JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

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Coal Mine Methane Capture and Utilization at Holodnaya Balka Mine in Donetsk Oblast
Version – 2, Feb,9,2007

A.2. Description of the project:

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The proposed project includes improvement of coal mine methane (CMM) drainage system and utilization of CMM at Holodnaya Balka Mine through installation of a combined heat and power plant (CHP), and flare system. The proposed project is environmentally sound, resource-saving, and provides reduction of greenhouse gas (GHG) emissions. Moreover, the project will provide additional benefits such as mine's economic efficiency, labour protection and safety, and stimulus for initiation of similar projects at other similar coal mine sites.

A.3. Project participants:

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Party involved	Legal entity project participant (as applicable)	Project participant if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host Party)	Private Scientific and Industrial Company "Sinapse"	Yes
	State Enterprise "Makeyevugol"	
	State Joint Stock Company "Holodnaya Balka"	
	Ministry of Coal Industry of Ukraine	
	Scientific Engineering Centre "Biomass"	
Japan	The Chugoku Electric Power Co., Inc.	No
	Shimizu Corporation	

1) Private Scientific and Industrial Company "Sinapse"– project owner, and project implementation entity. PS&IC "Sinapse" possesses experience in the implementation of similar type of project. The company is an authorized representative of GE Jenbacher in Ukraine - producer of CMM utilization equipment;
2) State Enterprise "Makeyevugol" – Legal entity, the Ukrainian state-owned coal mine association, to which Holodnaya Balka coalmine is subordinated. The SE "Makeyevugol" itself is subordinated to the Ministry of Coal Industry of Ukraine;
3) State Joint Stock Company "Holodnaya Balka" – structural unit of SE "Makeyevugol", a coal mining enterprise;
4) Ministry of Coal Industry of Ukraine – governmental body, which determines the coal sector policy in the host country, manages all state-owned Ukrainian coal mine associations, mines, and coal processing facilities;
5) Scientific Engineering Centre "Biomass"– private consulting company, involved in the JI project development;
6) The Chugoku Electric Power Co., Inc. – Japanese Power Company pursuing implementation of the project, participates in preparation of the JI project, and project financing. The company acquires a share of ERUs;
7) Shimizu Corporation – Japanese general construction and engineering firm pursuing project

implementation, participates in project financing and acquires the remaining share of ERUs.

A.4. Technical description of the project:

A.4.1. Location of the project:

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A.4.1.1. Host Party(ies):

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Host country: Ukraine

A.4.1.2. Region/State/Province etc.:

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Donetsk Oblast

A.4.1.3. City/Town/Community etc.:

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Makeyevka City

Figure A-1. Map of Ukraine, indicating Holodnaya Balka Mine

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

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Holodnaya Balka mine property is located in the central section of Donetsk and Makeyevka geological and industrial district, within the city limits of Makeyevka (population > 400,000), which is a major industrial center. The mine's property is situated on the southern slope of the main Donetsk watershed, on the right, and partly on the left slope of the Gruzskaya River, which is a tributary of the Calmius River. The surface area is a prairie-type flatland that is crisscrossed by multiple ravines, or «balkas» in Ukrainian, hence the name of the mine. Elevation ranges from 234 meters above sea level in the northern section of the property to 124 meters in the valleys of the ravines. Total mine's area is 55.56 km^2.

Holodnaya Balka mine possesses CMM degasification system, which includes Vacuum Pump Station (VPS), approximately 9 km of underground degasification pipelines, sets of underground boreholes for methane suction connected with major degasification pipelines by flexible pipes.

Currently, degasification system of Holodaya Balka mine provides CMM flow from the underground boreholes through degasification pipelines to VPS, where CMM moisture is removed, methane concentration and gas flow rate are measured. Afterwards, part of CMM transferred from VPS to mine's boiler house for hot water and heat production, while the remaining part of CMM is released to the atmosphere.

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

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The technology to be applied in the project is represented by a CHP unit suitable for CMM consumption, and flare system.

Combined Heat and Power (CHP)

The CHP consists of a gas engine, generator, heat exchanger, control panel, system inter-connection line and instrumentation that allow stable operation even when using sparse methane gas with fluctuant density or composition such as CMM. The gas engine will have generating efficiency of 40.8%, equivalent to or better than the conventional types of steam turbines that currently used by generating companies in Ukraine. In addition, high-level technology will be needed for a stable operation of gas engine using sparse gas fuel with fluctuant density or composition, like CMM. The following table indicates main specifications of the CHP planned for the project.

It is anticipated that CHP will be installed with installed electric capacity around 1 MW. When the installed CHP is not in operation due to maintenance or whatever reason, only flaring system will be operating.

Table A-1. Basic Specifications of gas-reciprocating module JMC 320

Mine gas (25÷100% CH_4), 1500 rpm (50 Hz)

NO_X emission level	Electric power, kW_{el}	Electric efficiency, %	Thermal power, kW_{th}	Thermal efficiency, %	Total efficiency, %
500 mg / Nm^3	1,063	40.8	1,140	43.7	84.5

Source: PS&IC Sinapse

Electricity generation on low calorific gases has been applied in many European countries. These technologies have a proved record of effective energy use. Thus, it is unlikely that they will be superseded by other superior technology during the project period.

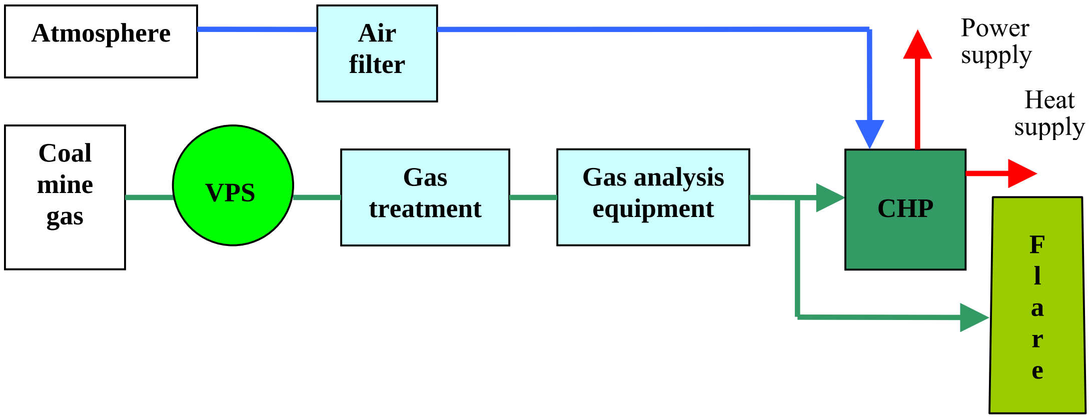

Figure A-2. Schematic view of the CMM collection and treatment system.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

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The specific project framework is summarized below:

- Holodnaya Balka mine (the mine) possesses obsolete methane draining system, which consists of underground pipeline network and a vacuum pump station on the surface. This draining system currently captures CMM that is partially consumed by mine's boiler house, while the remaining part of CMM is emitted to the atmosphere. This practice has prevailed for more than 10 years;
- The mine neither captures nor uses CBM or PMM;
- The mine does not possess equipment for utilization of all captured CMM due to the lack of public funds and investments in coal sector;
- There is no national, local or sectoral legislation requiring compulsory collection and utilization of CMM at Ukrainian mines. Existing methane draining system at Holodnaya Balka mine was installed only for safety reasons;
- CMM combustion has never been a common practice in Ukraine's coal sector;
- Electricity produced on CMM by CHP will reduce power consumption by the end-user (the mine). Ukrainian thermal power plants that primarily consume coal operate on the margin. Thus GHG emissions related to the grid and power transportation losses in the grid will be reduced;
- Project implementation requires substantial financing and implementation expertise. Coal mine association, to which Holodnaya Balka Mine belongs, lacks both financial resources and qualified staff to implement and service the CHP on CMM. The proposed technology has never been applied at Ukraine's state-owned mines. Currently, only PS&IC Sinapse possesses relevant experience and expertise in Ukraine, who has been authorized a project owner;
- Considering economic situation in the sector and other above mentioned factors it is very unlikely that any advanced technology will be applied at the project mine site in addition to existing boiler house. Thus, it is very likely that current practice will continue if project is not applied. No reduction of methane emissions will occur. Detailed explanation of why BAU is the most probable scenario representing the baseline is provided in Section B "Application of a baseline methodology".

A.4.3.1. Estimated amount of emission reductions over the crediting period:

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Length of the crediting period	5 years (1 January 2008 – 31 December 2012)
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2008	49,899
Year 2009	49,747
Year 2010	49,596
Year 2011	49,445
Year 2012	49,294
Total estimated emission reductions over the crediting period (tones of CO_2 equivalent)	247,981
Annual average of estimated emission reductions over the crediting period/period within which ERUs are to be generated (tones of CO_2 equivalent)	49,596

A.5. Project approval by the Parties involved:

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The project has been officially approved by the Government of Japan. Ukrainian Government requires project to be determined before approval.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

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ACM0008 "Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical and motive) and heat and/or destruction by flaring" version 03 approved by CDM Executive Board on 22 December 2006.
URL: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html
Approved consolidated baseline methodology ACM0008.

The following tables B-1 and B-2 explain the reason why the methodology applies to this project:

Table B-1 Comparison of proposed extraction activities with applicability of the methodology

ACM0008 Applicability	Proposed extraction activities
surface drainage wells to capture CBM associated with mining activities	Yes
underground boreholes in the mine to capture pre mining CMM	Yes
surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM	Yes
Ventilation CMM that would normally be vented	Yes

Table B-2 Comparison of proposed CMM utilization activities with applicability of the methodology

ACM0008 Applicability	Proposed CMM utilization activities
The methane is captured and destroyed through flaring	Included
The methane is captured and destroyed through utilization to produce electricity, motive power and/or thermal energy; emission reductions may or may not be claimed for displacing or avoiding energy from other sources	Included
The remaining share of the methane to be diluted for safety reason may still be vented	Part of CMM is still vented in the proposed project
All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented	Compliance with applicability

Besides the applicability, ACM0008 also defines the types of activities that could not be applied for this methodology. The proposed project does not involve any of those activities. (Table B-3)

Table B-3 Comparison of proposed project with inapplicable activities stated in the methodology

ACM0008 Applicability	Proposed project activities
Operate in open cast mines	Underground operated coal mine
Capture methane from abandoned/decommissioned coalmines	Both coal production and CMM extraction are under way in the coal mine
Capture/use of vitgin coal-bed methane, e.g. methane of hibh quality extracted from coal seams	Extraction activities are concomitance with coal production

independently of any mining activities	
Use CO2 or any other fluid/gas to enhance CBM drainage before mining takes place	No other gas or liquid except for air is added for CMM extraction

The applicable conditions, key assumptions, scope of data, data source in the methodology fit the project. The methodology is certain to lead to a transparent and conservative estimate of the emission reduction of the project activity.

The "Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical and motive) and heat and/or destruction by flaring" is applied to the Holodnaya Balka Coal Mine in accordance with following steps:

1. Identification of the baseline scenario
2. Calculation of emissions reductions

1. Identification of the Baseline Scenario

Step 1. Identify technically feasible options for capturing and/or using CMM

Step 1a. Options for CMM extraction

Possible options technically feasible to capture CMM and comply with safety regulations could include:
A. Ventilation air methane;
B. Pre mining CMM extraction including CBM to Goaf drainage and/or Indirect CBM to Goaf only;
C. Post mining CMM extraction;
D. Possible combinations of options A, B, and C with the relative shares of gas specified.

Extraction of methane through option A (ventilation air methane) alone does not provide enough relief to working conditions at the mine face to ensure safety. Options B (pre mining CMM), and C (post mining CMM) are never utilized as a stand-alone remedies for reducing methane emission from coal mines or stand-alone method to ensure the mining safety. In addition, low permeability coals in the mining area prohibit option B from being technically feasible. Therefore, option D is the only technically feasible option for CMM extraction.

The current situation for methane extraction at the Holodnaya Balka Coal Mine is a combination of option A and B (see Table B-4). The proposed project activity not undertaken as a JI project activity will increase the drainage efficiency about 20% (according to mine's engineers). But during the crediting period, the proposed project will not involve any CBM drainage.

Table B-4 CMM of Current Situation and Proposed project Activity

Current Situation		Proposed project Activity	
Ventilation CMM	Drainage CMM	Ventilation CMM	Drainage CMM
60%	40%	60%	40%

Step 1b. Options for extracted CMM treatment

The CMM treatment options at the Holodnaya Balka Coal Mine could include the following:
i. Venting;
ii. Using/destroying ventilation air methane rather than venting it;
iii. Flaring of CMM;
iv. Use for additional grid power generation;
v. Use for additional captive power generation;

vi. Use for additional heat generation;
vii. Feed into gas pipeline (to be used as fuel for vehicles or heat/power generation);
viii. Possible combinations of options i to vii with the relative shares of gas treated under each option specified which is the component of the proposed project not undertaken as a JI project.

Step 1c. Options for energy production
Besides energy production options iv, v, vi, vii in Step 1b, energy could be generated as regional grid electricity (electricity generation in fossil fuel fired power stations in the regional grid), coal fired residential usage and coal fired boilers.

Step 2. Eliminate baseline options that do not comply with legal or regulatory requirements
All options are comply with Ukrainian regal or regulatory requirements. (There is no low or regulation that would restrict any of there options. Only if construction in implied than Sanitary norms and regulations must be met and projects have to be reconciled with pertinent authorities (e.g. fire department, etc))

Step 3. Formulate baseline scenario alternatives
Alternatives for CMM extraction include:
Alternative Scenario A
A combination of CMM ventilation via ventilation fans, underground boreholes and post mining CMM drainage galleries. In average, ventilation air methane would be of 60% of total volumes. This is the continuation of the current CMM extraction practice.

Alternative Scenario B
New in-mine drainage boreholes, surface drilling for CBM extraction, improvement of the extraction system gathering lines, construction and low quality and high quality drained gas streams segregation will be in place to guarantee a minimum methane concentration of drained gas at 30-40%. This is the proposed project not implemented as a JI project.

Total extracted CMM volume will not change at any baseline scenario.

Alternatives for CMM treatment includes:

Alternative Scenario i
One possible baseline scenario for CMM treatment is to continue current methane ventilation and drainage practices at the coal mine. In this case, some part of methane is vented to the atmosphere. The coal mine will continue purchasing power from the grid.

Alternative Scenario ii
This scenario includes use and/or destruction of VAM (methane concentration at < 0.5%) at the coal mine. In this case technologies such as thermal or catalytic oxidation or lean fuel gas turbines must be applied.

Alternative Scenario iii
Recovered CMM may simply be destroyed through flaring. While this option has not gained widespread acceptance in the coal mining community, it has been successfully demonstrated in two industrialized countries: Australia and the United Kingdom.

Alternative Scenario iv
Recovered CMM could be combusted in reciprocating engines or gas turbines that generate electricity for the local grid.

Alternative Scenario v
Recovered CMM could be combusted in reciprocating engines or gas turbines that generate electricity for use directly at the coal mine.

Alternative Scenario vi
Recovered CMM could be combusted in gas boilers to produce additional thermal energy or heat at the coal mine. This thermal energy could be in form of hot water, hot air, or steam.

Alternative Scenario vii
A gas purification plant could be constructed at the coal mine and all of the CMM recovered could be processed and gas sold to the natural gas pipeline grid or to be used as fuel for vehicles, if one is nearby and accessible. Generally, high pressure natural gas pipeline specifications require delivered gas to be >99.5% CH_4. A similar alternative would be to supply gas to a local pipeline for residential or commercial use. The low pressure-type system usually requires the delivered gas to be >99.5% CH_4.

Alternative Scenario viii
Recovered CMM will be utilized in alternative scenario i, v and vi. No CBM will be involved here. This is the proposed project activity not implemented as JI. In this scenario, power used at the coalmine would be from the grid. Combination of non-feasible options is a non-feasible option.

Step 4. Eliminate baseline scenario alternatives that face prohibitive barriers

Several barriers would prevent the identified baseline scenario alternatives to occur in the absence of the JI. In the following steps, we will assess the identified baseline alternative scenarios in CMM extraction and treatment phase.

Considering the alternatives for CMM extraction:

Alternative Scenario A
This is the BAU scenario. No barrier exists for this alternative.

Alternative Scenario B
New in-mine drainage boreholes, surface drilling for CBM extraction, improvement of the extraction system gathering lines, and low quality and high quality drained gas streams segregation will be in place to guarantee a minimum methane concentration of drained gas at 30-40%. This alternative faces the following barriers:

Technological barriers
Development, operation, and maintenance of the proposed CMM extraction improvement strongly requires the technology and experience in reservoir engineering, drilling and gas production, while all coal mines in Ukraine lack such conditions. Surface goaf well is a very advanced technology for CMM extraction from such low permeability and complex geological condition area for improving the gas quality to accommodate utilization projects. Obviously the initial stage of the gas extraction from them will face a lot of difficulties.

Investment barriers
The improvement of CMM drainage system mainly relies on investment from coal mine association SE "Makeyevugol". However, since the reason of CMM drainage is ensuring safe working conditions at coalmine, as long as the current drainage practice can fulfil the coal production's requirements, no coalmine would put investment on new and innovative CMM extraction simply because it conflicts with the major business activity – coal production. Surface drilling for CBM production also requires investments, which are scarce in the coal sector.

Prevailing practice barriers
Surface-drilled goaf well technology is rarely used by Ukraine's coalmines. Geological conditions and coal seam permeability influence the drilling process and drainage effect from the drilled goaf well. SE "Makeyevugol" is recognized as one of most difficult mining area for gas drainage and surface drilling because of its high methane content, while extremely low coal seam permeability with extremely complex geological condition areas. Commercial scale surface-drilled goaf wells had never been implemented in such difficult mining areas in the country. Considering the above mentioned, it can be determined that a serious barrier prohibits this alternative to be implemented.

Since we have determined that alternative scenario B in CMM extraction phase should be eliminated due to many existing barriers, we will only consider those CMM treatment alternatives under CMM extraction alternative scenario A. A barrier analysis is conducted below on them.

Barriers that are specific to alternative scenario i, ii, iii, iv, v, vi, vii and viii are as follows:
Alternative Scenario i
BAU, no barriers exist.

Alternative Scenario ii
There are no coal mines using and/or destroying of VAM in Ukraine. Installing VAM utilization system requires heavy investment and high technologies. The coal mines in Ukrainian are lack of them.

Alternative Scenario iii
Because this option does not utilized the energy potential of CMM, it does not address the energy shortage issues that exist in Ukraine, particularly with the use of clean burning gas. Much of the CMM will be vented to the atmosphere since flaring requires methane concentrations above 25%. Flaring also requires additional cost without any revenue can be created. It has been successfully demonstrated in two industrialized countries: Australia and the United Kingdom. So obviously, it faces barriers from investment, technology and prevailing practice. Finally, the flaring of methane at coal mines is not viewed favourable by workers underground due to the additional risk of fire and explosion.

Alternative Scenario iv
Power reciprocating engines require stable amount and high concentrations of methane. – The reciprocating engines produced in Ukraine (e.g. Pervomajskdieselmash) or Russian can only work on natural gas (>95% of methane), while some European companies (GE Jenbacher) produce gas engines that can consume gases with methane content > 25%. The average methane concentration at Holodnaya Balka Coal Mine of 2001 to 2005 is about 33%. As power generators require stable methane amount and concentrations, it is hard to operate. In addition, the capital cost will be huge. Without the technical and financial assistance from JI, such investment in Ukraine is obviously not feasible.
There is one coal mine which installed CHPs Plant in Ukraine using. JI scheme. Thus this scenario is not common in Ukraine.

Alternative Scenario v
Same as above.

Alternative Scenario vi
The Holodnaya Balka Coal Mine already has a boiler house and supplies necessary hot water, hot air and steam. Thus production of additional heat requires additional cost without any revenue can be created.

Alternative Scenario vii
The capitalization of a purification plant, large storage tanks and pipeline would not occur without a guaranteed quantity and quality of CMM that would justify investment in such an activity. A study of the

average monthly methane concentrations of the CMM produced at Holodnaya Balka Coal Mine indicates that this option faces huge technological barriers improving the current gas collection system to provide such guarantees. Without the technical and financial assistance from JI, such utilization option in Ukraine is obviously not feasible.

Alternative Scenario viii
The alternative scenario is the combination of some of the options above. Many barriers exist in Holodnaya Balka Coal Mine due to the extreme low coal seam permeability and low concentration methane drainage. Therefore, this scenario is not a plausible scenario alternative without JI.

The identified barriers described above would prevent the implementation of alternative scenario B in CMM extraction stage. Under alternative scenario A, options ii, iii, iv, v, vii and viii at CMM treatment stage will face tremendous barriers. As a result, only the venting with the continue CMM drainage and ventilation, which is the current BAU scenario, is the only plausible baseline scenario candidates if without JI assistance.

2. Calculation of emissions reductions
The emissions reductions created from the project is the net difference between the baseline emissions and the project emissions for a given year. In order to calculate the difference, the baseline and project emissions must first be determined.

2.1 Project Emission

According to ACM0008/Version 03 Equation (1), project emissions are defined in Equation (B1.1).

$PE_y = PE_{ME}+PE_{MD}+PE_{UM}$ (B1.1)

Where:

PE_y - Project emissions in year y (tCO_2e)
PE_{ME} - Project emissions from energy use to capture and use methane (tCO_2e)
PE_{MD} - Project emissions from methane destroyed (tCO_2e)
PE_{UM} - Project emissions from un-combusted methane (tCO_2e)

2.1.1. Combustion emissions from additional energy required for CMM capture and use

Project emissions, which are generated from the use of energy for capturing and utilizing methane emitted in the project, are defined in ACM0008/Version 03 Equations (2) to (B1.2). Additional heat consumption $CONS_{HEAT,PJ}$ and additional fossil fuel consumption $CONS_{FOSSFUEL,PJ}$ for capturing and utilizing methane have been deleted from ACM0008/Version 03 Equation (B1.2). However, in the proposed project, the existing system for heat and fossil fuel would be used and the project activity does not need additional heat or fossil fuel, there is no additional heat or fossil fuel consumption. Regarding with additional electricity consumption, the project activity needs the Gas Treatment System and, for the operation of it, 10kW compressor will be installed.

$PE_{ME} = CONS_{ELEC,PJ} *CEF_{ELEC}$ (B1.2)

Where:

PE_{ME} - Project emissions from energy use due to capture and use of methane (tCO_2e)
$CONS_{ELEC,PJ}$ - Additional electricity consumption for capture and use of methane, if any (MWh)
CEF_{ELEC} - Carbon emission factors for electricity grid applicable to Ukraine(tCO_2e/MWh)

2.1.2. Combustion emissions from use of captured methane

Project emissions from destructed methane are defined in ACM0008/Version 03 Equation (3) to (B.1.3). Incidentally, methane that is destructed after being supplied to the gas grid or used in vehicles, i.e. MD_{GAS}, has been deleted from ACM0008/Version 03 Equation (3) because corresponding equipment does not exist.

$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT} +) * (CEF_{CH4} + r * CEF_{NMHC})$ (B.1.3)

With:

$r = PC_{NMHC} / PC_{CH4}$ (B.1.4)

Where:

- PE_{MD} - Project emissions from CMM/CBM destroyed (tCO_2e)
- MD_{FL} - Methane destroyed through flaring (tCH_4)
- MD_{ELEC} - Methane destroyed through power generation (tCH_4)
- MD_{HEAT} - Methane destroyed through heat generation (tCH_4)

- CEF_{CH4} - Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
- CEF_{NMHC} -Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_2eq/tNMHC$)
- r - Relative proportion of NMHC compared to methane
- PC_{CH4} - Concentration (in mass) of methane in extracted gas (%)
- PC_{NMHC} - NMHC concentration (in mass) in extracted gas (%)

$MD_{FL} = MM_{FL} - (PE_{flare}/GWP_{CH4})$ (B.1.5)

Where:

- MD_{FL} - Methane destroyed through flaring (tCH_4)
- MM_{FL} - Methane measured sent to flare (tCH_4)
- PE_{flare} - Project emissions from flaring of the residual gas steam (tCO_{2e})
- GWP_{CH4} -Global warming potential of methane (21tCO2e/tCH4)

$MD_{ELEC} = MM_{ELEC} * Eff_{ELEC}$ (B.1.6)

Where:

- MD_{ELEC} - Methane destroyed through power generation (tCH_4)
- MM_{ELEC} - Methane measured and sent to CHP (tCH_4)
- Eff_{ELEC} - Efficiency of methane destruction/oxidation in CHP (taken as 99.5% from IPCC)

$MD_{HEAT} = MM_{HEAT} * Eff_{HEAT}$ (B.1.7)

Where:

- MD_{HEAT} - Methane destroyed through heat generation (tCH_4)
- MM_{HEAT} - Methane measured sent to heat plant (tCH_4)
- Eff_{HEAT} - Efficiency of methane destruction/oxidation in heat plant (taken as 99.5% from IPCC)

2.1.3. Un-combusted methane from flaring and uses

Project emissions of non-combusted methane are defined in ACM0008/Version 03 Equation (9) to Equation (B.1.8). Incidentally, the measured amount of methane MM_i used for the objective of i in ACM0008/Version 03 Equation (9) shall be the measured amount of methane MM_{FL} sent to the flare stack, the measured amount of methane MM_{ELEC} sent to the power plant, and the measured amount of methane MM_{HEAT} sent to the heat generating plant.

$$PE_{UM} = GWP_{CH4} * [MM_{ELEC} *(1-Eff_{ELEC}) + MM_{HEAT} * (1-Eff_{HEAT})] + PE_{flare} \quad (B.1.8)$$

Where:

PE_{UM} - Project emissions from un-combusted methane (tCO_2e)
GWP_{CH4} - Global warming potential of methane (21 tCO_2e/tCH_4)
MM_{ELEC} - Methane measured sent to CHP (tCH_4)
Eff_{ELEC} - Efficiency of methane destruction/oxidation in CHP (taken as 99.5% from IPCC)
MM_{HEAT} - Methane measured and sent to heat plant (boiler house) (tCH_4)
Eff_{HEAT} - Efficiency of methane destruction/oxidation in heat plant (boiler house) (taken as 99.5% from IPCC)
PE_{flare} - Project emission from flaring of the residual gas stream (tCO_{2e})

2.2 Baseline Emissions

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad (B.2.1)$$

Where:

BE_y - Baseline emissions in year y (tCO_2e)
$BE_{MD,y}$ - Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_2e)
$BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)
$BE_{Use,y}$ - Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO_2e)

2.2.1. Methane destruction in the baseline

$$BE_{MD,y} = (CEF_{CH4} + r*CEF_{NMHC}) *CMM_{BLth,y} \quad (B.2.2)$$

Where:

$BE_{MD,y}$ - Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_2e)
$CMM_{BL,th,y}$ - Pre-mining CMM that would have been captured and destroyed by thermal demand in the baseline scenario (tCH_4)
CEF_{CH4} - Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
CEF_{NMHC} - Carbon emission factor for combusted non methane hydrocarbons (varies, and should be obtained through periodical analysis of captured methane) ($tCO_2eq/tNMHC$)
r - Relative proportion of NMHC compared to methane

With:

$r = PC_{NMHC} / PC_{CH4}$
PC_{CH4} - Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC} - NMHC concentration (in mass) in extracted gas (%)

Furthermore, $CMM_{BL,th,y}$ is obtained from ACM0008/Version 03 Equation (12). Since ACM0008/Version 03 allows “Use of monthly data in cases where daily measured data cannot be utilized,” use of monthly data shall be assumed in the project because daily data are not available.

$$CMM_{BL,th,y} = \sum_{k=1}^{12} TH_{BL,th,y} \quad (B.2.3)$$

Where:

$CMM_{BL,th,y}$ - Pre-mining CMM that would have been captured and destroyed by thermal demand in the baseline scenario (tCH_4);
$TH_{BL,k,y}$ - Methane used to serve estimated thermal energy demand in the baseline for month k in year y;
TH - index for thermal use of CMM in the baseline, which includes on-site consumption.

$$TH_{BL,k} = (TH_{BL,y}/12)*d^{max}_k \quad (B.2.4)$$

Where:

$TH_{BL,y}$ - Projected annual baseline thermal demand for year y (tCH_4)
d_k - Scalar adjustment factor for month k to reflect seasonal variations, such that $\Sigma d_k=12$
d^{max}_k - maximum scalar adjustment factor for month k over the 5 years prior to the start of the project (i.e. $\Sigma d^{max}_k >12$)

The above contents can be arranged according to Equations (B.2.2), (B.2.3) and (B.2.4).

$$BE_{MD,y} = (CEF_{CH4}+r*CEF_{NMHC}) * \sum_{k=1}^{12}(TH_{BL,y}/12)d^{max}_k \quad (B.2.5)$$

In order to account for methane in the monthly fluctuation in CMM demand, the maxim scalar adjustment factor (d^{max}_k) is calculated based on 5-years monthly historical CMM demand data of all various end users.

2.2.2. Methane released into the atmosphere

Baseline atmospheric emissions of methane that are prevented by the project activities in year y are defined in ACM0008/Version 03 Equation (14) to Equation (B.2.6). Incidentally, since CBM and PMM in ACM0008/Version 03 Equation (14) are not pertinent to the project, the related equations are omitted.

$$BE_{MRy} = GWP_{CH4} * \Sigma_{k=1}^{12} (CMM_{Pj,i,y} - CMM_{BLi,y}) \quad (B.2.6)$$

Where:

$BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)
i - Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses)
$CMM_{PJ,i,y}$ - Pre-mining CMM captured, sent to and destroyed by use *i* in the project in year y (expressed in tCH_4)
$CMM_{BL,i,y}$ - Pre-mining CMM that would have been captured, sent to and destroyed by use *i* in the baseline scenario in year y (expressed in tCH_4)
GWP_{CH4} - Global warming potential of methane (21 tCO_2e/tCH_4)

Since $CMM_{BL,i,y}$ only indicates the portion of combusted methane by boiler house in the project scenario, this shall be treated as $CMM_{BL,th,y}$, and moreover (E 2.3) shall be substituted.

$$BE_{MRy} = GWP_{CH4}*[(CMM_{PJ,FL,y} + CMM_{PJ,ELEC,,y}+ CMM_{PJ,HEAT,,y}) - \sum_{k=1} (TH_{BL,y}/12)d^{max}_{k}] \quad (B.2.7)$$

2.2..3 Emission from power/heat generation replaced by project

Total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO_2) is defined by following expression based on expression (22), (24), of ACM0008/Version 03. In addition, terms related to CBM and PMM defined by ACM0008/Version 03 are ignored since they are not applicable.

$$BE_{Use,y} = GEN_y * EF_{ELEC} + HEAT_y * EF_{HEAT} \quad (B.2.8)$$

Where:

- $BE_{Use,y}$ - Total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO_2)
- GEN_y - Electricity generated by project activity in year y (MWh), including through the use of CBM
- EF_{ELEC} -Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh). Source: IPCC.
- $HEAT_y$ - Heat generation by project activity in year y (GJ)
- EF_{HEAT} -Emissions factor for production replaced by Project activity (tCO_2/GJ).

2.2..3.1 Combination of Grid power emission factor

Grid power emission factor and captive emission factor in year y is defined by following expression based on express (29) of ACM008/Version 03. However, a captive power generation is not in Holodnaya Balka Mine. Term related to captive power defined ACM0008/Version 03 are ignored since they are not applicable.

$$EF_{ELEC,y} = S_{grid} * EF_{grid,y} \quad (B.2.9)$$

Where:

- $EF_{ELEC,y}$ -Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh). Source: IPCC.
- $S_{grid,y}$ -Share of facility electricity demand supplied by grid imports (100%)
- $EF_{grid,y}$ -CO_2 Emissions factor for the captive emission factor for the grid electricity displaced due to the project activity during the year y [1](tCO_2/MWh).

2.2..3.2 Heat generation emission factor

The baseline scenario includes heat generation (either existing or new) that is replaced by the project activity, the Emission Factor for displaced heat generation is calculated as follows:

---

[1] *** Grid CO_2 emission factors** for the period 2000-2012 for Ukraine's electricity generating sources originate from the IPCC publication referenced by the 'Annex2 Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of operational Guidelines for PDD's of JI projects, *Volume 1: General guidelines*, *Version 2.3*, Ministry of Economic Affairs of the Netherlands, May 2004'.

It is impossible to use ACM0002 methodology for carbon emission factor calculations for due to the unavailability to project developers of necessary information needed to use this methodology. Thus, default numbers calculated by IPCC and recommended by ERUPT PDD Guidelines were used.

$EF_{heat,y}$ =($Ef_{CO2,j}$/Effheat)*(44/12)*(1TJ/1000GJ) (B.2.10)

Where:

$EF_{heat,y}$ -Emission factor for heat generation (tCO_2/GJ)
EF_{CO2} -CO2 emission factor of fuel used in heat generation (t/TJ)
Eff_{heat} -Boiler efficiency the heat generation (t/TJ)
44/12 -Carbon to Carbon Dioxide conversion factor
1/1000 –TJ to GJ conversion factor

As a conservative approach, the boiler efficiency for the proposed project Eff_{heat} is taken as 100% based on the net calorific value.

2.3 Leakage

The leakage of a JI project emissions may be a result of:

1. Displacement of baseline thermal energy uses
2. JI drainage from outside the de-stressed zone
3. Impact of JI project activity on coal production
4. Impact of JI project activity on coal prices and market dynamics.

Considering the proposed project:

1. Baseline thermal energy demand fall into "Where regulations require that local thermal demand is met before all other uses, which is common in, then this leakage can be ignored."
2. No CBM drainage involves
3. No noticeable impact of JI Project activity on coal production since the baseline scenario is not ventilation only.
4. No reliable scientific information is currently available to assess the risk of impact of JI project on coal prices and market dynamics.

Therefore, no leakage effects need to be accounted for the proposed project.

2.4 Emission Reductions

The emissions reductions ensuing from the project are net difference between baseline emissions and project emissions for a given year.

The emission reduction *ERy* by the project activity during a given year *y* is the difference between the baseline emissions (*BEy*) and project emissions (*PEy*), as follows:

$$ER\,y = BE\,y - PEy \quad \text{(B.4.1)}$$

Where:

ERy emissions reductions of the project activity during the year *y* (tCO2e)
BE,y baseline emissions during the year *y* (tCO2e)
PEy project emissions during the year *y* (tCO2e)

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

>>

Application of additionality test to project activity

The baseline methodology indicates *The additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the Executive Board.*

Step 0. Preliminary screening based on the starting data of the project activity

Since the project is a JI undertaking, there are no plans for it to commence before December 31, 2007. Therefore, this step can be skipped.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations
ACM0008 indicate that *step 1 of the tool for the demonstration and assessment of additionality can be ignored*, therefore skip step1.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method:
For this project activity entitles related revenue from the sale of power in addition to ERU. Therefore, simple cost analysis (Option I) cannot be applied, this means that either investment comparison analysis (Option II) or benchmark analysis (Option III) is adopted. Here, Option III is adopted.

Sub-step 2b – Option III. Apply benchmark analysis:

Benchmark analysis complies with this step, and the most appropriate financial indicator in this case is internal rate of return (IRR). The IRR is a key indicator adopted by project investor. It can be influenced by perceived technical and/or political risk and by the cost of money. The IRR must exceed at least host country's discount rate. According to National Bank of Ukraine the discount rate for Ukraine is 8.5%, (Source: www.bank.gov.ua).

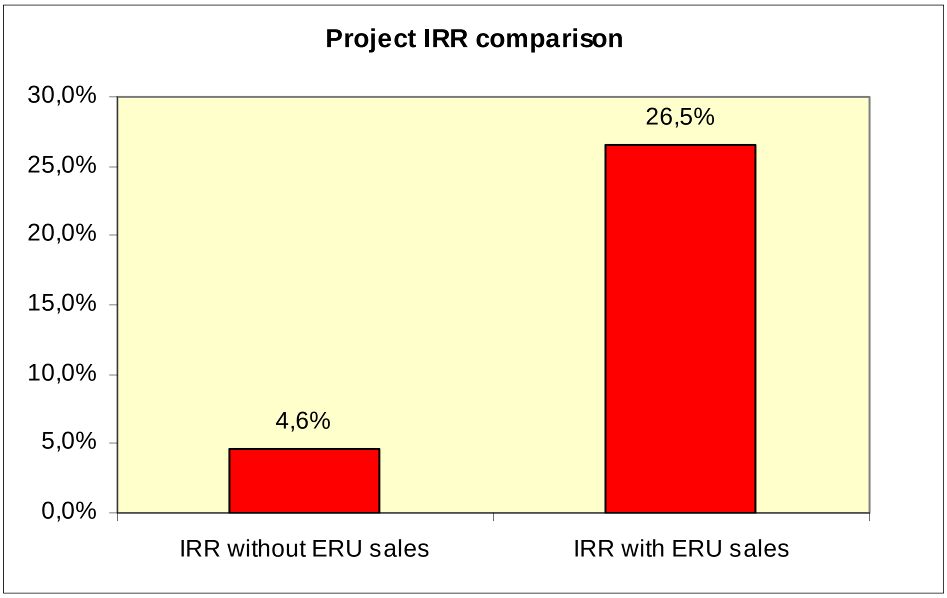


Figure B-1. Project IRR comparison.

Source: Feasibility study

As specified above, the project offers a 4.6% IRR, and 8 years simple pay back period. The results indicate that the proposed JI project is not financially attractive when compared to the benchmark value of 8.5%.

Sub-step 2c. Calculation and comparison of financial indicators:

The key determinants of the project economic analysis are capital cost, operating and fuel costs and the electricity tariff. Table B-5 presents key economic parameters of the project.

Table B-5. Key economic parameters of the project

Indicator	**Unit**	
Annual electricity generation	MWh	8,182
Electricity Sale Price	EUR/kWh	0.0416
Annual pure methane consumption by CHP	m^3	2,012,000

Indicator	**Unit**	**Overall Investment**
Preparation and construction works	EUR	382,260
Equipment, transportation, VAT, and custom fee	EUR	686,656
Flare system	EUR	195,911
Contingency expenses	EUR	126,483
Total	EUR	1,391,310

Sub-step 2d. Sensitivity analysis

In the case of the proposed project, the sales price of electricity, investment cost and operating cost for power generation are parameters that are the mot influential factors to the IRR calculation and with uncertainty. Therefore, the sensitivity analysis is preformed by raising and reducing these parameters from the assumption within the range of 15%.

Table B-6. IRR sensitivity analysis for the expected parameters

Sensitivity factors	**-15%**	**-10%**	**-5%**	**0%**	**5%**	**10%**	**15%**
Electricity price fluctuation	0.1%	1.7%	3.2%	4.6%	6.0%	7.4%	8.8%
Contingency costs fluctuation	4.9%	4.8%	4.7%	4.6%	4.5%	4.4%	4.3%
Operation and maintenance costs fluctuation	5.4%	5.2%	4.9%	4.6%	4.3%	4.1%	3.8%

From the calculation outcomes as shown in Table B-6, the IRR for the proposed project will vary to different degrees with these three uncertain elements. The electricity price is the most important factor affecting the IRR among the three major uncertain elements, though it is unlikely to change largely during the project period As a conclusion, the proposed project without ERU revenue is still not financially attractive enough considering this sensitivity analysis.

Step 3. Barrier analysis
Since Step 2 was implemented, Step 3 can be skipped.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:
There is only one example of CMM utilization under proposed technology in Ukraine, which is a similar project in Donetsk region. That project is being implemented under JI scheme, it do not cast any doubt on the additionality of this project.

Sub-step 4b. Discuss any similar options that are occurring:
There in no similar activities without JI scheme observed in Ukraine, Sub-step 4b can be skipped.

Step 5. Impact of JI registration

The JI incentives will result in real, measurable GHG emissions reductions in the coal mining sector in Ukraine. In addition, the financial benefits from the sale of the ERU will allow the project participants access to capital not otherwise available, attract new technologies to the region, and reduce the risk associated with future CMM recovery and utilization projects in Ukraine. Furthermore, JI incentives will help overcome project barriers mentioned above such that these types of CMM recovery and use projects may be replicated throughout the coal mine industry in Ukraine.

If the proposed project fails to approved and registered as a JI project, the expected consequences are:
- JI revenues in an important supplement to project revenues. Without it the project will much likely lead to cash flow crisis and project failure; and
- The proposed project faces high technological risk but lacks necessary financial reserve. Without JI assistance, the proposed project owner may discontinue or delay implementing the proposed project considering the high technical risk.

In conclusion, it is obvious that the proposed project activity is not baseline scenario. Without additional support possible from JI, the proposed scenario will not occur. The proposed project has strong additionality and can reduce the greenhouse gas emission. If the proposed project fails to be registered as a JI project, this portion of emission reduction can not be realized.

B.3. Description of how the definition of the project boundary is applied to the project:

>>

For the purpose of determining *project emissions*, the project boundary includes:
- CO_2 emissions from methane combustion in gas engine, power plant or heat generation plant;
- CO_2 emissions from the combustion of non-methane hydrocarbons (NMHCs), if they represent more than 1% by volume of the extracted coal mine gas;
- CO_2 emissions from on-site fuel or electricity consumption due to the project activity, including transport of the CMM;
- Fugitive emissions from unburned methane

For the purpose of determining *baseline emissions*, project boundary includes the following emission sources:
- CH_4 emissions as a result of venting gas that would be utilized in the project scenario;
- CO_2 emissions from the destruction of methane in the baseline scenario;
- CO_2 emissions from the production of heat and power (motive and electrical) that is replaced by the project activity.

The *spatial extent* of the project boundary comprises:
- All equipment installed and used as part of the project for extraction, compression, and storage of CMM at the project site, and transport to an off-site user.
- Heat generation facilities installed and used as part of the project.
- Power plants connected to the electricity grid, where the project replace power from the grid, as per the definition of project electricity system and connected electricity system given by IPCC.

More specifically, the project boundary of the proposed baseline and project emissions begins *downstream* of the CMM pumping stations operated by the coal mine, and includes pipelines that transmit gas, gas boilers, and CHP equipment. Gas compression equipment used to transport gas for residential use will also be within the project boundary. Any continued venting of C<< from baseline scenario (such as pump stations) not connected to the project activity is excluded from the project boundary.

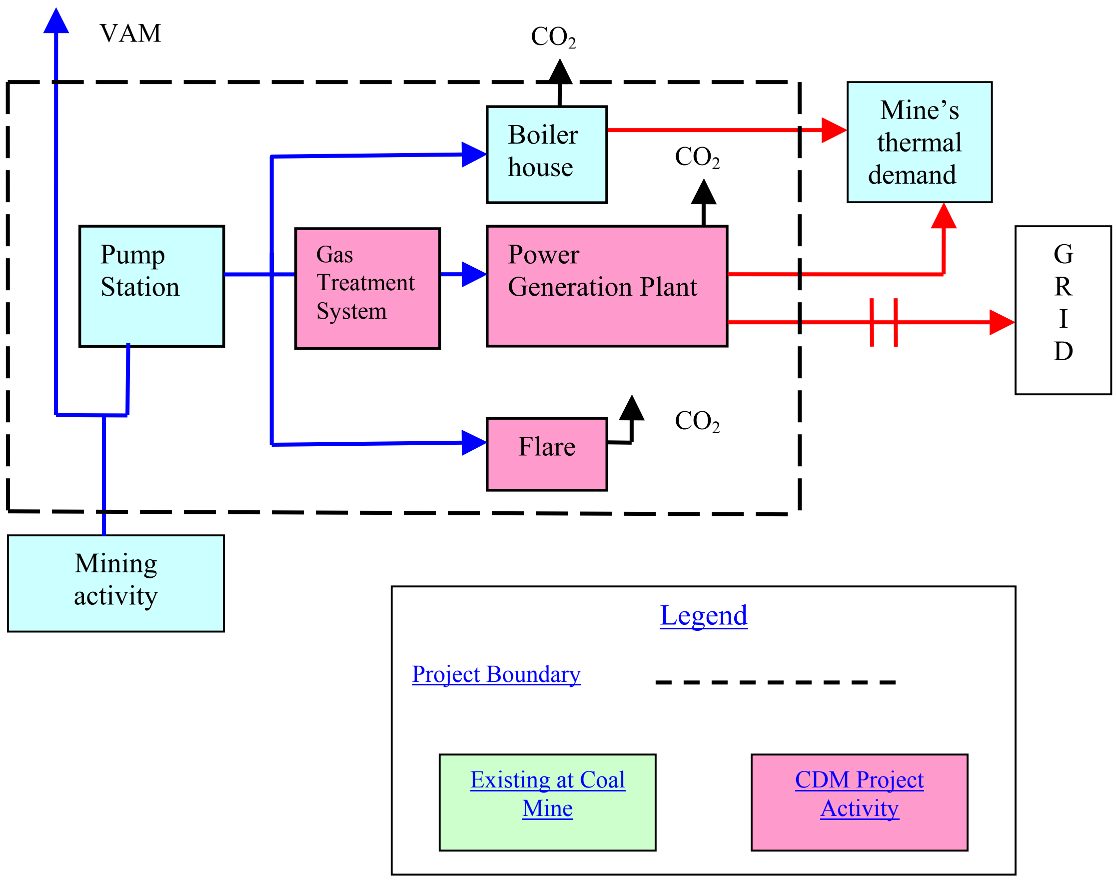


Figure B-2. Project boundaries.

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

>>

Details of the baseline study are included in Annex 2.
Date of completion: 25/12/2006.
The baseline was determined by:

Name/origination Project participant	Project Participate Yes/No
Hideo Yata / Kaori Fujikawa The Chugoku Electric Power Co., Inc. 4-33, Komachi, Naka-ku, Hiroshima, 730-8701, Japan Tel +81-82-523-6424 Fax +81-82-523-6422	Yes
Hiroyuki Kurita Shimizu Corp. SEAVAS SOUTH,1,2,3 Shibaura, Minato-ku, Tokyo 105-8007 Japan	Yes

Tel +81-3-5441-0137 Fax +81-3-5441-0469	
Georgiy Geletukha / Alexander Filonenko Scientific Engineering Centre "Biomass" 2-a Zheliabova Str., Kyiv, 03057, Ukraine Tel +380-44-456-6365 Fax +380-44045609462	No

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

>>
July 1, 2007

C.2. Expected operational lifetime of the project:

>>
15 years 0 months

C.3. Length of the crediting period:

>>
5 years and 0 months (from January 1, 2008 to December 31, 2012)
If this JI project will be eligible for ERU trading during next commitment period, the crediting period will be extended by another 5 years and 0 months.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

>>

1) Monitoring methodology reference

The monitoring methodology appropriate to this project is ACM0008 version 03 approved by CDM Executive Board on 22 December 2006. The title of the methodology: **"Consolidated monitoring methodology for virgin coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring"**

URL: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

2) Justification of the choice of the methodology and why it is applicable to the project:

The applicability criteria in the methodology state that the methodology applies to following project activities:

The following tables D-1 and D-2 explain the reason why the methodology applies to this project:

Table D-1 Comparison of proposed extraction activities with applicability of the methodology

ACM0008 Applicability	**Proposed extraction activities**
underground boreholes in the mine to capture pre mining CMM	Yes
surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM	Yes
Ventilation CMM that would normally be vented	Yes

Table D-2 Comparison of proposed CMM utilization activities with applicability of the methodology

ACM0008 Applicability	**Proposed CMM utilization activities**
The methane is captured and destroyed through flaring	Included
The methane is captured and destroyed through	

utilization to produce electricity, motive power and/or thermal energy; emission reductions may or may not be claimed for displacing or avoiding energy from other sources	The proposed projrct is CMM power generation and waste heat recovery

Besides the applicability, ACM0008 also defines the types of activities that could not be applied for this methodology. The proposed project does not involve any of those activities. (Table D-3)

Table D-3 Comparison of proposed project with inapplicable activities stated in the methodology

ACM0008 Applicability	**Proposed project activities**
Capture methane from abandoned/decommissioned coalmines	Both coal production and CMM extraction are under way in the coal mine
Capture/use of vitgin coal-bed methane, e.g. methane of hibh quality extracted from coal seams independently of any mining activities	All necessary parameters are measurable
Operate in opencast mines.	Underground operated coal mines

The applicable conditions, key assumptions, scope of data, data source in the methodology fit the project. The methodology is certain to lead to a transparent and conservative estimate of the emission reduction of the project activity.

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
Overall								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P1	PEy Project emissions in		tCO_2e	c	monthly	100%	electronic	(Archived data to be kept for

	yearly y							Crediting period +2 yrs)
P2	PE_{ME} Project emissions from energy use to capture and use methane		tCO_2e	c	monthly	100%	electronic	(Crediting period +2 yrs)
P3	PE_{MD} Project emissions from methane destroyed		tCO_2e	c	monthly	100%	electronic	(Crediting period +2 yrs)
P4	PE_{UM} Project emissions from		tCO_2e	c	monthly	100%	electronic	(Crediting period +2 yrs)
Combustion emissions from additional energy required for CMM capture and use								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P5	$CONS_{ELEC.PJ}$ Additional electricity consumption by project		MWh	m	continuous	100%	electronic	(Archived data to be kept for Crediting period +2 yrs)
P6	$CEF_{ELEC\ PJ}$ Carbon emission factor of $CONS_{ELEC\ PJ}$		tCO_2/ MWh	c	Ex ante	100%	electronic	(Crediting period +2 yrs)
Combustion emissions from use of captured methane								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P7	MD_{FL} Methane destroyed by		tCH_4	c	monthly	100%	electronic	(Archived data to be kept for

	flare							Crediting period +2 yrs)
P8	MM_{FL} Methane sent to flare	IPCC	tCH_4	m	continuous	100%	electronic	Flow meters will record gas volumes, pressure and temperature. Density of methane under normal conditions 0.67kg/m^3 according to (Revised IPCC Reference Manual) (Crediting period +2 yrs)
P9	PE_{flare} Project emissions from flaring of the residual gas stream		tCO_{2e}	M/c	See coments	n/a	electronic	The parameters used for determining the project emissions from flaring of the residual gas stream (PE_{flare}) should be monitored as per the "Tool to determine project emissions from flaring gases containing eMethane" (During the crediting amd two years after)
P10	MD_{ELEC} Methane destroyed by CHP		tCH_4	c	Calculated monthly	100%	electronic	(Crediting period +2 yrs)
P11	MM_{ELEC} Methane destroyed by CHP		tCH_4	m	Continuous	100%	electronic	Flow meters will record gas volumes, pressure and temperature.

								Density of methane under normal conditions of temperature and pressure is 0.67kg/m3(Revised 1996 IPCC Reference Manual p1.24 and 1.16) (Crediting period +2 yrs)
P12	Eff_{ELEC} Efficiency of methane destruction/oxidation in CHP	IPCC		e	Ex ante			Set at 99.5% (IPCC)
P13	MD_{HEAT} Methane destroyed by heat generation		tCH_4	c	Calculated monthly	100%	electronic	(Crediting period +2 yrs)
P14	MM_{HEAT} Meth ane sent to boiler	IPCC	tCH4	m	Continuous	100%	electronic	Flow meters will record gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.67kg/m3(Revised 1996 IPCC Reference Manual p1.24 and 1.16) (Crediting period +2 yrs)
P15	Eff_{HEAT} Efficiency of methane destruction/oxidation in heat plant	IPCC	-	e	Ex ant			Set at 99.5%(IPCC)
P16	CEF_{CH4}							Constant value:

	Carbon emission factor for CH_4							tCO_2e / tCH_4= 2.75
P17	CEF_{NMHC} Carbon emission factor for combusted non methane hydrocarbons (various)							To be obtained through periodical analysis of the fractional composition of captured
P18	PC_{CH4} Concentration methane in extracted gas gas		%	m (concentration, optical and calorific)	Hourly/Daily	100%		(Crediting period +2 yrs)
P19	Pc_{NMHC} NMHC concentration in coal mine gas		%	m (concentration, optical and calorific)	Annually	100%		Used to check if more than 1% of emission and to calculater (Crediting period +2 yrs)
P20	r Relative proportion of NMHC compared to methane		%	c	Annually	100%		
Un-combusted methane from end uses								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P21	$GWPc_{H4}$ Global warming potential of methane	IPCC		e	Ex ante			Set at 21
P22	MM_{ELEC} Methane destroyed by CHP		tCH_4	m	Continuous	100%	electronic	Flow meters will record gas volumes, pressure and temperature (Archived data to

								be kept for Crediting period +2 yrs)
P23	Eff_{ELEC} Efficiency of methane destruction/oxidation in CHP	IPCC		e	Ex ante			Set at 99.5% (IPCC)
P24	MM_{HEAT} Methane destroyed by heat generation		tCH_4	m	Continuous	100%	electronic	Flow meters will record gas volumes, pressure and temperature. (Crediting period +2 yrs)
P25	Eff_{HEAT} Efficiency of methane destruction/oxidation in heat plant	IPCC	-	e	Ex ant			Set at 99.5%(IPCC)
P26	PE_{flare} Project emissions from flaring of the residual gas stream		tCO_{2e}	m/c	See Comments	n/a	Electric	The parameters used for determining the project emissions from flaring of the residual gas stream (PE_{flare}) should be monitored as per the *"Tool to determine project emissions from flaring gases containing Methane"* (During the crediting period and two years)

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

>>

Project Emissions:

$PE_y = PE_{ME}+PE_{MD}+PE_{MU}$

Where:

Pe_y - Project emissions in year y (tCO_2e)
PE_{ME} - Project emissions from energy use to capture and use methane (tCO_2e)
PE_{MD} - Project emissions from methane destroyed (tCO_2e)
PE_{UM} - Project emissions from un-combusted methane (tCO_2e)

Project emissions from additional energy required for CMM capture and use:

$PE_{ME} = CONS_{ELEC,PJ} *CEF_{ELEC}$

Where:

PE_{ME} - Project emissions from energy use to capture and use methane (tCO_2e)
$CONS_{ELEC, PJ}$ - Additional electricity consumption for capture and use of methane, if any (MWh)
CEF_{ELEC} - Carbon emissions factor of electricity used by coal mine (tCO_2e/MWh)

Project emissions from methane destroyed:

$PE_{MD} = (MD_{FL} + MD_{ELEC} + MD_{HEAT})*(CEF_{CH4} +r*CEF_{NMHC})$

With:

$r = PC_{NMHC} / PC_{CH4}$

Where:

PE_{MD} - Project emissions from CMM/destroyed (tCO_2e)
MD_{FL} - Methane destroyed through flaring (tCH_4)
MD_{ELEC} - Methane destroyed through power generation (tCH_4)
MD_{HEAT} - Methane destroyed through heat generation (tCH_4)
CEF_{CH4} - Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
CEF_{NMHC} - Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_2eq/tNMHC$)

r - Relative proportion of NMHC compared to methane
PC_{CH4} - Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC} - NMHC concentration (in mass) in extracted gas (%)

$$MD_{FL} = MM_{FL} - (PE_{flare}) / GWP_{CH4})$$

Where:
MD_{FL} - Methane destroyed through flaring (tCH_4)
MM_{FL} - Methane measured sent to flare (tCH_4)
GWP_{CH4} - Global warming potential of methane (21 tCO_2e/tCH_4)
PE_{flare} - Project emissions from flaring of the residual gas strem (tCO_2e)

$$MD_{ELEC} = MM_{ELEC} * Eff_{ELEC}$$

Where:
MD_{ELEC} - Methane destroyed through power generation (tCH_4)
MM_{ELEC} - Methane measured sent to power plant (tCH_4)
Eff_{ELEC} - Efficiency of methane destruction/oxidation in power plant (99.5% from IPCC)

$$MD_{HEAT} = MM_{HEAT} * Eff_{HEAT}$$

Where:
MD_{HEAT} - Methane destroyed through heat generation (tCH_4)
MM_{HEAT} - Methane measured sent to heat plant (tCH_4)
Eff_{HEAT} - Efficiency of methane destruction/oxidation in heat plant (taken as 99.5% from IPCC)

Un-combusted methane from flaring and end uses:

$$PE_{UM} = GWP_{CH4} * [MM_{ELEC}*(1-Eff_{ELEC}) + MM_{HEAT} * (1-Eff_{HEAT})]+PE_{flare}$$

Where:
PE_{UM} - Project emissions from un-combusted methane (tCO_2e)
GWP_{CH4} - Global warming potential of methane (21 tCO_2e/tCH_4)

MM_{ELEC} - Methane measured sent to power plant (tCH_4)
Eff_{ELEC} - Efficiency of methane destruction/oxidation in CHP (taken as 99.5% from IPCC)
MM_{HEAT} - Methane measured sent to heat plant (tCH_4)

Eff_{HEAT} - Efficiency of methane destruction/oxidation in heat plant (taken as 99.5% from IPCC)
PE_{flare} - Project emissions from flaring of the residual gas stream (tCO_2e)

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
Overall								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Bl	BEy Baseline emissions in year y		tCO_2	c	yearly	100%	electronic	(Archived data to be kept for Crediting period +2 yrs)
B2	$BE_{MD,y}$ Baseline emissions from destruction of methane in the baseline scenario in year y		tCO_2	c	yearly	100%	electronic	(Crediting period +2 yrs)
B3	$BE_{MR,y}$ Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity		tCO_2	c	yearly	100%	electronic	(Crediting period +2 yrs)

B4	$BE_{Use,y}$ Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y		tCO_2	c	yearly	100%	electronic	(Crediting period +2 yrs)
Methane destruction due to thermal demand in baseline								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B5	$CMM_{Bli,y}$ CMM that would have been captured, used and destroyed by use *i* in the baseline scenario in year y		tCH_4	e	Estimated ex-ante at start of project	100%	electronic	(Archived data to be kept for Crediting period +2 yrs)
B6	$TH_{BL,y}$ Projected annual baseline CMM demand for thermal energy uses		tCH_4	e	Ex ante	100%	electronic	Estimated by procedure defined in the corresponding baseline methodology (Crediting period +2 yrs)
B7	CEF_{CH4} Carbon emission factor for methane	IPCC	tCO_{2e}/tCH_4					tCO_2e/tCH_4 =2.75

B8	d_k^{max} Scalar adjustment factor for month k, based on the seasonal load shape (Σ dkmax > 12)			c	Ex ante	100%	electronic	(Crediting period +2 yrs)

Baseline emissions from methane released into the atmosphere

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B9	$CMM_{BL,th,,y}$ Pre-mining CMM that would have been captured, sent to and destroyed by use *Heat Generation* in the baseline scenario in year y		tCH_4	m	Ex ante	100%	electronic	(Archived data to be kept for Crediting period +2 yrs)
B10	$CMM_{PJ,FL,y}$ Pre-mining CMM captured, sent to and destroyed by use *Flaring* in the project activity in year y		tCH_4	m	continuous	100%	electronic	(Crediting period +2 yrs)

B11	$CMM_{PJ,ELEC,,y}$ Pre-mining CMM captured, sent to and destroyed by use power *Generation* in the project activity in year y in the baseline scenario in year y		tCH_4	m	continuous	100%	electronic	(Crediting period +2 yrs)
B12	$CMM_{PJ,HEAT,,y}$ Pre-mining CMM captured, sent to and destroyed by use Heat *Generation* in the project activity in year y in the baseline scenario in year y		tCH_4	m	continuous	100%	electronic	(Crediting period +2 yrs)
B13	GWP_{CH4} Global warming potential of methane		tCO2e/tCH4	e	Ex ante			21 tCO2e/tCH4
B14	CEF_{CH4} Carbon emission factor for combusted methane		tCO2e/tCH4	e	Ex ante			2.75 tCO2e/tCH4
Baseline emissions from power/heat generation and replaced project								

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B15	GENv Electricity generation by project		MWh	m	continuous	100%	electronic	(Archived data to be kept for Crediting period +2 yrs)
B16	$HEAT_y$ Heat generation by project		GJ	m	continuous	100%	electronic	Thermometer and flow are adopted to continuously monitor the temperature difference of the heated medium and its flow rate to determine the amount of waste heat recovery (Crediting period +2 yrs)
B17	EF_{ELEC} CO_2 emission factor of the grid		tCO_2 /MWh	c	yearly	100%	electronic	Volume 1: General guideline, version 2.3, Ministry of Economic Affairs of the Netherlands, May 2004 (Crediting period +2 yrs)
B18	$EF_{CO2,CH4}$ CO_2 emission factor of CH4 used for heat production	IPCC	tC/TJ	e	Ex-ante	100%	electronic	IPCC defaults 13.5 tC/TJ (Crediting period +2 yrs)
B19	Eff_{heat} Energy efficiency of heat plant		%	e	Ex-ante	100%	electronic	100% (Crediting period +2 yrs)

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

>>

Baseline Emission:

$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$

Where:

BE_y - Baseline emissions in year y (tCO_2e)
$BE_{MD,y}$ - Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_2e)
$BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)
$BE_{Use,y}$ - Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO_2e)

Baseline methane destruction emissions:

$$BE_{MD,y} = (CEF_{CH4} + r * CEF_{NMHC}) * \sum_{k=1}^{12} (TH_{BL,y}/12^{*1}) d^{max}_k$$

Where:

$BE_{MD,y}$ - Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_2e)

$TH_{BL,y}$ - Projected annual baseline thermal demand for year y (tCH_4)
d_k - Scalar adjustment factor for day k to reflect seasonal variations, such that $\Sigma d_k=12$
d^{max}_k - Maximum scalar adjustment factor for day k over the 5 years prior to the start of the project activity (i.e. $\Sigma d^{max}_k>12$)

CEF_{CH4} - Carbon emission factor for combusted methane (2.75 tCO_2e/tCH_4)
CEF_{NMHC} - Carbon emission factor for combusted non methane hydrocarbons (various. To be obtained through periodical analysis of captured methane) ($tCO_2eq/tNMHC$)
r - Relative proportion of NMHC compared to methane

With:

$r = PC_{NMHC} / PC_{CH4}$

[*1] The use of monthly data is admitted by the methodology: “Consolidated monitoring methodology for virgin coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring”

PC_{CH4} - Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC} - NMHC concentration (in mass) in extracted gas (%)

Baseline methane release:

$$BE_{MRy} = GWP_{CH4} * [(CMM_{PJ,FL,y} + CMM_{PJ,ELEC,,y} + CMM_{PJ,HEAT,,y}) - \sum_{k=1}^{12} (TH_{BL,y}/12) d^{max}_{k}]$$

Where:

$BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_2e)
$TH_{BL,y}$ - Projected annual baseline thermal demand for year y (tCH_4)
d_k - Scalar adjustment factor for day k to reflect seasonal variations, such that $\Sigma d_k = 12$
d^{max}_k - Maximum scalar adjustment factor for day k over the 5 years prior to the start of the project activity (i.e. $\Sigma d^{max}_k > 12$)
$MD_{FL,y}$ - CMM that would have been captured, used and destroyed by use *Flaring in* the baseline scenario in year y

$MD_{ELEC,y}$ - CMM that would have been captured, used and destroyed by use *Generation* in the baseline scenario in year y

$MD_{HEAT,y}$ - CMM that would have been captured, used and destroyed by use *heat Generation* in the baseline scenario in year y

GWP_{CH4} - Global warming potential of methane ($tCO_2e/tCH_4 = 21$)

Emission from power generation replaced by project:

$$BE_{Use,y} = GEN_y * EF_{ELEC} + HEAT_y * EF_{HEAT}$$

Where:

$BE_{Use,y}$ - Total baseline emissions from the production of power or heat replaced by the project activity in year y (tCO_2)
GEN_y - Electricity generated by project activity in year y (MWh), including through the use of CBM
EF_{ELEC} - Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh).
$HEAT_y$ - Heat generation by project activity in year y (GJ), including through the use of CBM
EF_{HEAT} - Emissions factor for production replaced by Project activity (tCO_2/GJ).

$EF_{ELEC,y} = S_{grid} * EF_{grid,y}$

Where:

$EF_{ELEC,y}$ -Emissions factor of electricity (grid, captive or a combination) replaced by project (tCO_2/MWh). Source: IPCC.

$S_{grid,y}$ -Share of facility electricity demand supplied by grid imports (100%)

$EF_{grid,y}$ -CO_2 Emissions factor for the captive emission factor for the grid electricity displaced due to the project activity during the year y (tCO_2/MWh).

$EF_{heat,y} = (Ef_{CO2,j}/Eff_{heat})*(44/12)*(1TJ/1000GJ)$

Where:

$EF_{heat,y}$ -Emission factor for heat generation (tCO_2/GJ)

EF_{CO2} -CO2 emission factor of fuel used in heat generation (t/TJ)

Eff_{heat} -Boiler efficiency the heat generation (t/TJ)

44/12 -Carbon to Carbon Dioxide conversion factor

1/1000 -TJ to GJ conversion factor

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

Not applicable

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not appricable

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

>>
Not applicable

D.1.3. Treatment of leakage in the monitoring plan:

Not applicable

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

>>
Not applicable

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

>>
The emission reduction *ERy* by the project activity during a given year *y* is the difference between the baseline emissions (*BEy*) and project emissions (*PEy*), as follows:

$$ER\ y = BE\ y - PE\ y$$

Where:

ERy - Emissions reductions of the project activity during the year *y* (tCO2e)
BE,y - Baseline emissions during the year *y* (tCO2e)
PEy - Project emissions during the year *y* (tCO2e)

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

>>

The host Party has not established any specific procedures on information collection and archiving on project's environmental impacts.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P5, P8,P9,P11, P14,P22,P24,P26, B9,B10,B11,B12, B15,B16	Low	Corresponding measuring equipment (flow meters, meters, thermometers, manometers) will be subject to regular maintenance regime to ensure accuracy. Each device is to be checked regularly by a specialized company in the presence of a state verifier in accordance with the regulation stated in Ukraine and the Cheeking Schedule mentioned in Section D. The exceptional verification is to be carried out after obtaining of unfeasible data.
P18, P19	Low	Gas analysis will be conducted by a licensed company to ensure accuracy.
P12,P17,B13, B14,B18,B19		The data are calculated on other monitored data, or the data are IPCC defaults values, so QA/QC procedures are not necessary.

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

>>

Data handling

A transparent system for collection and storage of measured data in the electronic form are established. A transparent system for computation in the form of Excel sheets is established.

Quality assurance:

-A department that is responsible for operation of the CHP and Flare system will be set up based on the existing Donetsk subdivision of Sinapse. In the staff of this department a person will be assigned responsible for a data monitoring. It is assumed to implement automatic monitoring, collection and processing of data every hour. In any case all measuring equipment has at least half a year independent (including energy independent) archive of measured data, which can be extracted and processed any time.

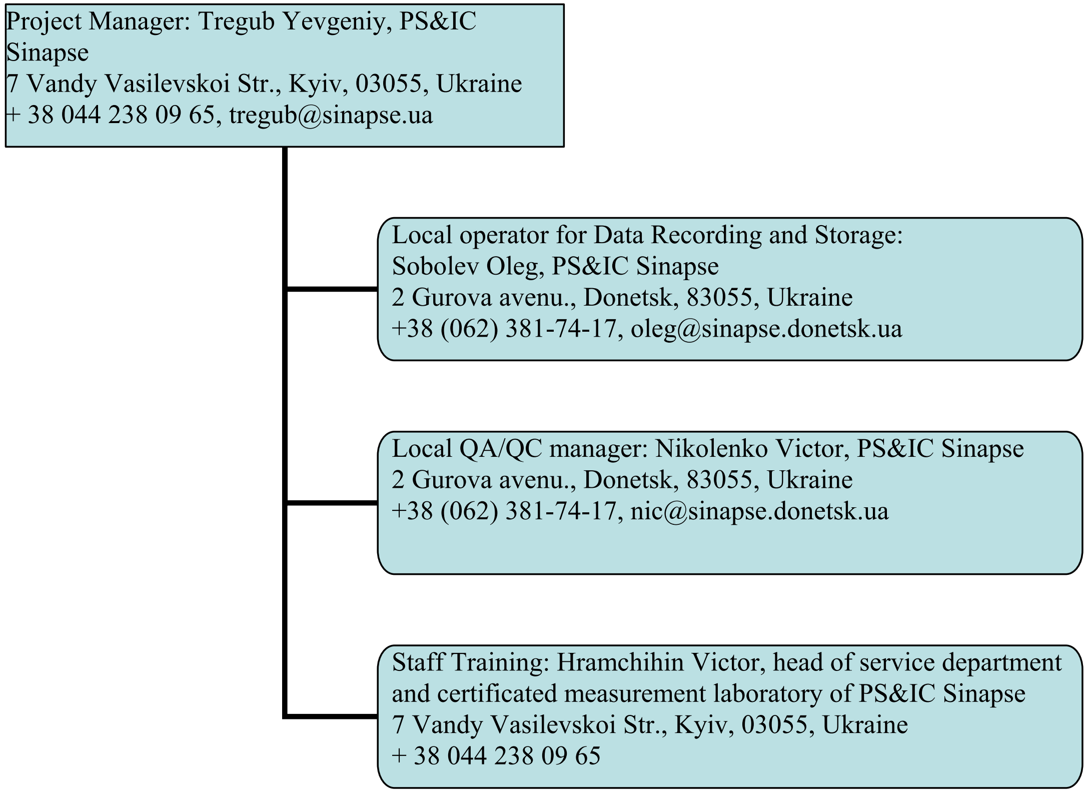
- PS&IC Sinapse will designate a system manager to be in charge of and accountable for the generation of ERs including monitoring, record keeping, computation and recording of ERs, validation and verification

- The system manager will officially sign off on all worksheets used for the recording and calculation of ERs

-Well-defined protocols and routine procedures, with good, professional data entry, extraction and reporting procedures will make it considerably easier for the validator and verifier to do their work
- Proper management processes and systems records will be kept by the project. The verifiers can request copies of such records to judge compliance with the required management system.
- The monitoring manual will be compiled and working staff in the monitoring department will fulfill their responsibilities using this manual.

Reporting:
- The project manager will prepare reports, as needed for audit and verification purposes.
Training:
- Required capacity and internal training will be equipped to the operational staff and the monitoring staff to enable them to undertake the tasks required by this Monitoring Plan. Appropriate staff training will be provided before this project starts operating and generating ERs.

All measured data are to be stored in the non-processed electronic form in the memory of measuring devices for at least half a year. Besides the processed measured and calculated values are to be stored in the electronic form in EXCEL sheets, and in paper. The person responsible for storage of processed data is Tregub Yevgeniy.



D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

>>

Names	Project Participate Yes/No
Hideo Yata / Kaori Fujikawa The Chugoku Electric Power Co., Inc.	Yes

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Fedorov Saveliy/ Tregub Yevgeniy PS&IC Sinapse 7 Vandy Vasilevskoi, + 38 044 238 09 65 + 38 044 238 09 70	Yes
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SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

>>

The project emission are calculated in the way that clarified in Section B. The delailed calculation results for the crediting period are shown in Table E-1

Table E-1. Greenhouse Gas Emissions by Sources in Project scenario (t CO_2e)

Year	PE_{ME}	PE_{MD}	PE_{UM}	PE
2008	74	17,860	4,615	22,549
2009	72	17,860	4,615	22,547
2010	70	17,860	4,615	22,546
2011	68	17,860	4,615	22,544
2012	67	17,860	4,615	22,542

E.2. Estimated leakage:

>>

As stated in Section B, no leakage effects need to be accounted for under this proposed project.

E.3. The sum of E.1. and E.2.:

>>

Table E-2 shows the overall project emission at the Project for the crediting period. The actual project activity emission would be represented by the small amounts of uncombusted CH4 and CO2 emissions produced from the utilization activities.

Table E-2. Estimated GHG project emissions with the account of leakage

Year	Leakage	PE
2008	0	22,549
2009	0	22,547
2010	0	22,546
2011	0	22,544
2012	0	22,542

E.4. Estimated baseline emissions:

>>

The GHG emission in the baseline are equal to the methane CMM extracted from the coal mine drainage systems (that would have been released to the atmosphere) but is sent to the utilization activities, plus any GHG emission produced without the proposed project. The baseline emissions are calculated using the equations and parameters clarified in Section B. the estimated baseline GHG emissions at the project is shown in Table E-3.

Table E-3. Baseline Greenhouse Gas Emission by Sources (t CO_2e)

Year	BE_{MD}	BE_{MR}	BE_{Use}	BE
2008	10,813	53,818	7,817	72,448
2009	10,813	53,818	7,664	72,295
2010	10,813	53,818	7,511	72,142
2011	10,813	53,818	7,358	71,989

2012	10,813	53,818	7,205	71,836

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

>>

The emissions reductions created from the project activity are the net difference between the baseline emission and the project emissions for a given year. Ex-ante emissions at the project is projected for estimating proposes only since any actual emissions will be measured ex-post according to the monitoring methodology. The total baseline emissions are shown in Table E-4.

Table E-4. Emission reduction units (tCO_2e)

Year	BE	PE	ER
2008	72,448	22,549	49,899
2009	72,295	22,547	49,747
2010	72,142	22,546	49,596
2011	71,989	22,544	49,445
2012	71,836	22,542	49,294

E.6. Table providing values obtained when applying formulae above:

>>

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2008	22,549	0	72,448	49,899
Year 2009	22,547	0	72,295	49,747
Year 2010	22,546	0	72,142	49,596
Year 2011	22,544	0	71,989	49,445
Year 2012	22,542	0	71,836	49,294
Total (tonnes of CO_2 equivalent)	112,728	0	360,709	247,981

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

>>

The following paragraphs describe the results of environmental impact analysis.

(a) Legal framework

The Government of Ukraine officially regards environmental protection as a high priority. It passed the Law on the Protection of the Environment in June 1991, and followed this up with numerous regulations, decisions and other government and regional level activities between 1998 and 2001. The following were major legislation adopted during this period:

- Law of Ukraine on Environmental Expertise: This Law has passed through the Supreme Council (Verkhovna Rada) of Ukraine, and signed by the President on September 2, 1995.
- The Ukrainian Law on Protection of Ambient Air (June 21, 2001) covers the conservation and improvement of air quality, environmental safety pertaining to the life of human activities, prevention of environmental impacts by hazardous substances, and regulation of activities that have an impact on the environment.
- The Law of Ukraine on Alternative Liquid and Gas Fuels (February 14, 2000) deals with fuel substitution activities, which are a high priority area of development in Ukraine. Within this, CMM is regarded as an alternative fuel.
- State Building Standard SBS A.2.2.-1-95, 2003 new version. Name: Composition and contents of EIA materials for projecting and construction of enterprises, buildings, and facilities.

Note that apart from these laws, there are no regulations that apply to the location where the project is carried out.

(b) Analysis of environmental impacts

This project will reduce the amount of fuel used to generate power in the energy system and as a result, bring about positive effect to the environment by reducing the amount of pollutants emitted into the atmosphere. At the same time, employment opportunities will be created. In addition, no negative effects on the environment are expected. In other words, this project coincides with policy priorities and strategies of Ukraine's economic, social, and environmental sectors.
The following environmental risks are associated with coal mining:

- Fire and explosions: Although the risk of fire or explosions in coal mines is managed by ventilation system, the risk of fire or explosions caused by accidental methane discharges still remains.
- Global warming: Methane is a strong GHG gas. Its emissions from mine's ventilation system and discharges of drained methane to the atmosphere contribute to global warming and adversely affect the environment.

Expected positive environmental effects caused by this Project:

- **Fire and explosions:** Basically all methane produced within the project boundary will be destroyed on CHP and flare in the project scenario. Risk of fires and explosions will be diminished.
- Global warming: As it was mentioned before, emissions of green house gas CH_4 will be transformed to a safer CO_2. Transformation of methane to carbon dioxide will pose positive impact on environment.
- **Replacement of power produced by old power system:** The project foresees installation of gas engine generator, which is an up-to-date technology for CMM utilization. This technology is more efficient than power stations, which already exist in the Ukraine, and allows curbing green house gas emissions. Most Ukrainian Thermal Power Plants that operate on the margin use coal as a primary fuel. CMM is much cleaner fuel than coal, which also causes less emission of criteria pollutants (SO_2, NO_x, and PM).

Therefore, the project has positive impacts on environment and conforms to general Ukrainian environmental protection policies and principles. Besides environmental benefits, this project will also have positive effect on local economy and social life.

Certainly there are minor negative details that can be applied to the project, and which can be mitigated by adopting countermeasures:

- **Noise and vibrations:** Installation of new gas engine power facility may cause noise and vibration. However, since this CHP is low-capacity, and container type, its noise and vibration characteristics will fully meet the sanitary norms. Also, considering the fact that CHP will be installed on coal mine's territory, which is far from any residential or administrative buildings, additional noise and vibrations will not cause negative social effect. Impact on CHP operators is also minimal and within the sanitary norms.
- **Air pollution resulting from CHP exhaust gases:** Operation of CHP will cause emissions of SOx and NOx contained in exhaust gases. However, since CHP will be situated primarily far from households, and since the capacity of CHP is small, these negative effects will not cause any serious problems.
- **Other impacts:** Impacts on soil and water are also minimal. CHP will require small amount of water and oil for the operation. Thus, no significant oil spills or water pollution is expected within the project.

(c) Project participants opinion

Environmental impact analysis shows that the project will basically have positive impact on environment. Detailed environmental impact assessment is under development as a part of a technical project.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
Environmental impacts of the Project are considered as insignificant.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

>>
Participants identified the following major stakeholders:

- **Ministry of Coal Industry of Ukraine** – policy making governmental entity
- **State Enterprise "Makeyevugol"** – Project participant;
- **Holodnaya Balka mine** – Project implementation object;

Stakeholders Comments were obtained through surveying. All comments are positive.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

1. Summary of coal production from 2000 to 2012 (t/year)

Year	Holodnaya Balka Mine
2000	472,197 t
2001	450,488 t
2002	423,388 t
2003	511,308 t
2004	567,715 t
2005	415,628 t
2006	347,276 t
2007	404,000 t(Plan)
2008	420,000 t(Plan)
2009	440,000 t(Plan)
2010	460,000 t(Plan)
2011	480,000 t(Plan)
2012	500,000 t(Plan)

Data sources for the baseline calculation

Baseline data were taken from SE "Makeyevugol" records; mine's future coal production plans; 'Reconstruction of Methane Draining System' for Holodnaya Balka Mine developed by Donetsk Coke Company; data on electricity production by new CHP and IPCC Table for Carbon Emission Factors.

Statistical data:
Basically, the debit of captured methane by drainage system depends on geological conditions of mining, and methane draining efficiency. The more efficient the drainage system – the less methane will be vented to atmosphere as VAM. The concentration of methane in captured CMM is not a constant value, though it fluctuates in a range suitable for CMM utilization with proposed project technology. Based on statistical gas flow rate and methane concentration data from previous years and on the future mine's production plans a stable flow of methane is achievable. If additional methane draining system improvement measures are implemented, e.g. drainage pipes hermetization and replacement, replacement of old pumps, application of isolation materials around drainage borehole heads, it will contribute to a higher concentration of CH_4 in the CMM, and actually higher debit of methane due to higher capture efficiency. Thus, less VAM will be emitted to atmosphere. But even under mine's current activity level the volume of CMM will be sufficient to cover mine's heat demand and supply for project operation. Minor fluctuations in CH_4 concentration and gas flow will not influence the project unless some unpredictable force-majeur situation takes place.

Table 2. Monthly volume of captured methane (in nm^3 CH_4) by Vacuum Pump Station in 2001-2005

Month/Year	2001	2002	2003	2004	2005
January	1,056,628	882,086	544,608	794,592	611,568

February	1,037,030	816,883	689,472	568,512	520,128
March	1,144,569	879,408	647,280	700,848	520,128
April	1,032,480	797,040	660,960	717,120	574,560
May	1,010,649	763,790	607,104	682,992	647,280
June	853,200	771,984	557,280	626,400	509,760
July	830,304	709,776	705,312	772,272	495,504
August	843,696	671,385	691,920	651,744	495,504
September	773,280	643,680	626,400	565,920	508,896
October	795,038	614,693	723,168	575,856	513,360
November	855,360	568,944	717,120	747,320	449,280
December	950,385	566,928	665,136	682,992	455,328
Total	11,182,619	8,686,597	7,835,760	8,086,568	6,301,296

Table 3. Methane consumption by boiler house (in nm^3 CH_4), indicating thermal demand by maximum monthly consumption in 2001-2005.

Month/year	2001	2002	2003	2004	2005
January	669,600	647,851	479,362	616,032	580,320
February	564,480	540,960	516,896	561,276	443,520
March	446,400	540,920	513,023	556,208	401,760
April	345,600	416,780	496,640	496,800	345,600
May	345,600	326,780	426,752	444,608	200,880
June	259,200	296,880	440,000	440,000	224,640
July	259,200	301,776	317,120	408,000	214,272
August	259,200	399,520	324,080	390,084	200,880
September	259,200	439,520	440,000	387,600	203,040
October	302,400	526,254	516,032	496,400	275,520
November	446,400	499,438	548,000	533,840	367,200
December	535,680	499,294	564,639	546,775	388,368
Total:	4,692,958	5,435,976	5,582,543	5,877,624	3,845,999

3. Grid emission factor

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belarus	580	574	568	562	555	549	543	537	531	525	518	512	506
Bulgaria	1069	1047	1024	1002	979	957	934	912	890	867	845	822	800
Croatia	784	771	758	745	733	720	707	694	681	668	655	642	629
Czech Republic	830	816	801	787	772	758	743	729	714	700	685	671	656
Estonia	966	947	928	909	889	870	851	832	813	794	775	756	737
Hungary	745	733	721	710	698	686	675	663	651	640	628	616	605
Latvia	476	473	471	468	465	463	460	457	454	452	449	446	444
Poland	910	892	875	858	841	824	807	790	772	755	738	721	704
Romania	777	764	751	738	726	713	700	687	675	662	649	637	624
Russia	627	619	612	604	596	588	581	573	565	557	550	542	534
Slovakia	652	643	635	626	617	609	600	592	583	575	566	557	549
Slovenia	826	811	797	783	768	754	740	725	711	696	682	668	653
Ukraine	996	976	956	936	916	896	876	856	836	816	796	776	756

Table B2 *Baseline carbon emission factors for JI projects* ***reducing electricity consumption*** *(in gCO_2/kWh)*

*** Grid CO_2 emission factors** for the period 2000-2012 for Ukraine's electricity generating sources originate from the IPCC publication referenced by the 'Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of operational Guidelines for PDD's of JI projects**,** *Volume 1: General guidelines***,** *Version 2.3***,** Ministry of Economic Affairs of the Netherlands**,** May 2004'.

It is impossible to use ACM0002 methodology for carbon emission factor calculations for due to the unavailability to project developers of necessary information needed to use this methodology. Thus, default numbers calculated by IPCC and recommended by ERUPT PDD Guidelines were used. See Table above.

4. Key input data
The following data and factors were used for baseline emission calculation. This information relates to the practical application of a new proposed baseline.

Key Input Data			
Data	**Unit**	**Value**	**Source**
ERU price	Euro/t CO_2	7.00	Expected price
Expected debit of CH4 capture from 2008	m^3/min	19.067	Expected debit of captured CH_4 in 2008 and following years according to 'Reconstruction of Methane Draining System', Table 2.3.5. Donetsk coke company, Research and Design Bureau, Project is 19.067 m^3/min. Thus, annual methane debit will be 7 183 t/year.
CMM (test data)			
CH_4 content in drained CMM	%	33.05	Gas test on 29.03.2006
CH_4 content in drained CMM	%	30.77	Gas test on 14.04.2006
CH_4 content in drained CMM	%	37.22	Gas test on 4.05.2006
CH_4 content in drained CMM	%	49.90	Gas test on 15.05.2006
CMM Lower Heating Value	MJ/Nm^3	11.9	Gas test on 29.03.2006
CMM Lower Heating Value	MJ/Nm^3	11.1	Gas test on 14.04.2006
CMM Lower Heating Value	MJ/Nm^3	12.5	Gas test on 4.05.2006
CMM Lower Heating Value	MJ/Nm^3	15.9	Gas test on 15.05.2006
Methane			
Methane GWP	-	21	IPCC 1996
CEF_CH_4	tCO_2/tCH_4	2.75	Molecular mass ratio
Methane density	t/m^3	0.00067	IPCC 1996
Electricity*			
CEF_2008	tCO_2/MJ	0.836	From Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of operational Guidelines for PDD's of JI projects (ERUPT 4, Senter, the Netherlands)
CEF_2009	tCO_2/MJ	0.816	Same
CEF_2010	tCO_2/MJ	0.796	Same
CEF_2011	tCO_2/MJ	0.776	Same
CEF_2012	tCO_2/MJ	0.756	Same
Equipment parameters			
Installed electric capacity	kW_{el}	1063	Producer
Installed thermal capacity	kW_{th}	1140	Producer
Electric efficiency	%	40.8	Producer
Thermal efficiency	%	43.7	Producer

5.ProjectIRR

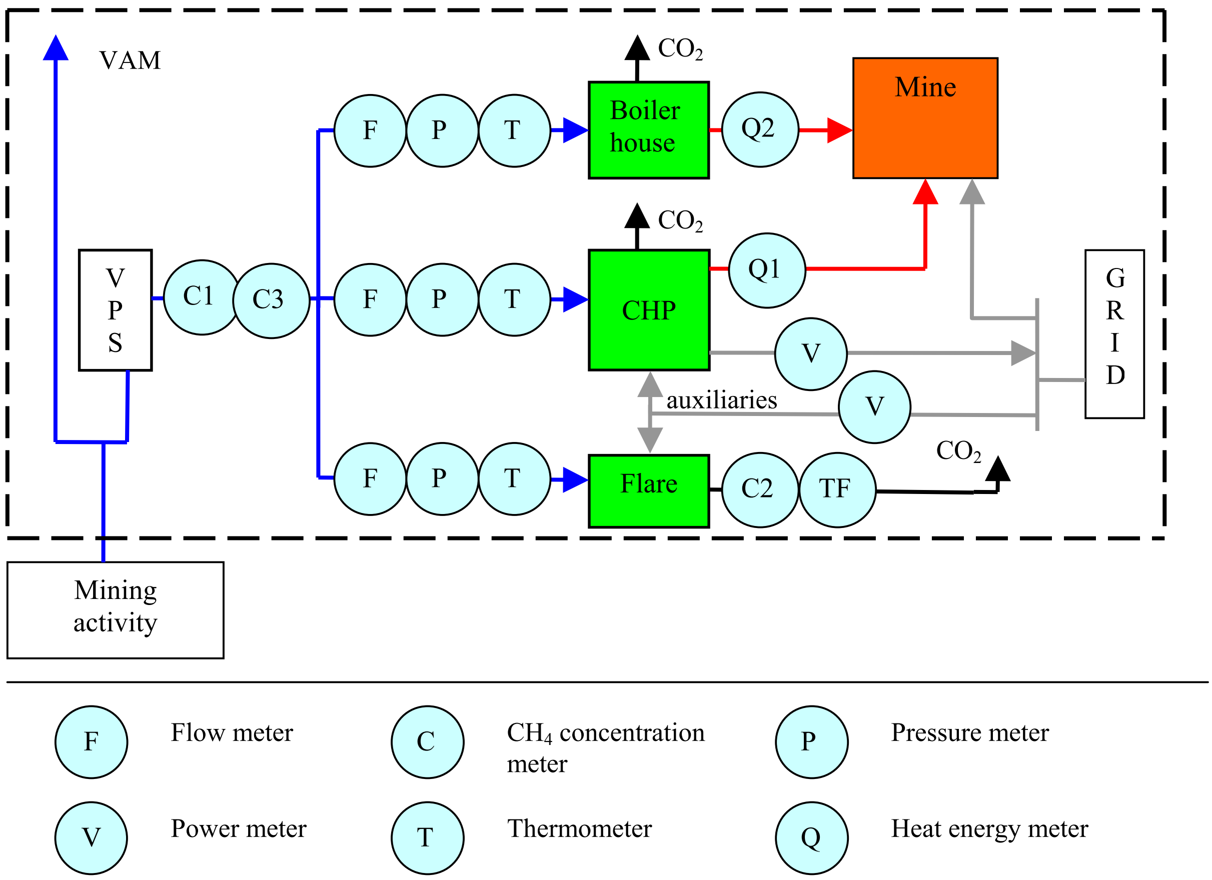
Economic calculations (without ERU), Euro											
	Year of operation										
	2007	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***
Investments	1,391,310										
Operational costs		64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935
Loan interest payments	0	177,392	177,392	133,044	88,696	44,348	0	0	0	0	0
Depreciation charges		305,046	238,164	185,947	145,178	113,347	88,496	69,093	53,944	42,117	32,883
Total revenue	0	340,842	340,842	340,842	340,842	340,842	340,842	340,842	340,842	340,842	340,842
Balance sheet profit		-206,531	-139,650	-43,084	42,033	118,211	187,411	206,814	221,962	233,790	243,024
Income tax		0	0	0	10,508	29,553	46,853	51,703	55,491	58,447	60,756
Net profit		-206,531	-139,650	-43,084	31,525	88,659	140,558	155,110	166,472	175,342	182,268
Cash flow	-1,391,310	98,515	98,515	142,863	176,702	202,006	229,054	224,203	220,416	217,459	215,151
Economic calculations (with ERU), Euro											
Investments	1,391,310										
Operational costs		64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935	64,935
Loan interest payments	0	177,392	177,392	133,044	88,696	44,348	0	0	0	0	0
Depreciation charges		305,046	238,164	185,947	145,178	113,347	88,496	69,093	53,944	42,117	32,883
ERU Incom		308,000	308,000	308,000	308,000	308,000	308,000	308,000	308,000	308,000	308,000
Total revenue	0	648,842	648,842	648,842	648,842	648,842	648,842	648,842	648,842	648,842	648,842
Balance sheet profit		101,469	168,350	264,916	350,033	426,211	495,411	514,814	529,962	541,790	551,024
Income tax		25,367	42,088	66,229	87,508	106,553	123,853	128,703	132,491	135,447	137,756
Net profit		76,101	126,263	198,687	262,525	319,659	371,558	386,110	397,472	406,342	413,268
Cash flow	-1,391,310	381,148	364,427	384,634	407,702	433,006	460,054	455,203	451,416	448,459	446,151
IRR *(without ERU)*	**4.6%**										
IRR *(with ERU),*	**26.5%**										

Annex 3

MONITORING PLAN

The implementation of the monitoring plan is to ensure that real, measurable, long-term Greenhouse Gas Emission Reduction can be monitored, recorded and reported. It is a crucial procedure to identity the final ERUs of the propsed project. This monitoring plan for the proposed project activity will be implemented by the project owner, PS&IC Sinapse.

1. What data will be monitored?
As is shown in Section D, there are two series of data that need to be monitored: Project related emissions and Baseline related emission. The detailed meters installation is illustrated in the following figure;



2. How will the data be monitored, recorded and managed?

All meters installed in the proposed project should be accorded with national standard. All the equipment used will be serviced, calibrated and maintained in accordance with the original manufactures instructions and complete recorded preservation. Data storage and filing system is to be established.

Recording preservation is the most important process in the monitoring plan. Without accurate and efficient record keeping, project emission reductions can not be verified. As stand in Section D4, the responsible personal for monitoring JI related information would be appointed by the proposal project owner and supervised by the JI developer.

The data are analyzed on a daily basis by the operator. In case of a drift of one parameter the operator can react quickly and fix any potential problems. All data required for the emission calculations will be kept in the onsite-monitoring database. On a regular basis, all monitoring information is analyzed following the formulae in Section B.

3. Calibration of Meter and Metering

The following procedure will be undertaking to calibration the equipment in the proposed project:

1) The metering equipment shall have sufficient accuracy so that error resulting from such equipment shall not exceed manufacturer standard requirement. The accuracy of current flow meters in is following list. Their equipments have enough accuracy for this project. Therefore, manufacture will change these models, functionally-equivalent equipments will be adopted. .

C1,C2,TF – the same device: industrial infrared emission monitoring system, stationary
Type SWG-300 (manufactured by MRU, be http://www.mru.de/uk/produkte/produkte_detailinfo.asp?menuID=2&uMenuID=21&kat=9&ukat=24&pid=55)
Accuracies and Ranges:

- CH_4 in CMM gas: 20÷70% CH_4 (vol), precision of measurements 0.7%
- CH_4 in the exhaust gas of the flare: 0÷1% CH_4 (vol), precision of measurements 0.01%
- O_2 in the exhaust gas of the flare: 0÷25% O_2 (vol), precision of measurements 0.2%
- temperature of the flare: 0÷1700°C, precision of measurements in the range 200÷1700°C is 1°C

Calibration requirements: at least each 1 year by local manufacturer's representative office (www.mru.kiev.ua)

C3 – unknown device for measurement NMHC concentration in coal mine gas annually. These measurements will be carried out by an independent authorized laboratory based on gas sampling under GOST 23781-87 annually.

V – power meters
Type: EA05R LX S (EuroAlfa, ABB, www.abb.ru/metronica)
Accuracies (grade of accuracy): 0.5S – as for commercial count by Ukrainian norms. The accuracy of power accounting is also defined by the type and accuracy of current and voltage transformers, the accuracy class of which should be no less than 0.5 and which are selected by rated currents and voltages in accordance with Ukrainian regulations on electricity commercial accounting.
Calibration requirements: each 4 years by local state verification office (or by local specialized agency together with state verification office specialist). Manufacturer's recommendation: each 8 years.
Notes: Device has a memory for 1 year, clock, RS232/485 output for downloading data, battery.

Q1 – electromagnetic heat meter for CHP heat production
Type: SA-97/2 DN80 (manufactured by "Aswega-U", Ukraine; www.aswega.com.ua)
The meters are certified in Ukraine for heat commercial accounting (Certificate No. U919-98)
Accuracies (grade of accuracy): 4 – as for commercial count by Ukrainian norms.
In the flow range 5 ÷ 125 m^3/h and Δt>20°C accuracies (ratio error) is +/- 4%.
In the flow range 5 ÷ 125 m^3/h and Δt>10°C accuracies (ratio error) is +/- 4.5%.
Range: water flow: 5 ÷ 125 m^3/h; Δt 3÷140°C;
Calibration requirements: each 4 years by local state verification office (or by local specialized agency together with state verification office specialist).
Notes: Device has a memory for 1 year, clock, RS232/485 output for downloading data, battery.

Q2 – electromagnetic heat meter for Boiler house heat production
Type: SA-97/2 DN150 (manufactured by "Aswega-U", Ukraine; www.aswega.com.ua)
The meters are certified in Ukraine for heat commercial accounting (Certificate No. U919-98)
Accuracies (grade of accuracy): 4 – as for commercial count by Ukrainian norms.
In the flow range 20 ÷ 500 m^3/h and Δt>20°C accuracies (ratio error) is +/- 4%.
In the flow range 20 ÷ 500 m^3/h and Δt>10°C accuracies (ratio error) is +/- 4.5%.
Range: water flow: 20 ÷ 500 m^3/h; Δt 3÷140°C;
Calibration requirements: each 4 years by local state verification office (or by local specialized agency together with state verification office specialist).
Notes: Device has a memory for 1 year, clock, RS232/485 output for downloading data, battery

F+P,T – vortex flow meter with P,T correction
Type: VRSG-1 (manufactured by "IRVIS", Russia http://www.gorgaz.ru/)

DN 100 for CHP CMM gas supply line
Range: 27 ÷ 1250 m^3/h
Accuracies in the range 250÷ 1250 m^3/h accuracies (ratio error) is
- volume flow measuring channel - ±1,0%;
- temperature measuring channel - ±0,5%;
- pressure measuring channel - ±0,6%.
- inner clock - ±0,15%.

DN 125 for Flare CMM gas supply line
Range: 32 ÷ 1800 m^3/h
Accuracies in the range 360÷ 1250 m^3/h accuracies (ratio error) is
- volume flow measuring channel - ±1,0%;
- temperature measuring channel - ±0,5%;
- pressure measuring channel - ±0,6%.
- inner clock - ±0,15%.

DN 200 for Boiler house CMM gas supply line
Range: 90 ÷ 5000 m^3/h
Accuracies in the range 1000 ÷ 5000 m^3/h accuracies (ratio error) is
- volume flow measuring channel - ±1,0%;
- temperature measuring cha- ±0,5%;
- pressure measuring channel - ±0,6%.
- inner clock - ±0,15%.

Calibration requirements: each 2 years by local state verification office (or by local manufacture representive office with state verification office specialist).
Notes: Device has a memory for 1 year, clock, RS232/485 output for downloading data, battery.

4. Verification Procedure

The main objective of the verification is to independently verify whether the emission reductions reported in the PDD has been achieved by the proposed project. It is expected that the verification could be done annually.
Main verification activities for the project included:

1) The project owner, PS&IC Sinapse will sign a verification service agreement with specific AIE in accordance with relevant JISC regulations:
2) The project owner will provide the completed data records.
3) The project owner will cooperate with AIE to implement the verification process, i.e. the personnel in charge of monitoring and data handling should be available for interview and answer questions honestly;

To be summarized, the project owner PS&IC Sinapse will implement a proper monitoring plan to make sure that the emission reduction for the proposed project would be measured accurately.