_4	t		
	N_2O	t		
	CF_4	t	31	620
	C_2F_6	t	4	80
	Other	t		
	Total	t CO_2 eq.	1,739,389	34,787,783
C) Effect (B-A)	CO_2	t	-292,341	-5,846,817
	CH_4	t		
	N_2O	t		
	CF_4	t	-29	-580
	C_2F_6	t	-2	-40
	Other	t		
	Total	t CO_2 eq.	-499,241	-9,984,817

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	869,500	17,390,000
	CH_4	t		
	N_2O	t		
	CF_4	t	60	1,200
	C_2F_6	t	6	120
	Other	t		
	Total	t CO_2 eq.	1,314,700	26,294,000
B) JI project scenario	CO_2	t	727,389	14,547,771
	CH_4	t		
	N_2O	t		
	CF_4	t	31	620
	C_2F_6	t	4	80
	Other	t		
	Total	t CO_2 eq.	965,689	19,313,771
C) Effect (B-A)	CO_2	t	-142,111	-2,842,229
	CH_4	t		
	N_2O	t		
	CF_4	t	-29	-580
	C_2F_6	t	-2	-40
	Other	t		
	Total	t CO_2 eq.	-349,011	-6,980,229

7.10. INSTALLATION OF NEW ENERGY EFFICIENCY PUMPS ON DNIPROVSKA AND DESNIANSKA WATERWORKS OF KIEVVODOKANAL

A Description of Project

A1 Title of Project: "Installation of new energy efficiency pumps on Dniprovska and Desnianska Waterworks of Kievvodokanal"*

*The management of Kievvodokanal suggests to combine two projects into one 2-stages project, as they are similar.

A.2 Participants/actors

Item	Participant 1	Participant 2	Participant 3
Name of organization	Kievvodokanal	Invest Engineering	KOWI
Function within project	Project owner	Design organization	Design organization
Street	1 Leyptsigska str.	1 Leyptsigska str.	Parallevej, 15
Post code	01015	01015	DK-2800
City	Kiev	Kiev	Lyngby
Country	Ukraine	Ukraine	Denmark
Contact person	-------------------------	-------------------------	-------------------------
Surname	Khomyakov	Luzhko	Vesth-Hansen
First & middle name	Valery Vasilyevich	Evgeny Vladimirivich	Karsten
Job title	The first deputy General Director	Director	
Direct tel	(+ 380 44) 254 35 93	(+380 44) 228 78 58	(+45 45) 97 22 11
Direct fax	(+ 380 44) 290 20 76	(+380 44) 229 60 07	(+45 45) 97 22 11
Direct E-mail		real-invest@ukr.ua	kvh@cpwi.dk

A.3 Project

Item	Please fill in if applicable
General description of JI project	The project idea is the installation of new high-efficiency pumps, thereby reducing the electricity consumption from the grid and, consequently, the GHG emissions from the fossil fuel savings at thermal power plants. Desnyanska and Dniprovska stations are the most important structural units of JSC "Kievodokanal" and the main water pumping stations, incorporating 6 substations in the water-supply system of Kiev. They pump daily 1.2M m^3 of water from the rivers of Dnipro and Desna into the water-supply system of the city. According to data of an energy audit, the technical condition and efficiency of operation of the main power generating and pumping plants are poor. Electric motors and pumps at the Dniprovska station have been operating for about 25 years, on average, and at the Desnyanska station for more than 30 years. This equipment has exhausted its service life and is subject to replacement with a new one that is more efficient and reliable. Furthermore, reduction in the water consumption, due to recession in the production, has resulted in the fact that the pumps maintain excessive water level in the water-supply system, as their configuration, technical characteristics and capabilities of regulation, do not allow to increase operation efficiency by maintaining the optimal level during the day. This also results in a considerable excess of electricity consumption. The project envisions the replacement of the basic production equipment (the most powerful pumps at both water-pumping stations), maintaining its current capacity. The pumps operating at first-lift level stations are expected to be replaced with high-performance immersion units (probably those made by GRUNDFOS), which enclose pumps and driving motors in one single housing. This will allow to abandon the use of the installed 16-m shafts, which connect ground motors with pumps, increasing reliability and efficiency. All first-lift level stations will be provided with frequency invertors to regulate the operation of one pump. For the smooth starting of other pumps, it is planned to use domestic high voltage regulators, which will enable step-by-step regulation of pumps' capacity through frequent starts and stoppages. Replacement of the pumping units will require substitution of the existing power cables and

	other electrical equipment, as well as construction works.
General description of project baseline (reference scenario)	The project baseline was built under the assumption that, without significant investment, a status quo scenario would be maintained. It is assumed that, without the implementation of this project, the existing equipment would not be replaced, during its technical life, with new equipment. Energy savings are calculated assuming constant energy demand, and using energy efficiency data for the new equipment.
Type of project	Energy efficiency
Exact location **Project starting date**	Kiev, Ukraine To be determined
Project life	20 years (operation time of equipment)
Stage of project	The feasibility study is available in both Ukrainian and English.
Technical data	In total, 56 units are to be replaced, including pumps of type 48NDSV, 40NDS, 20D6, and other pumps with capacity from 2,000 to 14,400 m^3 of water per hour. The project envisages the holding of a tender to select new pumps featuring the most suitable technical parameters, quality and price. Preliminary calculations to determine the cost parameters are based on data of imported immersion pumps of type S3 5008M and S2 3004H.
Main project risks	Major risk: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). Minor risk: • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule.

A.4 Cost (to the extent possible):

First Stage: Installation of new energy efficient pumps on Dniprovska pump station.

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3,646,500	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	0[117]	0
1.3. Energy savings p.a.	USD (2000 prices)	1,500,994	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent	0	1,117,558
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	1,446,917	0

[117] O&M cost assumed the same for both – the JI Project and the Baseline scenario

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	1,117,558
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	272,102
2.3. Incremental costs of project [5]	USD (2000 prices)	- 1,446,917
2.4. Cost per t CO_2 [6]	USD / t CO_2	-5.32

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also valid for costs and revenues in future years.

[2] All revenues and costs are aggregated and discounted over project life.

[3] Calculated as the difference between the GHG effect caused by the project and the GHG effect of the baseline.

[4] Incremental project GHG net effect as shown in table E2 (over whole project life) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5	10
IRR with carbon credits (%)	30.2	37.9	45.6
NPV at 10% with carbon credits (thousand USD)	5,240	7,403	9,565
NPV at 20% with carbon credits (thousand USD)	1,447	2,581	3,714
NPV at 30% with carbon credits (thousand USD)	14	727	1,440

Investment per ton avoided emissions	USD/t CO_2 eq.	3.3

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3,646,500	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	0	0
1.3. Energy savings p.a.	USD (2000 prices)	1,500,994	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent		477,589
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	1,446,917	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equi valent	477,589
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	116,283
2.3. Incremental costs of project [5]	USD (2000 prices)	-1,446,917
2.4. Cost per t CO_2 [6]	USD / tCO_2	-12.4

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5	10
IRR with carbon credits (%)	30.2	33.5	36.8
NPV at 10% with carbon credits (thousand USD)	5,240	6,164	7,088
NPV at 20% with carbon credits (thousand USD)	1, 447	1,931	2,416
NPV at 30% with carbon credits (thousand USD)	14	319	623

Investment per ton avoided emissions	USD/t CO_2 eq.	7.6

Second Stage: Installation of new energy efficient pumps on Desnianska pump station.

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	9,776,800	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	0	0
1.3. Energy savings p.a.	USD (2000 prices)	3,445,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent		2,564,959
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	2,233,604	0

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	2,564,959
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	624,514
2.3. Incremental costs of project [5]	USD (2000 prices)	-2,223,604
2.4. Cost per t CO_2 [6]	USD / tCO_2	-3.6

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5	10
IRR with carbon credits (%)	25.9	32.6	39.2
NPV at 10% with carbon credits (thousand USD)	10,911	15,874	20,837
NPV at 20% with carbon credits (thousand USD)	2,234	4,836	7,438
NPV at 30% with carbon credits (thousand USD)	-996	640	2,275

Capital-intensive of emissions avoided	USD/t CO_2 eq.	3.8

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

	Unit	*JI Project*	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	9,776,800	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	0	0
1.3. Energy savings p.a.	USD (2000 prices)	3,445,000	0
1.4. GHG effect (for details see table E2)	t CO_2 equivalent		1,096,136
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	2,233,604	- 11,795,410

2. Incremental Project Costs and Effects

	Unit	*Incremental Effects and Costs of JI Project*
2.1. Incremental GHG effect over project life [3]	t CO_2 equivalent	1,096,136
2.2. Incremental GHG effect over project life, discounted [4]	t CO_2 equivalent	266,886
2.3. Incremental costs of project [5]	USD (2000 prices)	- 2,233,604
2.4. Cost per t CO_2[6]	USD / tCO_2	-8.4

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
Carbon Price, USD/ton CO_2	0	5	10
IRR with carbon credits (%)	25.9	28.8	31.6
NPV at 10% with carbon credits (thousand USD)	10,911	13,032	15,153
NPV at 20% with carbon credits (thousand USD)	2,234	3,346	4,458
NPV at 30% with carbon credits (thousand USD)	-996	-297	402

Capital-intensive of emissions avoided	USD/t CO_2 eq.	8.9

Describe how costs are determined; specify key assumptions:

First Stage: the projected cost is USD 3.5M for Dniprovska pump station.

Cost of new energy efficient pumps (USD)	2,353,980
Cost of auxiliary materials (USD)	245,410
Cost of cable fittings (USD)	105,180
Installation labor (USD)	225,000
Design and engineering (USD)	255,430
Customs (USD)	130,000
Contingency (USD)	331,500
Project cost	**3,646,500**

Second Stage: the projected cost is USD 9.6M for Desnianska pump station.

Cost of new energy efficient pumps (USD)	5,950,000
Cost of auxiliary materials (USD)	1,152,000
Cost of cable fittings (USD)	250,000
Installation labor (USD)	550,000
Design and engineering (USD)	350,000
Customs (USD)	750,000
Contingency (USD)	750,000
Project cost	**9,650,000**

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project will have positive impacts including improvement of the local environmental situation by reducing air pollutant emissions (due to decreased need for energy production from heat plants). Negative effects are not expected. The proposed project is therefore compatible with national economic development, socio-economic and environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of air pollution.

Local social/cultural benefits:

- Better skilled personnel

Local economic benefits, including transfer of environmentally sound technology and know-how:

- Incrreased profitability/efficiency of “Kiyvvokanal”;
- Less use of electrisity;
- Less water losses.

E Benefits related to the Mitigation of Climate Change, and environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why dimate benefits achieved by the JI project are additional to any that would otherwise occur

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital, which is due to the low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurances and do to shortages of own financial resources.

The plant management has known about the advantages of the project for a long time but still can not find the appropriate financial possibilities for its implementation.

The GHG emission reduction under the JI project scenario will result from the replacement of the current electricity consumption from the grid and was estimated with allowance to decrease its power generation at thermal power plants operating on coal, natural gas and fuel oil. No energy savings would have been made without the project.

The calculation of the GHG emission reduction is based on electricity savings data, which is provided by project developer - Design organization “Invest Engineering”.

First Stage: Installation of new energy efficient pumps on Dniprovska pump station.

Energy saving and CO_2 emission per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Anticipated annual electricity saving, thousand kWh	68,227
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	55,878

Energy saving and CO_2 emission per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Anticipated annual electricity saving, thousand kWh	67,227
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	23,879

Second Stage: Installation of new energy efficient pumps on Desnianska pump station.

Energy saving and CO_2 emission per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Anticipated annual electricity saving, thousand kWh	156,591

Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	128,248

Energy saving and CO_2 emission per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Anticipated annual electricity saving, thousand kWh	156,591
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	54,807

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

There is no GHG emission in JI project scenario because calculation of the GHG emissions reduction is based on electricity saving data.

First Stage: Installation of new energy efficient pumps on Dniprovska pump station.

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	55,878	1,117,558
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	55,878	1,117,557
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	- 55,878	- 1,117,558
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	- 55,878	- 1,117,558

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	23,879	477,589
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	23,879	477,589
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	- 23,879	- 477,589
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-23,879	- 477,589

Second Stage: Installation of new energy efficient pumps on Desnianska pump station.

E.2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	128,248	2,564,959
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	128,248	2,564,959
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	- 128,248	- 2,564,959
	CH_4	t		
	N_2O	t		
	Other	T		
	Total	t CO_2 eq.	- 128,248	- 2,564,959

E.2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	54,807	1,096,136
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	54,807	1,096,136
B) JI project scenario	CO_2	t	-	-
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-	-
C) Effect (B-A)	CO_2	t	- 54,807	- 1,096,136
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	- 54,807	- 1,096,136

7.11. INSTALLATION GAS TURBINE COMBINED CYCLE AT IVANO-FRANKIVSK CHP

A Description of Project

A.1 Title of Project: Installation Gas Turbine Combined Cycle at Ivano-Frankivsk CHP

A.2 Participants/actors

Item	**Participant 1**	**Participant 2**
Name of organization	Ivano-Frankivsk Teplokomunenergo	SENTECH, INC
Function within project	Project owner	Project partner
Street	59a Bogdana Khmelnitskogo Str.	4733 Bethesda Ave, Ste 608,
Post code	76006	MD 20814
City	Ivano-Frankivsk	Bethesda
Country	Ukraine	USA
Contact person	----------------------------	----------------------------------
Surname	Chukhniy	Markel
First & middle name	Bogdan Mikhalovich	Lawrence
Job title	Director	Vice-president
Direct phone	+38 03422 63511	+301 654-7224
Direct fax	+38 03422 60483	+301 654-7832
Direct E-mail		LMarkel@systemscorp.com

Item	Participant 3	Participant 4
Name of organization	Energy Service company “ESCo West”	Tysak Engineering
Function within project	Project partner	Design organization
Street	67 Galytska str. Of. 610	29 Flint Rd
Post code	76019	01720
City	Ivano-Frankivsk	Acton, MA
Country	Ukraine	USA
Contact person	----------------------------	-----------------------------
Surname	Korzhik	Popelka
First & middle name	Mykola Fedorovich	Andrew
Job title	President	Vice president
Direct phone	(+380 3422) 7-60-99	(+978) 635 9336
Direct fax	(+380 3422) 4-81-85	(+978) 263 0444
Direct E-mail	info@escowest.com	APopelka@aol.com

A.3 Project

Item	Please fill in if applicable
General description of JI project	The combined generation of heat and electricity, based on low-carbon fuels, can result in a reduction of energy use and CO_2 emissions. The Ivano-Frankivsk district heat system produces only heat and purchases all electricity needs for the plant, substations and distribution pumps operation from the grid. The steam turbines equipment is dismantled at Ivano-Frankivsk CHP. The project idea is the installation of a Gas Turbine Combined Cycle (GTCC) with a electric generator capacity of 51.2 MW_e, double pressure Heat Recovery Steam Generator (HRSG), backpressure steam turbine with two pressure levels with electric generator capacity of 7.5 MW_e, heat exchanger station, and dry cooling system for operation in condensing mode. This option assumes the use of cooling systems for a period of time during the shoulder season. This option assumes that four out of the total of eight existing boilers PTVM-30 and one boiler KVGM-100, with a total capacity of 221 MW_t will be upgraded by a new control system and will remain in operation. The thermal capacity of the GTCC was determined based on average capacity demands in CHP plants at the shoulder season (beginning and end of the heating season) of the year 2000. Thermal capacity is distributed between heat exchanger (35 MW) in backpressure of Steam Turbine and the hot water heat exchanger in HRSG (10 MW) which cools the exhaust gases down to 110 ^{0}C. The corresponding gas turbine has an electrical capacity of 51.2 MW and the steam turbine has an electrical capacity of 7.5 MW. In order to operate the system during the lower summer demand, the GTCC is equipped with a dry cooling system with a cooling capacity of 35 MW. This will allow the system to operate about 7 000 to 8 000 hour annually.
General description of project baseline (reference scenario)	The project baseline represents existing situations and conditions of equipment without any investment, as it is at this time. It is assumed that the existing equipment will be operated “as is” and the repair and maintenance costs in Ivano-Frankivsk district heat system will increase gradually and will double over the evaluated period.
Type of project	Energy efficiency
Exact location	Ivano-Frankivsk
Project starting date	2004
1st. Year of operation	2006
Lifetime of project	20 years (technical life of the installed equipment)
Stage of project	feasibility study is carried out
Technical data	*Main Parameters of Gas Turbine Combined Cycle* Fuel consumption: 3 337 852 GJ Net electricity supplied: 424 718 MWh Net heat supply: 895 222 GJ Net electric efficiency: 45.8 % Net total efficiency: 72.6 %

	Parameters of Gas Turbine (ISO):	
	Type:	Trent
	Manufacturer:	Rolls-Royce
	Installed Capacity:	51.19 MW
	Efficiency:	41.571 %
	Flue Gas Quantity:	159.2 kg/s
	Flue Gas Temperature:	427.7 ^{0}C
	Parameters of Steam Turbine at 15 C	
	Installed Electric Capacity	7.5 MWe
	H-P Steam Pressure	3.4 Mpa
	H-P Steam Temperature	410 ^{0}C
	H-P Steam Qty	46.5 t/hr
	L-P Steam Pressure	1.2 Mpa
	L-P Steam Temperature	220 ^{0}C
	L-P Steam Qty	8.5 t/hr
	Backpressure	0.054 Mpa
	Thermal gradient of Hot Water	80/60 ^{0}C

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2004 prices) [1]	36 871 500	-
1.2. Operation and maintenance costs p.a.	USD (2004 prices)	8 669 739	4 930 128
1.3. Revenues p.a.	USD (2004 prices)	17 889 821	7 096 520
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	5 350 372	9 890 457
1.5. Discount rate	%	20	
1.6. Project life	years	20	
1.7. Net Present Value (NPV) [2]	USD (2004 prices)	- 2 137 016	7 417 557

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	4 540 086
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	1 105 415
2.3. Incremental costs of project [5]	USD (2004 prices)	9 554 573
2.4. Cost per t CO_2 [6]	USD / tCO_2	8.6

[1] All costs and revenues are to be given in USD based on the price level of the year 2004. This is also true for costs and revenues in future years.
[2] All revenues and costs (incl. income tax) aggregated and discounted over project lifetime.
[3] Calculated as GHG emissions Baseline – GHG emissions Project
[4] Incremental project GHG net effect as shown in table E2 (over whole life time of project) discounted with discount rate as listed in 1.5 in the table A4.
[5] Calculated as NPV of baseline minus NPV of project
[6] Calculated by dividing item 2.3 by item 2.1 (both table A4).

Results of Financial Analysis with carbon credits (819 g CO_2/kWh)

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	12.6	15.7	18.6
NPV at 10% with carbon credits, thousand USD	6 192	14 039	21 886
NPV at 20% with carbon credits, thousand USD	-9 555	-5 737	-1 919
NPV at 30% with carbon credits, thousand USD	-13 954	-11 731	-9 508

Investment per tonne of avoided emissions	USD/t CO_2 eq.	8.1

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2004 prices) [1]	36 871 500	-
1.2. Operation and maintenance costs p.a.	USD (2004 prices)	8 669 739	4 930 128
1.3. Revenues p.a.	USD (2004 prices)	17 889 821	7 096 520
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	5 350 372	5 825 296
1.5. Discount rate	%	20	
1.6. Project life	Years	20	
1.7. Net Present Value (NPV) [2]	USD (2004 prices)	- 2 137 016	7 417 557

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	474 924
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	115 634
2.3. Incremental costs of project [5]	USD (2004 prices)	9 554 573
2.4. Cost per t CO_2 [6]	USD / tCO_2	82.6

Results of Financial Analysis with carbon credits (350 g CO_2/kWh)

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	12.6	12.9	13.2
NPV at 10% with carbon credits, thousand USD	6 192	7 013	7 834
NPV at 20% with carbon credits, thousand USD	-9 555	-9 155	-8 756
NPV at 30% with carbon credits, thousand USD	-13 954	-13 722	-13 489

Investment per tonne of avoided emissions	USD/t CO_2 eq.	77.6

Describe how costs are determined; specify key assumptions:

The capital costs for the project were established on the basis of individual technologies or of plant modifications and standard investment values used in the Eastern Europe industry.

Estimates for the combined cycle plants were developed by applying the cost estimating model that is part of the combined cycle design software. Results were modified to reflect the specific scope and location of the units with adjustments for local labor and material and partial scope for the repowering cases. The cost of the GTCC option were based on the manufacturer's price information and assessment of the cost of modifications necessary for the installation.

Economic Inputs and Assumptions

Average price of natural gas (34,1 MJ/m3):	55.00 USD/thousand m^3
Average heat price	3.29 USD/GJ (in 12/2001)
Average price for electricity	37.18 USD/MWh
Average sale price of electricity (to grid)	28.0 USD/MWh market
Cost of maintenance of gas turbines	4 USD/MWh
Cost of maintenance of steam turbine	2 USD/MWh

Fuel consumption and energy production

		JI project scenario	*Project baseline scenario*
Fuel consumption – total	[GJ]	4 792 522	2 500 532
Fuel consumption – GT	[GJ]	3 337 852	
Fuel consumption – boilers	[GJ]	1 454 671	2 500 532
Heat production – total	[GJ]	2 664 960	2 199 921
Heat realization	[GJ]	2 156 997	2 156 997
Electricity production - total (MWh/year)	[MWh]	433 386	
Electricity own – electricity	[MWh]	8 668	
Electricity own – heat	[MWh]	12 232	10 215
Electricity balance	[MWh]	412 487	-10 215
Electricity delivery	[MWh]	412 487	0

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

Negative effects are not expected. The proposed project is therefore compatible with the national economic development, the socio-economic and the environment priorities and strategies.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of air pollutions.

Local social/cultural benefits:

- The project will result in the creation of at least 35 new jobs and better skilled personnel;
- The project will result in the creation of short term jobs in the area for the implementation of GTCC project;
- The project provides a more comfortable indoor environment for the residents of the buildings serviced by the GTCC included in the project;
- Improves the regional economic development;
- Knowledge transfer about GTCC as an energy source and the promotion of sustainable development.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- The project will help to increase the efficiency and reduce costs for energy supply;
- More stable energy supply;
- The project will reduce the system maintenance and repair costs resulting from high impurity levels;
- Increased profitability/efficiency of Ivano-Frankivsk CHP;
- Promotion of modern high-efficiency environmentally sound technology;
- The project will reduce the energy intensity of the power system in Ukraine;
- The experiences from this project encouraged the actors to go further with new projects.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why

climate benefits achieved by the JI project are additional to any that would otherwise occur

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital, which is due to the low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurances and do to shortages of own financial resources.

Project baseline was built in accordance to the status quo scenario. It is assumed that without significant investment a status quo scenario will be maintained. The GHG emission reductions under the JI project scenario will result from the decreasing power generation at thermal power plants operating on coal, natural gas and fuel oil.

Energy consumption and CO_2 emissions per year for Option: 819 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	433 386
Emission factor, gCO_2/kWh	819
CO_2 emissions from electricity, t	354 943
Natural gas, thousand m^3	73 545
Natural gas, TJ	2 501
Emission factor, CO_2 t/TJ	55.8195
CO_2 emissions from Natural Gas combustion, t	139 580

Energy consumption and CO_2 emissions per year for Option: 350 g CO_2/kWh

Name	*Project baseline scenario*
Electricity, thousand kWh	433 386
Emission factor, gCO_2/kWh	350
CO_2 emissions from electricity, t	151 685
Natural gas, thousand m^3	73 545
Natural gas, TJ	2 501
Emission factor, CO_2 t/TJ	55.8195
CO_2 emissions from Natural Gas combustion, t	139 580

E.2 Estimated emissions with the JI project:

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.

The proposed combined generation of heat and electricity, based on low-carbon fuels, can result in a reduction of energy use and CO_2 emissions.

Energy consumption and CO_2 emissions per year for both Options: 819 g and 350 g CO_2 per kWh

Name	*JI project scenario*
Electricity, thousand kWh	0
Natural gas, thousand m^3	140 599
Natural gas, TJ	4 793
Emission factor, CO_2 t/TJ	55.8195
CO_2 emission from Natural Gas combustion, t	267 519

E2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	494 523	9 890 457
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	494 523	9 890 457
B) JI project scenario	CO_2	t	267 519	5 350 372
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	267 519	5 350 372
C) Effect (B-A)	CO_2	t	- 227 004	- 4 540 086
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	- 227 004	- 4 540 086

E2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	***Unit***	***Emission per year***	***Total emission over project life***
A) Project baseline scenario	CO_2	t	291 265	5 825 296
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	291 265	5 825 296
B) JI project scenario	CO_2	t	267 519	5 350 372
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	267 519	5 350 372
C) Effect (B -A)	CO_2	t	- 23 746	-474 924
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	- 23 746	-474 924

7.12. DISTRICT HEATING SYSTEM REHABILITATION IN VINNITSA

A. Description of project

A.1. Title of the project: "District Heating System Rehabilitation in Vinnitsa city"

A.2. Participants/actors

Item	**Participant 1**	**Participant 2**	**Participant 3**
Name of organization	State Committee on Construction, Architecture and Housing Policy	Vinnitsa regional state administration	Vinnitsa District Heating Utility
Function within project	Host country representative	Governmental authority responsible for project administration	Implementing agency
Street	24 Dimitrova St.	70 Sobornastr.	13, 600-richchiapr.
Post code	03150	286 000	287100
City	Kiev	Vinnitsa	Vinnitsa
Country	Ukraine	Ukraine	Ukraine
Contact person			
Surname	Mr. Rul	Mr. Ivanov	Mr. Bark
First & middle name	Nicolai Vladimirovich	Yuri Ivanovich	Benjamin Lvovich
Job title	Vice-Chairman	Head of Vinnitsa Regional State Administration	Director
Direct tel	(38044) 226 25 06	(380432) 32 20 35	(380432) 44 60 31
Direct fax	(38044) 220 53 19	(380432) 32 75 40	(380432) 44 60 31
Direct E-mail			

Item	**Participant 4**	**Participant 5**	**Participant 6**
Name of organization	Regional Dept. on Environmental Protection	British Energy Consultancy Services	Institute of Engineering Ecology
Function within project	Monitoring agency	Project management and reporting	Consultant
Street	7Stusa, str.	13 Tryokhsviatitelskastr.	2AZheliabova Str.
Post code		252 001	03057
City	Vinnitsa	Kiev	Kiev
Country	Ukraine	Ukraine	Ukraine
Contact person			
Surname	Mrs. Yavorska	Mrs. Nekrasova	Mr. Sigal
First & middle name	Olena Grygoriivna	Anastasia	Alexander Isakovich
Job title	Head of Department	Business analyst	Director
Direct tel		(38044) 229 46 44, 228 64 63	(38044) 441 71 56
Direct fax		(38044) 229 46 44, 228 64 63	(38044) 446 92 62
Direct E-mail		nekrasova@british-energy.kiev.ua	

A.3. Activity

Item	**Please fill in if applicable**
General description	The gerneral project aim is to encourage and introduce more energy efficiency in the district heating production and distribution systems. The project will reduce GHG emissions by increasing the efficiency of the Vinnitsa district heating system, which will decrease natural gas consumption on boiler stations as well as losses on distribution systems. The project has the following components: • Boiler equipment rehabilitation: it involves investments in 140 small and medium boiler plants. Boilers serve residential houses and public buildings. New technologies include highly efficient gas-fired boilers; • Pipelines rehabilitation: it involves underground laying of some 300 km of double pre-insulated pipes from boiler plants to heat exchange stations and residential buildings; • Heat exchange stations rehabilitation: it involves the installation of 146 heat exchangers in 79 heat exchange stations, relevant controls and automation, and heat meters; • Technical assistance to project participants, including knowledge transfer, project management, environmental monitoring and marketing.
General description of project baseline (reference scenario)	In the absence of the project, no rehabilitation and replacement of the boiler plant equipment and piping should be envisaged within their lifetime duration because of the permanent lack of available funds in DH utility. Therefore an assumption was made on the continuous deterioration of heat-generating and distribution equipment, followed by the efficiency drop (1.5% annually) and increase of losses, fuel consumption and emission levels.
Type of project: **Location (exact, e.g. city, region, state):**	Energy efficiency Vinnitsa, administrative center of its region, Ukraine
Activity starting date:	2001
Lifetime of Activity:	25 years
Stage of activity:	Project pre-feasibility study has been done jointly by the Institute of Engineering Ecology and British Energy Kiev Office. Currently the search for investors both inside and outside the country is underway.
Technical data:	Technology will be used to reduce greenhouse gas emissions by producing hot water with more efficient gas-fired boilers and through efficiency measures. The project is divided into 5 stages, which could be done independently. 140 new boilers will be installed at 29 sites and 146 heat exchangers will be installed at 79 heat exchange stations. These facilities, capable of producing 330.9 Gcal per year of heat plus 10% reserve capacity, will be run in a base load cycle to supply 330.9 Gcal of hot water annually. Overall, system efficiency will be 47%. Vinnitsa DH utility is a heat production monopoly in the region. Generated hot water will be sold to local households, municipal consumers and state-owned companies at USD 13 per Gcal. Natural gas supply contracts with trader companies are extended on annual basis according to governmental procurement procedures. Hot water is distributed to local buildings for potable hot water use, industrial and heating applications from October through April, and used for domestic and industrial applications from May through September. Metering devices will be installed at heat exchange stations for improved metering and control functions. The hot water distribution system will be upgraded using pre-insulated pipes to prevent heat losses.

	Installation of modern plate heat exchangers at heat exchange stations will also contribute to system efficiency.
Main project risks	Major risk: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). Minor risks: • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Heat price risk: heat prices for residential consumers currently do not cover production costs, and the state subsidizes the difference. Governmental policy dictates that these subsidies will be gradually removed, bringing production costs in line with real economic conditions. We assume that residential consumers will not be able or willing to pay higher district heating prices and might therefore switch to individual heat production (local boilers in houses or flats)

A.4. Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	49 700 000	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	19 187 185	26 956 398
1.3. Revenues p.a.	USD (2000 prices)	-	-
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	8 492 832	13 693 443
1.5. Discount rate	%	20	
1.6. Project life	years	25	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	-101 097 880	-84 029 528

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	5 200 610
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	548 032
2.3. Incremental costs of project [5]	USD (2000 prices)	17 068 353
2.4. Cost per t CO_2 [6]	USD / t CO_2	31.1

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also true for costs and revenues in future years.

[2] All revenues and costs (incl. income tax) aggregated and discounted over project lifetime.

[3]. Calculated as GHG emissions Baseline – GHG emissions Project

[4] Incremental project GHG net effect as shown in table E2 (over whole life time of project) discounted with discount rate as listed in 1.5.

[5] Calculated as NPV of baseline minus NPV of project

[6] Calculated by dividing item 2.3. by item 2.2.

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	9.2	11.2	13.0
NPV at 10% with carbon credits, thousand USD	-2 707	4 148	11 004
NPV at 20% with carbon credits, thousand USD	-17 068	-14 328	11 588
NPV at 30% with carbon credits, thousand USD	-18 523	-17 098	-15 672

Investment per tonne of avoided emissions	USD/t CO_2 eq.	9.6

Describe how costs are determined; specify key assumptions

Item	*Cost, USD*
Capital expenses:	
• Equipment and piping:	
- Boilers	2 990 000
- heat exchangers	2 578 000
- pipes	32 517 000
• Installation and start-up	2 222 000
• Others	9 393 000
Total project:	49 700 000

The Vinnitsa DH utility is a monopolist in heat production in the region. Generated hot water will be sold to local households, municipal consumers and state-owned companies at a price of USD 13 per Gcal. Natural gas supply contracts with Trader Companies are extended to the annual basis according to the governmental procurement procedures. The cost of natural gas is assumed to be equal to USD 56.6 per 1000 m^3.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project contributes to fulfil the Ukrainian Energy and Environmental Policies.

D. Benefits derived from the activities implemented jointly project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

- Reduction of local air pollution.

Local social/cultural benefits:

- Improved working conditions, increased motivation;
- Better indoor climate in buildings;
- Creates a healthier environment for the workers.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Promotion of modern high-efficiency environmentally sound technology;
- The implementation of the GHG reduction measures will reduce the energy intensity of Vinnitsa DH utility.

E. Calculation of the contribution of activities implemented jointly projects that bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities.

E.1 Estimated emissions without the activity (project baseline)

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.
The additionality of this financially feasible project can be explained by the existence of a number of financial barriers for its implementation. The biggest of them are the lack of access to investment capital, which is due to the low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurances and do to shortages of own financial resources.
The project baseline was built in accordance to a status quo scenario for Vinnitsa DH utility. It is assumed that without significant investment a status quo scenario will be maintained. It is assumed that the continuous deterioration of the heat-generating and distribution equipment followed by the efficiency drop (1.5% annually) and the increase of losses, fuel consumption and emission levels. The Emission factor for natural gas combustion is 55.8195 t CO_2/TJ.

Energy consumption and CO_2 emissions per year

Years of project lifetime	*1*	*2*	*3*	*4*	…	*22*	*23*	*24*	*25*
Natural gas, thousand m^3	240 000	243 600	247 254	250 963	…	328 094	333 015	338 011	343 081
Natural gas, TJ	8 160	8 282	8 407	8 533	…	11 155	11 323	11 492	11 665
CO_2 emissions, t	455 491	462 324	469 258	476 297	…	622 683	632 023	641 503	651 126
Cumulative effect, t of CO_2 emissions	455 491	917 815	1 387 073	1 863 370	…	11 768 790	12 400 813	13 042 317	13 693 443

E.2 Estimated emissions with the activity

Description of the scenario, including methodologies applied. Specify key assumptions and emission factors used.
GHG emission reductions in the JI project scenario will result throughout the increasing efficiency of the Vinnitsa district heating system, which will decrease natural gas consumption on boiler stations and decrease losses on distribution systems

Energy consumption and CO_2 emissions per year

Years of project lifetime	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Natural gas, thousand m^3	234 748	229 689	218 285	200 812	191 262	175 849	167 219	169 836
Natural gas, TJ	7 981	7 809	7 422	6 828	6 503	5 979	5 685	5 774
CO_2 emissions, t	445 523	435 923	414 278	381 117	362 993	333 740	317 361	322 328
Cumulative effect, t of CO_2 emissions	445 523	881 446	1 295 724	1 676 842	2 039 835	2 373 574	2 690 935	3 013 263

Years of project lifetime	*9*	…	*25*
Natural gas, thousand m^3	169 836	…	169 836
Natural gas, TJ	5 774	…	5 774
CO_2 emissions, t	322 328	…	322 328
Cumulative effect, t of CO_2 emissions	3 335 591	…	8 492 832

E.2.1 Summary table: Projected emission reductions for the project

E2 Summary Table: Projected Emission Reductions

	GHG	*Unit*	*Emission per year*	*Total emission over project life*

A) Project baseline scenario	CO_2	t	547 738	13 693 443
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	547 738	13 693 443
B) JI project scenario	CO_2	t	339 713	8 492 832
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	339 713	8 492 832
C) Effect (B-A)	CO_2	t	- 208 024	- 5 200 610
	CH_4	t		
	N_2O	t		
	other	t		
	total	t CO_2 eq.	- 208 024	- 5 200 610

7.13. AFFORESTATION IN KHARKIV REGION

A Description of Project

A.1 Title of Project: "Afforestation in Kharkiv region"

A.2 Participants/actors

Item	Participant 1	Participant 2	Participant 3
Name of organization	Kharkiv Forest Management District of Ukrainian State Committee of Forestry	Ukrainian State Committee of Forestry	Ukrainian Research Institute of Forestry and Forest Melioration
Function within project	Project owner	Responsible for the project	Design organization
Street	3, Svobody sq.	5, Khreshchatic str.	86, Pushkinska str.
Post code	61000	01601	61024
City	Kharkiv	Kiev	Kharkiv
Country	Ukraine	Ukraine	Ukraine
Contact person	-------------------------	-------------------------	-------------------------
Surname	Ovchatenko	Kornienko	Buksha
First & middle name	Dmitro	Victor Petrovich	Igor Fedorovich
Job title	Head of regional forestry administrations	Head of the Science & Information Department	Head of Laboratory of Forest Monitoring and Certification
Direct tel	(+ 380 0572) 40-83-49	(+380 44) 228 78 58	(+ 380 572) 40 60 49 (+380 572) 43 15 49
Direct fax	(+ 380 0572) 47-85-87	(+380 44) 229 60 07	(+ 380 572) 43 25 20
Direct E-mail		yyy@mlg.kiev.ua	buksha@uriffm.com.ua

A.3 Project

Item	Please fill in if applicable
General description of JI project	The project was conceived as a forest carbon offset joint implementation demonstration project. The aim of the project is carbon sequestration, soil and watershed protection, and technical analysis of carbon accumulation in forest stands. The project will really be additional because a natural regeneration is not happening and, without the project, a forest stand would not grow.
General description of project baseline (reference scenario)	As baseline scenario, it was assumed that without the implementation of project, the amount of GHG determined for this project would not be sequestrated.
Type of project	Forestation and reforestation
Exact location	Kharkiv region, Ukraine
Project starting date	To be determined
Project life	Project life – 60 years in total, 10 years first step
Stage of project	Pre-feasibility study is completed
Technical data	Bad Lands, sites of the project, are situated in the four districts of the Kharkiv region (Balakleya, Bliznuky, Bogoduhiv and Krasnokutsk). Now the lands are being used as agricultural land (pasture), marginal land, and glade (not in use). State and local communities own 656.4 ha of this land, which do not need to be bought or rented in order to implement the carbon sequestration project. Another 237 ha represent marginal lands of agriculture enterprises, therefore they are private property that needs to be rented or bought.

	Area of potential forestation: 941 ha.
Main project risks	Major risk: • Approval risk: the project may not be recognized as JI project by the appropriate governmental entity (national JI office). Minor risks: • Completion risk: relates to cost overrun due to underestimation of project cost and delay of project implementation compared to projected schedule. • Cost risk: high transaction cost compared to project cost and achievable amount of ERUs.

A.4 Cost (to the extent possible):

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	470 500	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	9 253	-
1.3. Revenues p.a.	USD (2000 prices)	-	-
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	-	282 300
1.5. Discount rate	%	20	
1.6. Project life	years	60	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 431 212	-

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	282 300
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	23 525
2.3. Incremental costs of project [5]	USD (2000 prices)	431 212
2.4. Cost per t CO_2 [6]	USD / t CO_2	18.3

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also true for costs and revenues in future years.
[2] All revenues and costs (incl. income tax) aggregated and discounted over project lifetime.
[3]. Calculated as GHG emissions Baseline – GHG emissions Project
[4] Incremental project GHG net effect as shown in table E2 (over whole life time of project) discounted with discount rate as listed in 1.5. in the table A4.
[5] Calculated as NPV of baseline minus NPV of project
[6] Calculated by dividing item 2.3. by item 2.2. (both table A4).

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	< 0	7	9
NPV at 10% with carbon credits, thousand USD	-497	-261	-87
NPV at 20% with carbon credits, thousand USD	-431	-333	-235
NPV at 30% with carbon credits, thousand USD	-386	-326	-326

Investment per tonne avoided emissions	USD/t CO_2 eq.	1.67

The amount of investment for the first step of the project is approximately USD 500 per ha. The total investment without monitoring and certification will cost USD 470 500. These investments embrace the costs needed for preparing the forest culture project and the territory for forests planting, as well as they are needed to nurture or purchase the seedlings, lease the technique, and for the further planting, replanting (in case of damage) and care. Other costs, which will occure during the life cycle of the project will be: the cost for thinning and selective sanitary cutting in young stands, pest and disease control and the protection of the forest. Approximately this will be a USD 10 per ha und per year.

There are many types of positive effects and benefits, which are delivered by the project:

- Reduction of water and wind erosion of soil;
- Underground water quality improvement;
- Increase in biological diversity;
- Broadening recreation areas (for the tourism, rest etc.);
- Many kinds of side effects and secondary benefits such as hunting, picking berries, mushrooms;
- Lay in firewood for the winter (it is still and will further be important in some rural areas) based on sanitary felling;
- Commercial logging.

Alt these positive effects and benefits (excluding commercial logging) cannot be quantified today, which explains why only income from ERU selling and commercial logging was taken into account for the project benefit. For simplicity there has been assumed that all the trees would be felled, logged and sold in 60 years at once.

B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage

C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies.

The project is compatible with the Ukrainian government's desire to enhance environmental quality.

D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:

The benefits of the project derive from avoided CO_2 emission (due to avoided soil erosion and biomass decay) and from carbon sequestration (due to forest growth and soil carbon accumulation) that would not have occurred otherwise. In addition, the realization of the project improves the sustainability of local farming systems due to reduction of soil erosion and water protection.

Local social/cultural benefits:

- Provide environmental education to the surrounding communities, thereby enhancing their potential contribution to biodiversity conservation;
- Improve the variety and the attractiveness of the forest (no monocultures).

Local economic benefits, including transfer of environmentally sound technology and know-how: Increase in job opportunity

The benefits of the project accrues from the avoidance of CO_2 emissions (due to avoided soil erosion and biomass decay) and from the carbon sequestration (due to forest growth and soil carbon accumulation) that would not have occurred in the absence of the project activities.

E Benefits Related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.

The carbon sequestration (in wood biomass only) during the project cycle is in average 1.35 tonnes C/ha per year (5 t CO_2/ha per year). If we will account of carbon sequestration in understory and soil, cost per tone CO_2 will be decrease and achieved around USD 1.5.

E.2 Summary Table: Projected Emission Reductions

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	0	0
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	0	0
B) JI project scenario	CO_2	t	-4,705	-282,300
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-4,705	-282,300
C) Effect (B-A)	CO_2	t	-4,705	-282,300
	CH_4	t		
	N_2O	t		
	Other	t		
	Total	t CO_2 eq.	-4,705	-282,300

7.14. UTILIZING WOOD WASTE AS AN ALTERNATIVE FUEL FOR HEATING IN IVANO-FRANKIVSK REGION

Note: The pre-feasibility study is available in both Ukrainian and English.

A Description of Project

A.1 Title of Project: "Utilizing wood waste as an alternative fuel for heating in Ivano-Frankivsk region"

A.2 Participants/actors

Item	**Participant 1**	**Participant 2**	**Participant 3**
Name of organization	Ivano-Frankivs state regional administration	Climate Change Initiative	Ukrainian Mountain Forestry Research and Development Institute
Function within project	Project owner	Project developer	National consultant
Street	21, Grushevskogo Str	24/7, Instytutska Str., #4	31, Grushevskogo Str
Post code	76004	01021	76004
City	Ivano-Frankivs	Kyiv	Ivano-Frankivsk
Country	Ukraine	Ukraine	Ukraine
Contact person	-------------------------		-------------------------
Surname	Zvarych	Kulichenko	Korzhov
First & middle name	Igor Teodorovich	Natalia	Volodymir Leonidovich
Job title	Deputy Chairman of Ivano-Frankivsk Regional Administration	Project manager	Head of department
Direct phone	(+380 342) 552 035	+380 44 253 76 63	(+380 342) 55 24 58
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Direct e-mail	energo@industry.gov.if.ua	Natalia.Kulichenko@paconsulting.com	

A.3 Project

Item	**Please fill in if applicable**
General description of JI project	One of the most serious environmental problems in the Ivano-Frankivsk region is the large amount of wood waste produced by wood processing plants. Wood waste landfills are located on banks of rivers, and decaying wood waste produces methane emissions. Such a situation is dangerous for the environment. Another problem of the region is the lack of natural gas for heat and hot water supply. The main type of fuel is coal for heating institutional and public buildings. The existing heating system, which is running on coal is inefficient and environmentally perilous, particularly for emissions of greenhouse gases. The project objectives are fossil fuel conservations through the utilization of wood waste instead of the use of coal for heat generation; reduction of pollutions due to the dumping of this waste in to the rivers; reduction of heat generation costs. The Project implies the installation of equipment to produce fuel briquettes from wood waste. Additionally, it is proposed to install boilers on sawdust for heat production near to the sites of the wood waste generation because it is not expedient to transport the waste to the site of the fuel briquettes production.
General description of project baseline (reference scenario)	The Project baseline was built in accordance with a status quo scenario. It is assumed that a status quo scenario will be maintained without significant investment. Local state budget funds will continue to be used for purchasing coal and burning it to produce heat for institutional and public buildings. The situation without the project is considered with the assumption that existing equipment would not have been replaced during the technical lifetime

	of new equipment.
Type of project	Fuel-switching, renewable energy generation
Exact location	Ivano-Frankivsk region, Ukraine
Project starting date Lifetime of project	to be determined 20 years (technical life of installed equipment)
Stage of project	feasibility study was carried out

Technical data.

The project suggests an installation in different regions of Ivano-Frankivsk oblast (region) - four fuel briquettes processing lines with a capacity of 400 kg briquettes per hour and two processing lines with a capacity of 600 kg briquettes per hour. The total amount of produced briquettes will replace the annual consumption of 8 600 tonnes of coal, which are used today to produce heat and hot water for institutional and public buildings. Launching units of the above mentioned total capacity are possible through the combination of hydraulic press machines of varied individual production capacities. Technical specifications are described below.

Press machine type	***HLS 200***	***HLS 400***
Briquette diameter, mm	50	50
Maximum fuel briquettes production rate, kg/hour	200	400
Electric power, kW	14	28

High moisture content of the wood waste (40-60%) requires preliminary drying in order to reach a moisture content of 8-15%, which is acceptable for pressing. The hydraulic press delivery package includes a sawdust cylinder dryer. Its technical specifications are shown below.

Type	*BUS 200*	*BUS 400*
Capacity	109 kg/hour	218 kg/hour
Raw material volume, 45% moisture content	309 kg/ hour	618 kg/hour
Processes material volume, 15% moisture content	200 kg/hour	400 kg/hour
Raw material type	sawdust	
Electric power	5,3 kW	9,5 kW
Heat power	114 kW	300 kW
Sawdust intake for drying raw material	35 kg/hour	75 kg/hour

The project suggests an installation of 14 boilers with a capacity of 225 kW and 3 boilers with a capacity of 350 kW in different regions of Ivano-Frankivsk oblast near the sites of wood waste generation and where it is not expedient to transport the waste to the sites of fuel briquettes production.

Boilers are designed for using biomass in form of sawdust or woodchips with a maximum moisture content of 50%. Each boiler consists of a screw conveyor for fuel feeding, a burner, a residual combustion chamber, a heat exchanger, a exhaust blower, a separator with a filter and an ash removal device. The fuel is fed to the burner by the screw conveyor, equipped with a fire safety device that is a guarantee of the fire capture inside the bunker. Within the burner the fuel is moved by a special mechanism providing its gradual feeding, which also enables the burning of bark or wood waste with additions of dust and soil. The technical specifications of the boilers are shown below.

Specifications	Heat capacity	
	225 kW	350 kW
Fuel type	Wood waste, 50% moisture content	
Fuel expenditure, kg/hr	78	122
Performance factor	85%	85%
Temperature of smoke fumes at boiler outlet, °?	180	180
Maximum water working pressure, Mpa	0,6	0,6
Maximum electric power, kW	17	19

Project boundary

Regions of Ivano-Frankivsk oblast	*Fuel briquettes processing lines*	*Boilers*
Verhovyna	400 kg/hour	6 x 225 kW
Dolyna	400 kg/hour	3 x 350 kW
Kosiv	400 kg/hour	-
Nadvirna	600 kg/hour	5 x 225 kW
Rogatyn	600 kg/hour	3 x 225 kW
City of Yaremcha	400 kg/hour	-

Main project risks	Major risks: • Approval risk relates to not obtaining necessary approval of the project as JI from appropriate governmental entity (national JI office). • Offtake and sales risk relates to the possibility of lower volume of available wood waste and consequent failure to generate expected quantity of ERUs. Minor risk: • Completion risk relates to cost overrun due to underestimation of a project cost and time-delay of a project implementation compared to a projected timeline.

A.4 Cost (to the extent possible)

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (819 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3 179 280	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	46 528	0
1.3. Energy saving p.a.	USD (2000 prices)	414 093	0
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	27 437	438 742
1.5. Discount rate	%	20	
1.6. Project life	years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	- 1 411 800	0

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	411 305
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	100 144
2.3. Incremental costs of project [5]	USD (2000 prices)	1 411 800
2.4. Cost per t CO_2 [6]	USD / t CO_2	14.10

[1] All costs and revenues are to be given in USD based on the price level of the year 2000. This is also true for costs and revenues in future years.
[2] All revenues and costs (incl. income tax) aggregated and discounted over project lifetime.
[3]. Calculated as GHG emissions Baseline – GHG emissions Project
[4] Incremental project GHG net effect as shown in table E2 (over whole life time of project) discounted with discount rate as listed in 1.5. in the table A4.
[5] Calculated as NPV of baseline minus NPV of project
[6] Calculated by dividing item 2.3. by item 2.2. (both table A4).

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	7.2	11.3	15.1
NPV at 10% with carbon credits, thousand USD	-530	266	1 062
NPV at 20% with carbon credits, thousand USD	-1 412	-995	-577
NPV at 30% with carbon credits, thousand USD	-1 668	-1 405	-1 143

Investment per tonne avoided emissions	USD/t CO_2 eq.	7.7

1. Costs, Revenues and GHG Effects: Comparison between Baseline and Project (350 g CO_2/kWh)

		JI Project	*Baseline*
1.1. Total investment	USD (2000 prices) [1]	3 179 280	0
1.2. Operation and maintenance costs p.a.	USD (2000 prices)	46 528	0
1.3. Energy saving p.a.	USD (2000 prices)	414 093	0
1.4. GHG emissions (for details see table E2)	t CO_2 equivalent	- 1 411 800	0
1.5. Discount rate	%	20	
1.6. Project life	years	20	
1.7. Net Present Value (NPV) [2]	USD (2000 prices)	11 725	438 742

2. Incremental Project Costs and Effects

		Incremental Effects and Costs of JI Project
2.1. Incremental GHG effect over project life time [3]	t CO_2 equivalent	427 017
2.2. Incremental GHG effect over project life time, discounted [4]	t CO_2 equivalent	103 970
2.3. Incremental costs of project [5]	USD (2000 prices)	1 411 800
2.4. Cost per t CO_2 [6]	USD / t CO_2	13.6

Results of Financial Analysis based on ProForm Model

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU Cost, USD/tonne CO_2	0	5.0	10.0
IRR with carbon credits, %	7.2%	11.5%	15.4%
NPV at 10% with carbon credits, thousand USD	-530	296	1 123
NPV at 20% with carbon credits, thousand USD	-1 412	-979	-545
NPV at 30% with carbon credits, thousand USD	-1 668	-1 395	-1 123

Investment per tonne avoided emissions	USD/t CO_2 eq.	7.4

Describe how costs are determined; specify key assumptions:
Required investments for the implementation of the fuel briquette processing lines project are estimated to be 1,816 mln USD, including: (USD per fuel briquettes processing line)

	400 kg/hour	*600 kg/hour*
Briquette press machines	60 000	94 000
Sawdust dryer	145 300	182 000
Chipping machine	16 000	16 000
Transportation costs	5 000	10 000
Design and plan, project approval	2 000	2 000
Installation and start-up expenses	20 000	26 000
Personnel training	5 000	5 000
Contingency	20 000	26 500
Total project cost	273 300	361 500

Annual operation cost (USD per one fuel briquettes processing line):

	400 kg/hour	*600 kg/hour*
Operation cost	6 670	6 670
Electricity cost	4 213	6 402
Maintenance cost ($3/1000 kg fuel briquettes)	4 378	6 566
Total operation and maintenance cost	15 258	19 635

The project benefits will include savings on coal purchase costs. The current costs of coal (including transportation) are 220 Ukrainian hrivnya or US$40 per tonne. Annual coal saving will be 8 600 tonnes. The total revenues from the installation of fuel briquette processing lines will be US$353.6 thousand per year. To produce 10 200 tonnes of fuel briquettes per year and to replace the baseline coal consumption the briquette production lines will process 16 700 tonnes (37.3 thousand m^3) of wood waste per year.

Annual revenues (USD per one fuel briquettes processing line):

	400 kg/hour	*600 kg/hour*
Coal saving, tonnes per year	1 229	1 843
Revenues, USD per year	50 517	75 776

Required investments for wood waste boiler installation are estimated to be US$1,363 mln, including (USD per one boiler):

	225 kW	*350 kW*
Cost of boiler, including transportation costs	69 000	86 000
Design and planning, project approval	2 000	2 000
Installation and start-up expenses	1 000	1 000
Personnel training	500	500
Contingency	2 500	3 500
Total project cost	77 000	95 000

Annual operation cost (USD per one boiler):

	225 kW	*350 kW*
Electricity cost	1 100	1 222

The projects benefit will include savings on coal purchase costs. Total coal savings will be a 1 750 tonnes per year. The total revenues per wood waste boiler installation will be US$9 587 per year.

Annual revenues (USD per one boiler):

	225 kW	*350 kW*
Coal saving, t per year	93.8	145.9
Revenues, USD per year	3 752	5 836

The project case scenario assumes that the companies will transport wood waste to the fuel briquette plant location, and leave it there for free. This is seen as a benefit to the wood waste producers, who will have a chance of saving on compulsory waste utilization at landfills and on waste transportation due to shorter delivery routes.

Technical maintenance and operational costs of the existing coal boilers without project implementation are assumed to be equal to the project case, where the fuel briquettes are used. The existing coal boilers do not have to be replaced in order to start burning fuel briquettes.

7.14.1.1. B Governmental Acceptance, Approval or Endorsement

Not applicable to projects of NSS pipeline at the current stage.

7.14.1.2. C Compatibility with and supportiveness of national economic development and socio-economic and environment priorities

Describe (to the extent possible) how the project is compatible with and supportive of national economic development and socio-economic and environment priorities and strategies

The project contributes to fulfilling the Ukrainian Energy and Environmental Policies

7.14.1.3. D Benefits derived from the JI Project

Describe local benefits (and potential negative impacts) in detail. Provide quantitative information where possible.

Local environmental benefits:
The project environmental impact is positive due to reducing hazardous substances emissions into the atmosphere resulting from replacing coal combustion and to decreasing the amount of wood waste to be processed at landfills.
Atmospheric pollution: Significant reduction of hazardous substances emissions into the atmosphere is expected.
Water pollution: Significant reduction of negative impacts on ground water and hazards to the rivers resulting from decreased wood waste dumpings along the river banks are expected.
Human health: Air quality improvement that is going to have a positive impact on human health is expected.
Biodiversity: Improvement of water in rivers will lead to an improved environment for fish species. No negative impact on animal species is expected.
Waste: Ash produced as a result of wood waste combustion is expected to be used as a fertilizer or will be disposed at landfills. The rate of waste production in case of the project implementation (whatsoever) will be much smaller than that of the existing coal combustion process.
Local social/cultural benefits:

- No negative social and cultural impact is expected.
- Creation of qualified jobs.
- Increased public awareness on using biomass as a renewable energy source.
- Increasing the recreational potential of the region and tourism development, resulting in economic benefits for the region.
- Preserving existing forests from illegal felling and increasing the rate of wood waste utilization.

Local economic benefits, including transfer of environmentally sound technology and know-how**:**
The project is not expected to have any negative impacts on local economic development. Positive economic impacts will include:

- Using wood waste as an alternative energy source.
- Saving budget funds for the regions administration.
- Creating new jobs in the regions, which suffer from high unemployment.
- Promoting the use of modern wood waste utilization technology to produce energy.
- The project implementation will promote the project experience replication in other regions of the Ivano-Frankivsk oblast and throughout the Ukraine.

7.14.1.4. E Benefits related to the Mitigation of Climate Change, and Environmental Additionality

E.1 Estimated emissions without the JI project (project baseline), including discussion whether and why climate benefits achieved by the JI project are additional to any that would otherwise occur:

Description of the baseline scenario project environmental additionality, including methodologies applied. Specify key assumptions and emission factors used.
The legislation of the Ukraine allows the state budget funds to be spent only for the purposes envisaged in the budget. Therefore, the Ivano-Frankivsk state administration can not use the state budget funds that are intended for coal purchase to implement the project on fuel briquette production. There is also a financial barrier to the project implementation, which follows from the insufficient project cost-effectiveness from the point of view of the commercial bank investment credit. Under the current economic situation in Ukraine, it is not possible to attract private investment for the project due to its high capital costs and insufficient profitability. Therefore, attracting

additional financing under the JI mechanism is the only possibility for implementing the project under the existing economic situation.
In the baseline scenario, direct GHG emissions on the project site will result from coal burning to produce heat. IPCC suggests CO_2 emission factor of 91.8 t/TJ.
Direct CO_2 and methane emissions on the project site will be produced as a result of waste wood decomposition throughout the Ivano-Frankivsk region. The current estimates do not include GHG emissions from waste wood decomposition owing to the calculation complexity and appropriate reflection in national GHG inventory.
Direct GHG emissions beyond the project boundary are a result of methane emissions from coal underground mining.
The methodology for estimating methane emissions from underground coal mining consists of two steps. The first step involves estimating methane emissions from underground mining. The second step involves estimating emissions from post-mining activities. CH_4 emissions were calculated in accordance with IPCC methodology [1] with accounting for local emission factors used for the national GHG inventory in the Ukraine. It will remains to be determined whether ERUs can be issued to the project for these (indirect) reductions in methane emissions.

Emission factors

Activities	*Emission factors*
Underground coal mining	16.51 kg ??$_4$ / tonne of coal
Post-mining	1.34 kg ??$_4$ / tonne of coal

Baseline GHG emissions calculation

		Unit	*Year 1*	*Year 2*	…	*Year 20*	*Average for 2008-2012 period*
GHG emissions from coal burning (on site)							
1	Coal supply	tonne	10 352	10 352	…	10 352	10 352
2	Coal calorific value	Kcal/kg	4 538	4 538	…	4 538	4 538
3	Primary energy for heating	TJ	196.7	196.7	…	196.7	196.7
4	Emission factor CO_2	tonne/TJ	91.8	91.8	…	91.8	91.8
5	Emissions, CO_2 equivalent	tonne	18 056	18 056	…	18 056	18 056
GHG emissions from coal mining (off site)							
6	Coal extraction	tonne	10 352	10 352	…	10 352	10 352
7	Emission factor for underground coal extraction	kg ? ?$_4$ / tonne of coal	16.51	16.51	…	16.51	16.51
8	Emission factor after coal extraction	kg ? ?$_4$ / tonne of coal	1.34	1.34	…	1.34	1.34
9	Emissions, ? ?$_4$	tonne	185	185	…	185	185
10	Emissions, CO_2 equivalent	tonne	3 881	3 881	…	3 881	3 881

GHG emissions for coal transporting from a conventional district center to a customer site are assumed to equal those for transporting fuel briquettes, hence, these emissions were not included in the calculation.
Indirect GHG emissions, other than related to methane emissions from coal mining, on project site and off-site were not identified.

7.14.1.5. E.2 Estimated emissions with the JI project:

All assumptions made during the project preparation build upon experience of similar project implementations all over the world, as adapted to Ukrainian circumstances.
The project implies the installation of equipment to produce fuel briquettes from wood waste and wood waste boilers. The equipment capacity is sufficient to replace 10.3 thousand tonnes of coal used annually in the region to produce heat for institutional buildings.
Major assumptions as for the project activity:

- The amount of wood waste available in the regions will suffice over the project lifetime for supply wood waste boilers and to supply fuel briquettes processing lines to be used to produce heat energy for institutional buildings.
- The project case scenario will eliminate the need to extract 10.3 thousand tonnes of coal for heating annually.

Expenses for and GHG emissions from transporting fuel briquettes burning site are assumed equal without the project and with the project implementation. It is assumed that there is no difference whether coal or fuel briquettes are transported. This simplification is justified by the relatively small impact of transport-related emissions on the project's overall GHG impact.
Indirect GHG emission of the project will result from burning fossil fuel to produce electric energy for the fuel briquettes processing lines and operating wood waste boilers. Other direct or indirect GHG emissions on or off project site were not identified. The CO_2 from wood combustion is considered climate-neutral (IPCC convention).
The installed total electric capacity of the fuel briquettes processing lines is 352 kW. The installed total electric capacity of the boilers is 156 kW. Electricity consumption will be 1 675 thousand kW*h per year.

GHG emissions off project site, resulting from electricity consumption for fuel briquette production:

	Unit	*Year 1*	*Year 2*	…	*Year 20*	*Average for the period 2008-2012*
Electricity consumption	Thousand kW*h	1 675	1 675	…	1 675	1 675
Emission factor	g ??$_2$/kW*h	819	819	…	819	819
GHG emissions	tonne ? ?$_2$	1 372	1 372	…	1 372	1 372
Emission factor	g ??$_2$/kW*h	350	350	…	350	350
GHG emissions	tonne ? ?$_2$	586	586	…	586	586

E2 Summary Table: Projected Emission Reductions (819 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	18 057	361 131
	CH_4	t	185	3 696
	N_2O	t		
	other	t		
	total	t CO_2 eq.	21 937	438 742
B) JI project scenario	CO_2	t	1 372	27 437
	CH_4	t	-	-
	N_2O	t		
	other	t		
	total	t CO_2 eq.	1 372	27 437
C) Effect (B-A)	CO_2	t	-16 685	-333 694
	CH_4	t	-185	-3 696
	N_2O	t		
	other	t		
	total	t CO_2 eq.	-20 565	-411 305

E2 Summary Table: Projected Emission Reductions (350 g CO_2/kWh)

	GHG	*Unit*	*Emission per year*	*Total emission over project life*
A) Project baseline scenario	CO_2	t	18 057	361 131
	CH_4	t	185	3 696
	N_2O	t		
	other	t		
	total	t CO_2 eq.	21 937	438 742
B) JI project scenario	CO_2	t	586	11 725
	CH_4	t	-	-
	N_2O	t		
	other	t		
	total	t CO_2 eq.	586	11 725
C) Effect (B -A)	CO_2	t	-17 470	-349 405
	CH_4	t	-185	-3 696
	N_2O	t		
	other	t		
	total	t CO_2 eq.	-21 351	-427 017

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APPENDIX A: DESCRIPTION OF PROJECTS IN PCF TEMPLATE

Project Idea Note for
"Skochinsky mine methane capture and utilization"

Skochinsky mine

Date submitted:_____________

1. **Project Proponent**
   1.1. Name of Organization: Skochinsky Mine
   1.2. Organizational Category (Government/Government Agency /Municipality /Company /NGO: Skochinsky Mine is a State owned enterprise that is a part of the Donugol State Holding Company (an Association).
   1.3. Address: 83084, Donetsk City, Ukraine
   1.4. Contact Person: Miminoshvili Valery Veniaminovich, Director
   1.5. Phone/Fax: +(380 62) 272-4390 / +(380 62) 272-4210
   1.6. E-mail: trip@public.ua.net ; aef@public.ua.net
   1.7. Function of Proponent in the Project (Sponsor/Operational Entity/Intermediary/Technical Advisor): Project owner
   1.8. Project Sponsors (please list all). Please provide details of the lead sponsor(s) including previous experience with similar project and technologies and summarize the financial results for the last fiscal year. Please provide corporate rating from S&P and/or Moody's, if available.

The U.S. Environmental Protection Agency and the U.S. Agency for International Development co-sponsored preparations of the business plan for the Coalbed Methane Development project at Skochinsky mine. The mine was selected among the best candidate mines for implementation of the CBM projects. However, this project can be considered as a sample one, and the project developer may consider other attractive site in Donetsk Coal Basin. The list of the Donbass mines that have the highest potential for methane projects development can be found in a handbook prepared by the Partnership for Energy and Environmental Reform (www.peer.org.ua).

Skochinsky Mine: located within the boundaries of the city of Donetsk, is one of the 241 underground coal mines in the Ukraine. The Skochinsky Mine includes a reserve area of 80 square kilometers that contains methane of approximately 6.8 billion cubic meters. The mine reserve area contains thirty coal seams that have an aggregate thickness of 12.25 meters and the methane content of the coal seams range from 16 to 25 m^3/tonne. During 1999, the mine produced approximately 785 000 raw tonnes from one seam that ranged in thickness from 1.10 to 1.95 meters. Skochinsky is a State owned enterprise that is a part of the Donugol State Holding Company (an Association). Skochinsky Mine management and personnel have actively participated in gathering information and data for this business plan and have been supportive of the project.

2. **Type of Project**

2.1. Greenhouse Gases Targeted (CO_2//N_2O/HFCs/PFCs/SF_6): CH_4 emissions reduction

2.2. Type of Activities (Abatement/CO_2 Sequestration): Abatement

2.3. Field of Activities: Alternative Energy

2.4. If the project is hydropower, please provide the dam and reservoir size in metric dimensions.

3. Location of Project

3.1. Region (Africa/East Asia & Pacific/South Asia /Europe & Central Asia/Middle East & North Africa/Latin America & the Caribbean): Europe & Central Asia

3.2. Country (including the status of Kyoto Protocol ratification): Ukraine. Verhovna Rada (parliament) of Ukraine has not ratified the Kyoto Protocol yet.

3.3. City: Donetsk

3.4. Brief Description of Location: Skochinsky Mine is located within the boundaries of the city of Donetsk in the South-East of the country, which is one of the largest industrial centers in the Ukraine and the "capital" of Donetsk Coal Basin. The population of the City exceeds one million people.

4. Expected Schedule

4.1. Earliest Project Start Date: December, 2003

4.2. Current Status: Feasibility study has to be conducted prior to project development

4.3. Time Required Before Becoming Operational: 1.5 year

4.4. Project Lifetime: 13 years (including one year pilot phase)

5. Financing Sought

5.1. Project Financing:

5.1.1. Estimate of total project cost in US$: 51 895 300 US$
5.1.2. Financing (other than PCF) to be sought or already identified: To be identified.

5.2. Requested PCF Contribution: To be identified.

5.3. Expected Schedule for PCF Contribution: [Please Note: PCF contribution is provided, in principle, on delivery of Emission Reductions, but some up-front financing may be provided to support project implementation]: To be identified.

5.4. Brief Description of Other Financial Considerations: To be identified.

6. Technical Summary of Project

Please provide a brief paragraph of maximum 10 lines for each of the below.

6.1. Objective: The objective of the project is the commercial development and utilization of coalbed and coalmine methane at the Skochinsky Mine.

6.2. Brief Description of Project:

The project will entail three phases: pilot project, evaluation, and the full-scale development program. The pilot project phase will consist of the drilling and completion of five standard wells and one gob well. An evaluation phase will follow the pilot phase to access the results of the drilling and to allow time for the decision to continue into the development program. The project assumes a full year to complete the pilot phase and the evaluation period. The full-scale development program consists of the drilling and completion of four holes per month over a three-year period for a total of 144 wells. Selected coal seams and sandstones in the standard coalbed methane wells will be hydraulically stimulated to provide an avenue for the gas and water to flow from the formation to the well bore. The gob wells will produce gas from the relaxed fractured coal seams and sandstones resulting from the longwall mining operations. The produced gas will be sold into existing natural gas system.

6.3. Technology to be Employed:

The business plan of the project incorporates the utilization of Western technology and equipment and is patterned after similar projects that have been successfully implemented in other parts of the World. The standard wells, drilled to a depth of 1 400 meters, will have a density of three wells per square kilometer while the gob wells, drilled to a depth of 1 200 meters, will have an effective density of six wells per square kilometer. The location of the 144 wells to be drilled during the Drilling Program was determined after reviewing the geology of the mine area. The drilling area has an average gas content of over 20 cubic meters per tonne in the coal seams and a minimum of 0.8 cubic meters of gas per cubic meter of sandstone.

6.4. Brief Description of Technology [Please Note: PCF only supports projects that employ commercially available technology. It would be useful to provide a few examples of where the proposed technology was previously used]:

The Drilling Program includes drilling the standard (vertical) wells and the gob wells (drilled in the mined area). The standard wells will be hydraulically stimulated after drilling in order to increase gas flow. The gob wells will not be hydraulically stimulated. The gob wells will produce gas from the relaxed fractured coal seams and sandstones located above the longwall mining operations.

The well drilling envisions the use of Western drilling and completion equipment and technologies. Such equipment and technologies, provided for example by Haliburton Company, have been successfully implemented in similar projects in other parts of the World, such as the United States (Black Warrior Basin, Powder River Basin), Western Europe, China, and Australia.

7. Expected Environmental Benefits

Please provide a brief paragraph of maximum 10 lines for each of the below.

7.1. Estimate Greenhouse Gases Abated/CO_2 Sequestered in "tons of equivalent”

Methane extraction results in a 50% reduction in methane emissions per unit coal produced. Methane emissions are about 26.6 m^3/t coal produced in the baseline case, and about 13.3 m^3/t coal in the JI project case.

7.1.1. before 2008:

Year	*2003*	*2004*	*2005*	*2006*	*2007*
Methane emission reduction, tonnes	7 319	8 033	8 925	8 925	8 925
CO_2 equivalent emission reduction, tonnes	153 689	168 683	187 425	187 425	187 425
Cumulative emission reduction in carbon equivalent, tonnes	41 915	87 919	139 035	190 151	241 267

7.1.2. during 2008 – 2012:

Year	*2008*	*2009*	*2010*	*2011*	*2012*
Methane emission reduction, tonnes	8 925	8 925	8 925	8 925	8 925
CO_2 equivalent emission reduction, tonnes	187 425	187 425	187 425	187 425	187 425
Cumulative emission reduction in carbon equivalent, tonnes	51 116	102 232	153 348	204 464	255 580

7.1.3. during entire project lifetime:

Methane emission reduction, tonnes	104 601
CO_2 equivalent emission reduction, tonnes	2 196 621
Emission reduction in carbon equivalent, tonnes	599 078

Baseline (or Reference) Scenario [Please describe what would otherwise occur in the absence of PCF contribution. The description should include alternatives available for the end-use or application that the proposal addresses and the reason why the baseline option is the one which would be implemented in the absence of PCF resources. Please refer to the PCF Implementation Note # 3: *Baseline Methodologies for PCF Projects*, which can be viewed or downloaded on the PCF website]:

In the absence of JI resources methane emissions will continue from underground coal mining and post-mining activities. The additionality of this financially feasible project can be explained by the existence of number financial barriers for its implementation. Main of them are the lack of access to investment capital due to low interest of the Ukrainian commercial banks in project financing, high cost of debt financing, difficulties in obtaining guarantees/insurance and shortage of own financial resources.

7.3 If financial analysis is available for the PCF alternative proposed project, please describe Financial analysis is not available for the PCF alternative proposed project

a. forecast financial internal rate of return (FIRR) before injection of PCF funds

Financial efficiency analysis of project was performed for the following three scenarios:

- Enterprise does not receive compensation for achieved emissions reduction (Scenario A);
- Enterprise (together with the investor within the JI project) receives the compensation of USD18.3 per 1 ton of carbon emissions reduced (USD 5.0 per 1 ton of CO_2) (Scenario B);
- As above, with USD 36.7 per 1 ton of carbon (USD10.0 per 1 ton of CO_2) (Scenario C).

Each of these scenarios was analyzed for 3 different values of the cost of capital (discount rate): 10%, 20%, and 30%.

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, $/tonne CO_2	0	5.0	10.0
IRR with ERU credits (%)	26.0	29.7	33.4
NPV at 10% wit h ERU credits (thousand USD)	23 532	29 127	34 722
NPV at 20% with ERU credits (thousand USD)	5 476	8 771	12 067
NPV at 30% with ERU credits (thousand USD)	-2 289	-132	2 026

(b) forecast FIRR after injection of PCF funds (please note that the PCF intends to provide additional funding for the project, in principle, in the form of 'pay-on-delivery of Emission Reduction'): forecast FIRR after injection of PCF funds is not available

(c) marginal cost of carbon abatement calculated on a

(i) full project lifecycle

Marginal cost of carbon abatement is -9.1 USD / t of carbon eq. over full project lifecycle at 20% of discount rate.

(ii) Kyoto Protocol commitment period (2008-2012)

Marginal cost of carbon abatement is -10.7 USD / t of carbon eq. over commitment period at 20% of discount rate.

In all cases, please report the assumptions in the analysis.

All of the assumptions that have been used in developing the project are based on similar projects and then modified to adjust to conditions that are expected t o be encountered in the Ukraine. All of the operating and equipment costs are those in effect as of January 1, 2000 and all of the financial projections are based on a constant USD basis.

The project includes a Pilot Project Phase, an Evaluation Phase, and a Development Phase. Each Phase will be implemented in a manner to maximize the project cash flow and is patterned after development projects that have been successfully implemented in other countries.

The Project envisages the bulk of the methane to be sold to consumers within the existing system of natural gas transportation located in the distance less than 1 km from the mine property, and the minor proportion can be used at mine's own boiler-plants to substitute coal. In future the mined methane can fuel electric power generation for mine's own purposes. A separate economic analysis should be performed to identify the best methane utilization option.

The development costs for each standard well are estimated to be USD 331,000 and for each gob well to be USD 231,000:

- Total investments account for USD 51.9 million;
- Costs for Pilot Project Phase account for USD 6.2 million;
- Methane's price is at USD 50 per 1000 ?[3];

Annual volume of mined methane, million ? [3]

Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Methane	271	549	748	672	519	425	359	309	271	234	145	69

Financial analysis has been carried out with an allowance for income tax benefits (over the first three years there is tax exemption, over the following years the tax rate is at 15% - half of the current rate) envisaged for special economic zones, which is the city of Donetsk. There was an assumption taken that the current status will be maintained over the first 6 years after the pilot phase has been completed.

7.4. Specific Global & Local Environmental Benefits Expected:

Global environmental benefits: Emission reduction over project lifetime is 104.6 thousand t of methane.
Local environmental benefits: To be determined.
Local social/cultural benefits: improving coal mine safety, productivity and coal mine employee health. The development of CMM projects at coalmines in Ukraine can greatly reduce the number of accidents and fatalities that Ukrainian mines are presently experiencing. In 1999, Ukraine coalmines experienced 289 fatalities, or 3.6 deaths per one million raw tonnes of coal produced. This grave statistic is one of the worst in the world. Many of the fatalities are the result of outbursts caused by high gas pressures and from explosions caused by the ignition of high levels of methane. Pre-mining degasification of the coal reserves, with the drilling of vertical wells and utilizing enhanced underground degasification system, would greatly reduce the accident and fatality rates in Ukrainian coal mines. In addition, removal of the methane from the mines will increase productivity by reducing the number of mine slowdowns or shutdowns due to high methane levels.
Local economic benefits, including transfer of environmentally sound technology and know-how**:**

- Promotion of coal bed methane utilization systems;
- This project may also act as a catalyst to the formation of similar projects at other coal mines;

Creating an alternative energy source that would mitigate Ukraine’s dependency on imported fuel, primarily natural gas from Russia and other CIS countries.

7.5. Relevance for Host Country Socioeconomic and Environmental Priorities:

In 1999, the Cabinet of Ministers of Ukraine drafted a National Energy Program for the period 2000-2010. This program includes a set of goals for the energy sector to achieve a more balanced supply/demand situation through a combination of alternative energy sources and energy efficiency programs. One of the goals is to have eight billion cubic meters of CBM, including CMM, produced per year by the year 2010.
Capturing and utilizing CMM in Ukraine can significantly reduce the amount of greenhouse gas that coalmines presently emit into the atmosphere. During 1999, Ukrainian coalmines generated approximately 2 060 million cubic meters of methane. Through degasification systems, the mines captured approximately 257 million cubic meters of methane (13% of the total generated) and used only 79 million cubic meters of the captured methane; thus emitting approximately 1 981 million cubic meters of methane into the atmosphere. Not only this is a waste of a vitally needed energy resource but also CMM emissions contribute to the greenhouse gas effect.

Project Idea Note for

“Implementation of 1,5 MW_e power plant operating on landfill gas at Lugansk landfill”

Close Joint Stock Company “Protos”

Date submitted:_____________

1. Project Proponent

1.1. Name of Organization: Scientific Engineering Center “Biomass” and Close Joint Stock Company “Protos”

1.2. Organizational Category: Company

1.3. Address: P/o box 964, 2a Zhelyabova Str, 03067, Kyiv, Ukraine

1.4. Contact Person: G. Geletukha, Director of Scientific Engineering Center “Biomass”

1.5. Phone/Fax: (+380 44) 446-94-62, fax: (+380 44) 484-81-51

1.6. E-mail: geletukha@biomass.kiev.ua

1.7. Function of Proponent in the Project: Intermediary and Technical Advisor

1.8. Project Sponsors (please list all). Please provide details of the lead sponsor(s) including previous experience with similar project and technologies and summarize the financial results for the last fiscal year. Please provide corporate rating from S&P and/or Moody's, if available.

“Protos” is a company responsible for collection, transportation and placement of municipal solid wastes (MSW) at the landfill from Lugansk. “Protos” is a Closed Joint Stock Company working independently on commercial basis.

2. Type of Project

2.1. Greenhouse Gases Targeted: CO_2 and CH_4

2.2. Type of Activities (Abatement/CO_2 Sequestration): Abatement

2.3. Field of Activities: Reduction of methane (landfill gas) emissions / Renewable Energy

2.4 If the project is hydropower, please provide the dam and reservoir size in metric dimensions.

3. Location of Project

3.1. Region: Europe & Central Asia

3.2. Country (including the status of Kyoto Protocol ratification): Ukraine. Verhovna Rada (parliament) of Ukraine has not ratified the Kyoto Protocol yet.

3.3. City: Lugansk

3.4. Brief Description of Location: west of Ukraine, 830 km from Kyiv, capital of Ukraine. The population of the City is about 500 thousand people.

4. Expected Schedule

4.1. Earliest Project Start Date: Not yet available

4.2. Current Status: Advanced feasibility study in preparation

4.3. Time Required Before Becoming Operational: The project would be operational within one year of agreeing financing

4.4. Project Lifetime: Typical project lifetime for landfill gas utilization is 20 years. The project will be seeking a crediting period greater than the first commitment period 2008-2012 in order to keep the cost of ERUs low.

5. Financing Sought

5.1. Project Financing:

5.1.1. Estimate of total project cost in US$: 2 250.0 thousand USD.
5.1.2. Financing (other than PCF) to be sought or already identified: To be identified

5.2. Requested PCF Contribution: To be identified.

5.3. Expected Schedule for PCF Contribution: [Please Note: PCF contribution is provided, in principle, on delivery of Emission Reductions, but some up-front financing may be provided to support project implementation]: To be identified.

5.4. Brief Description of Other Financial Considerations: To be identified.

6. Technical Summary of Project

Please provide a brief paragraph of maximum 10 lines for each of the below.

6.1. Objective: Landfill gas utilization for electricity production at Lugansk landfill.

6.2. Brief Description of Project:

The landfill is located near the city of Lugansk. Landfill's area is 8 hectares, depth is 20-25 m. The volume capacity of the landfill is about 2 millions m^3. Its fullness is 90%, so the landfill contains 1.6 million tonnes of MSW. The landfill was opened in 1978. The average annual waste acceptance rate is 70-80 thousand cubic meters. Now the work on enlargement of the landfill site is being prepared.

It is planned to install 1.5 MW power plant at Lugansk landfill. The plant will cover the power demand of the landfill, and give an opportunity to sell most of the produced electricity to the grid. Such scheme is profitable for Lugansk landfill. Wholesale price of electricity for power producers is about USD 0.021 per kWh in Ukraine. According to calculations, production cost of electricity produced by 1.5 MW power plant operating on LFG will be about USD 0.016 per kWh. It is expected that electricity price will grow.

Implementation of power plant on the landfill results in:

- production of 12 GWh/year of electricity;
- reduction of CO_2 emission in the amount of nearly 57 000 t/year by avoiding methane emission from landfil.

6.3. Technology to be Employed: Project based on German "MAN" CHP unit manufacturer.

6.4. Brief Description of Technology [Please Note: PCF only supports projects that employ commercially available technology. It would be useful to provide a few examples of where the proposed technology was previously used]: German "MAN" CHP unit is commercially available and conventional technology.

7. Expected Environmental Benefits

Please provide a brief paragraph of maximum 10 lines for each of the below.

7.1. Estimate Greenhouse Gases Abated/CO_2 Sequestered in "tons of carbon equivalent”

7.1.4. before 2008:

	GHG	*Unit*	*2003*	*2004*	*2005*	*2006*	*2007*
A) Project baseline scenario	CH_4	tonnes	4 527	4 527	4 527	4 527	4 527
	CO_2	tonnes	9 828	9 828	9 828	9 828	9 828
	total	tonnes C eq.	28 608	28 608	28 608	28 608	28 608
B) JI project scenario	CH_4	tonnes	1811	1811	1811	1811	1811
	CO_2	tonnes	0	0	0	0	0
	total	tonnes C eq.	10 372	10 372	10 372	10 372	10 372
C) Effect (B-A)	CH_4	tonnes	-2 716	-2 716	-2 716	-2 716	-2 716
	CO_2	tonnes	-9 828	-9 828	-9 828	-9 828	-9 828
	total	tonnes C eq.	-18 236	-18 236	-18 236	-18 236	-18 236
D) Cumulative effect	CH_4	tonnes	-2 716	-5 432	-8 148	-10 864	-13 580
	CO_2	tonnes	-9 828	-19 656	-29 484	-39 312	-49 140
	total	tonnes C eq.	-18 236	-36 471	-54 707	-72 943	-91 178

7.1.5. during 2008 – 2012:

	GHG	*Unit*	*2008*	*2009*	*2010*	*2011*	*2012*
A) Project baseline scenario	CH_4	tonnes	4 527	4 527	4 527	4 527	4 527
	CO_2	tonnes	9 828	9 828	9 828	9 828	9 828
	total	tonnes C eq.	28 608	28 608	28 608	28 608	28 608
B) JI project scenario	CH_4	tonnes	1811	1811	1811	1811	1811
	CO_2	tonnes	0	0	0	0	0
	total	tonnes C eq.	10 372	10 372	10 372	10 372	10 372
C) Effect (B-A)	CH_4	tonnes	-2 716	-2 716	-2 716	-2 716	-2 716
	CO_2	tonnes	-9 828	-9 828	-9 828	-9 828	-9 828
	total	tonnes C eq.	-18 236	-18 236	-18 236	-18 236	-18 236
D) Cumulative effect	CH_4	tonnes	-2 716	-5 432	-8 148	-10 864	-13 580
	CO_2	tonnes	-9 828	-19 656	-29 484	-39 312	-49 140
	total	tonnes C eq.	-18 236	-36 471	-54 707	-72 943	-91 178

7.1.6. during entire project lifetime:

	GHG	*Unit*	*Total emission over project life*
A) Project baseline scenario	CH_4	tonnes	90 540
	CO_2	tonnes	196 560
	total	tonnes C eq.	572 155
B) JI project scenario	CH_4	tonnes	36 220
	CO_2	tonnes	0
	total	tonnes C eq.	207 442
C) Effect (B-A)	CH_4	tonnes	-54 320
	CO_2	tonnes	-196 560
	total	tonnes C eq.	-364 713

7.2. Baseline (or Reference) Scenario [Please describe what would otherwise occur in the absence of PCF contribution. The description should include alternatives available for the end-use or application that the

proposal addresses and the reason why the baseline option is the one which would be implemented in the absence of PCF resources. Please refer to the PCF Implementation Note # 3: *Baseline Methodologies for PCF Projects*, which can be viewed or downloaded on the PCF website]:

In the absence of PCF financing, the current situation would continue, with landfill gas from anaerobic decomposition of wastes being released into the atmosphere (corresponding to approximately 4,527 t of CH_4 or 95,067 t CO_2-equivalent per year).

The reason why the current project would not be undertaken without being a JI project is the lack of financial resources in the renewable energy sector of the Ukraine. There aren't any major changes in this situation, as the country's economy in general is unlikely to grow such that it would create a sufficient reserve for a more extensive support of the renewable energy sector in the next 15 years.

There is no currently existing LFG recovery and utilization project. The Ukrainian law currently has no requirement concerning landfill methane. The implementation of the collection and utilization system will be the first example in Ukraine having great demonstration effect.

7.3 If financial analysis is available for the PCF alternative proposed project, please describe: (a) forecast financial internal rate of return (FIRR) before injection of PCF funds

Financial efficiency analysis of project was performed for the following three scenarios:

- Enterprise does not receive compensation for achieved emissions reduction (Scenario A);
- Enterprise (together with the investor within the JI project) receives the compensation of USD18.3 per 1 ton of carbon emissions reduced (USD 5.0 per 1 ton of CO_2) (Scenario B);
- As above, with USD 36.7 per 1 ton of carbon (USD10.0 per 1 ton of CO_2) (Scenario C).

Each of these scenarios was analyzed for 3 different values of the cost of capital (discount rate): 10%, 20%, and 30%.

Financial Analysis	*SCENARIO A*	*SCENARIO B*	*SCENARIO C*
ERU cost, $/tonne CO_2	0	5.0	10.0
IRR with ERU credits (%)	3.3	21.3	36.6
NPV at 10% with ERU credits (thousand USD)	-840	1 747	4 335
NPV at 20% with ERU credits (thousand USD)	-1 243	114	1 470
NPV at 30% with ERU credits (thousand USD)	-1 334	-481	372

(b) forecast FIRR after injection of PCF funds (please note that the PCF intends to provide additional funding for the project, in principle, in the form of 'pay-on-delivery of Emission Reduction'): forecast FIRR after injection of PCF funds is not available

(c) marginal cost of carbon abatement calculated on a

(i) full project lifecycle

Marginal cost of carbon abatement is 6.2 USD / t of carbon eq. over full project lifecycle at 20% of discount rate.

(ii) Kyoto Protocol commitment period (2008-2012)

Marginal cost of carbon abatement is 13.6 USD / t of carbon eq. over commitment period at 20% of discount rate.

In all cases, please report the assumptions in the analysis.

Reduction of CO_2 that will take place due to reduction of fossil fuels combustion at thermal power plant for production of 12,000 MWh/year of electricity. To determine GHG emissions reduction resulting from potential JI electricity saving/production project realization, the following assumptions have been adopted:

- GHG emissions reduction (resulting from replacement of current energy generation technologies by more efficient) is estimated with allowance for decrease in power generation at thermal power plants, which operate on coal, natural gas and fuel oil.
- Specific consumption for power generation at thermal power plants is taken as a mean value for the thermal power plants of Ukraine for 1990 base year, which makes 346.3 gce/kWh or 35.5% efficiency [2]. In this case was assumed the specific consumption 819.7 g CO_2 per kWh for power generation

It is assumed that the LFG recovery system can cover approximately 80 percent of the waste in place. The average efficiency of the LFG extraction wells/collectors is assumed to be approximately 75 percent over the life of the landfill. The on-line availability of a LFG collection system is assumed to be 99 percent. Based on the figures outlined above, the LFG recovery rate for a utilization project in the Ukraine is estimated to be 60 percent of the total LFG generation rate. The estimate range is consistent with the findings reported by the USEPA, which reports that LFG recovery can range from approximately 60 to 85 percent.
The annual recovery of LFG is evaluated at 5 m^3 per ton of waste over a period of 20 years (100 m^3 in total).
Methane content in LFG is about 50%.

Reduction ??$_4$ emissions through biogas utilization from municipal solid waste:

Volume of Lugansk landfill, m^3	2 000 000
Average density of wastes, t/m^3	0.8
Annual recovery of LFG, m^3/t (wastes)	5
Recovery of LFG at Lugansk landfill, m^3/year	8 000 000
? ?$_4$ utilization (thousand m^3/year)	8 000 x 0.5 = 4 000
? ?$_4$ utilization (t/year)	2 716*
? ?$_4$ utilization over project life (t)	54 320
Emissions avoided in CO_2 equivalent over project life (tonne)	1 140 720**

*Specific weight of CH_4 is assumed to be equal to 679 g/m^3

** Global warming potential for CH_4 equals 21

7.4. Specific & Local Environmental Benefits Expected:

Global environmental benefits: At least 1,337,280 t ?O_2 eq. emissions reduction over project lifetime.
Local environmental benefits:

- Avoiding of LFG dissemination to nearby buildings (safety, odor);
- Reduction of the emission of hazardous gases.

Local social/cultural benefits: creation of at least 10 new jobs and better skilled personnel.
Local economic benefits, including transfer of environmentally sound technology and know-how:

- Promotion of landfill gas utilization systems;
- This project may also act as a catalyst to the formation of similar projects at other landfills in Ukraine;
- Production of 12 GWh/year of electricity;

7.5. Relevance for Host Country Socioeconomic and Environmental Priorities:

The project will have positive impacts including improvement of the local environmental situation by reducing air pollutant emissions (due to reduction of electricity production in energy system) and creation of new jobs. Negative effects are not expected. Proposed project is therefore compatible with national economic development, socio-economic and environment priorities and strategies. Landfill gas is determined as “alternative fuel” according to the Law of Ukraine “On alternative types of liquid and gas fuel” (N 1391-XIV of 01/14/2000), and administrative support is promised to projects on LFG plants implementation.

APPENDIX B: CO_2 EMISSION FACTORS FOR FUELS

TABLE: CO_2 EMISSION FACTORS FOR FUEL COMBUSTION

Fuel type	*Emission Factors, t CO_2 / TJ*
Crude Oil	72.6
Natural Gas Liquids	62.436
Gasoline	68.607
Jet Kerosene	70.785
Kerosene	71.148
Gas/Diesel Oil	73.326
Residual Fuel Oil	76.593
Lubricants	36.667
Steam Coal	92.708
Lignite	96.14
Peat	100.67
Coal Oils and Tars	91.762
Coke	106.00
Coke Gas	55.73
Natural Gas (Dry)	55.8195
Solid Biomass	98.67

APPENDIX C: PRE-SELECTED LIST OF POTENTIAL JI PROJECTS FOR CONSIDERATION

#	*Sector*	*Category*	*Title of the project*	*Investment, thousand USD*	*CO_2 reduction over life time, t*	*Cost* of emission avoided, USD per t CO_2 eq.*	*NPV at 20%, thousand USD*	*IRR, %*
1	Energy sector (coal)	Gas capture	Komsomolets -Donbassa mine methane capture and utilization	49 373	57 700 000		28 101	24.9%
2	Energy sector (coal)	Gas capture	Skochinsky mine methane capture and utilization	51 895	4 400 626	3.46	5 476	26%
3	Power sector	Renewable energy	Rehabilitation of Xrinitska hydropower plant (0.8 MW)	120	73 000		407	38%
4	Power sector	Energy efficiency	Co-generation on Poltava medical glass factory (3 MW)	1 500	446 300		1 202	21%
5	Power sector	Energy efficiency	Installation new steam turbines in existing boiler station at Tyre plant "Dniproshina" (12 MW)	5 600	990 659	2.68	538	22.5%
6	Power sector	Energy efficiency	Kachanov associated gas capture and utilization (Poltava region)	3 000	589 680	2.27	272	17.6%
7	Power sector	Renewable energy	Installation of Additional Wind Power at Novoazovsk (Donetsk oblast) and Tarkhankut (Autonomous Republic of the Crimea) Wind Plants	14 000	751 000	45.8	-442	6.8%
8	Power sector	Energy efficiency	Co-generation system on coke gas at Avdeevka coke plant (16 MW)	13 000	2 001 593	8.8	4 812	30.6%
9	Power sector	Energy efficiency	Co-generation system on coke gas at Bagley coke plant (12 MW)	2 922	1 182 000		5 194	32%
10	Power sector	Energy efficiency	Reconstruction of dust/coal power unit to be in line with modern foreign units at Trypillya thermal power plant (200MW)	290 000	5 463 400		-200 722	
11	Power sector	Energy efficiency	CHP installation at the VOZKO plant (2 MW)	1 230	184 600		685	18.5%
12	Industry	Energy efficiency	Heat recovery for ventilation of main production building (Rosava tyre plant)	3 401	322 290	7.5	-491	15.7%
13	Industry	Renewable energy	Implementation of steam wood fired 2 MWboiler at Teterevskiy State experimental-production timber industry enterprise	506	70 490		-1	10%

14	Agriculture	Renewable energy	Implementation of 110 kW_e+220 kW_{th} CHP biogas plant in cattle breeding farm	498	111 050		64	11.8%
15	Households	Renewable energy	Utilization of wood as a fuel for district heating plant of 1.4 MW_{th} in Kiev	338	21 994		129	15.3%
16	Households	Renewable energy	Implementation of 2 MW_e power plant operating on landfill gas at Lugansk landfill	1 512	1 396 080	0.86	-246	15.6%
17	Agriculture	Renewable energy	Implementation of 280 kW_e+560 kW_{th} CHP biogas plant in pig breeding farm	1 040	292 620	6.7	-398	9.2%
18	Industry	Renewable energy	Implementation of wood fired boiler of 1.5 MW_{th} capacity at Belichskiy wood processing plant	443	50 400		78	11.4%
19	Transport	Renewable energy	Construction of new biodiesel production enterprise (Kyiv)	6 100	544 000		2 655	16%
20	Agriculture	Renewable energy	Utilization of biogas and fertilizers from cattle waste in Poltava Oblast	1 000	19 400		637	19.4%
21	Industry	Industrial processes	Modernization of smelter to improve operating efficiency at the "Zaporizhzhiya Aluminium Enterprise”	200 000	9 984 817	8.68	-16 162	17.8%
22	Households	Renewable energy	Boiler transformation from coal to wood waste for heating in Carpathian Region	60	42 275		178	46%
23	Households	Energy efficiency	Installation of new energy efficiency pumps on Dniprovska Waterworks	3 647	1 117 558	6.38	1 447	30.2%
24	Households	Energy efficiency	Installation of new energy efficient pumps on Desnianska Waterworks	9 777	2 564 959	4.3	2 234	26%
25	Households	Energy efficiency	District heating system rehabilitation in Vinnitsa city	35 800	1 372 560	3.7		13%
26	Forestry	afforestation	Afforestation in Kharkiv region (5 000 ha)	564 600	941	2.5		
27	Forestry	afforestation	Afforestation in Mikolaijv region (5 000 ha)	1 500	1 500			
28	Forestry	afforestation	Afforestation in Lugansk region (5 000 ha)	1 500	1 500			
29	Forestry	afforestation	Afforestation in Kyiv region (5 000 ha)	1 500	1 500			
30	Forestry	afforestation	Affores tation of 61 700 ha of unusable and radioactive contaminated lands in Rivne region	200				