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:

>>
Utilization of Coal Mine Methane in SOSNICA Coal Mine, Poland

Sectoral scope: 8, 10

JI Track: 1

Version-3.0, October 27, 2011

A.2. Description of the project:

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a)Situation existing prior to the starting date of the project
Before the proposed project, CMM was released to the atmosphere through the ventilations at SOSNICA Coal Mine. The electricity was entirely supplied from the Grid and the heat was entirely generated by the existing coal boilers (2.86MW x 3units, 6.5MW x 2units).

b)Baseline scenario
Baseline scenario is the same as stated in above "a) Situation existing prior to the starting date of the project". Regarding the release of CMM into the atmosphere, there is no national or EU regulation in place at this moment and also there would be no related regulations for the future.

c)Project scenario
The proposed project is aimed at use of captured methane for energy production and flaring instead venting to the air, and three stages approach is being considered.

At stage 1 (since 11 March. 2007), the ventilation system has been improved for promoting the proposed project such as installing gas engine by building a Methane Recovery Station at the surface consisting 3 operational pumping units and 1 unit in reserve. The maximum capacity of the pumps is 160m3/min.

At stage 2 (since 29 May. 2009), a CMM powered newly constructed gas engine (Deutz Energy TCG 2020 V20) was installed as Combined Heat and Power System (CHP) to produce 1,934 kW of electrical and 1,937 kW of thermal power. Its expected annual power generation is 13,925MWh with the net electricity of 12,532MWh and annual heat generation is 50,207GJ with the net heat generation of 45,186GJ. Here for the purpose of enhancing the safety around the gas engine installation, heat utilization from the gas engine will be started in 2013, which is expected to reduce the temperature of the exhaust gas. The generated heat by the gas engine will be consumed only for the heat needs in SOSNICA Coal Mine replacing a part of the heat from the existing coal boilers and the additional heat will be released into the air by the cooling system.

At stage 3 (since 1 May. 2011), CMM burns in a newly constructed flare stack with a maximum capacity of 20Nm3-CH4/min.

Additionally further emission reduction will be achieved through replacement of import fossil grid energy heat and power to date used in the SOSNICA Coal Mine with in-plant power generation at stage 1. All electricity and heat generated by this project will be consumed within SOSNICA Coal Mine. In addition, SOSNICA Coal Mine will continue to purchase electricity from the Grid and to use captive coal boilers because net electricity generation and heat generation in this project are far below the each demand of electricity and heat in SOSNICA Coal Mine.
But emission reduction regarding electricity can not be claimed as Emission reduction units (ERUs) for

the purpose of avoiding indirect double-counting under EU-ETS.

Table A-1 Historical data on Electricity and Heat demand in SOSNICA Coal Mine (2005-2009)

Year	Electricity Demand (MWh)	Heat Demand (GJ)
2005	120,414	119,167
2006	127,604	120,620
2007	125,085	113,157
2008	115,927	111,540
2009	117,464	116,472
Average	121,299	116,191

The timeline of the project activity is shown below.

04/10/2004	Meeting held on 4th Oct 2004 in Central Mining Institute concerning possibilities of implementation of the Joint Implementation Mechanism along with the CMM utilisation activities in coalmines belonging to the Kompania Węglowa S.A. According to the final Meeting Protocol, the initial decision was made on the commencement of the JI procedure at coalmines Sośnica in Gliwice and Szczygłowice in Knurów
30/12/2004	Resolution No. 2504/2004 of 30th XII.2004 the Board Coal Company SA on start of the procurement under the Procurement Law Act Public entitled "Execution of the large diameter hole from the surface to the level of 550 m with buildings in the hole and on the surface of the pipeline diameter 400 for surface drainage in the station of KW SA KWK "Sośnica.
13/10/2005	Resolution No. 2679/2005 of the Board Coal Company SA on approve the contract award procedure covered by Act Right Procurement Fri "Execution for the surface methane recovery station of KW SA KWK "Sośnica - Makoszowy" the large diameter hole from the surface to a level of 550 m in the construction of the pipeline diameter hole 400.
27/10/2005	Resolution No. 2831/2005 of the Board Coal Company SA on approval of protocols from negotiations and design of contract with company Zakład Odmetanowania Kopalń "ZOK" Sp. z o. o. for realization of task" Construction of the surface methane recovery station at KW S.A. KWK "Sośnica - Makoszowy" Ruch Sośnica along with factual and financial schedule"
11/03/2007	Launching the surface methane recovery station
31/05/2007	KW S.A. Board's resolution no. 1709/2007 launching the procedure: "Construction of gas engines in casing of container type, powered with gas from surface methane recovery station along with infrastructure necessary for their operation at the KW S.A. Department "Szczygłowice" and Department "Sośnica – Makoszowy"
31/08/2007	Tender announcement for the task: "Construction of gas engines…."
09/10/2007	Opening the tender for the: "Construction of gas engines…."
30/05/2008	Signing of an agreement to design and carry out above-mentioned project with a consortium consisting of: Tychy Zakład Elektorniki Górniczej "ZEG" – project leader (Mining Electronics factory "ZEG" Inc. in Tychy) and Gliwice Zakład Projektowania i Doradztwa Technicznego "Gorprojekt" (Design and Technical Advising Company "GORPROJEKT" Ltd. in Gliwice) and Czech Company "TEDOM" s.r.o
16/10/2008	Decision of the President of Gliwice AB-7353/1368/2008 No project has been approved construction and authorization for the construction of generator,
29/04/2009	The complete, final acceptance of works related to construction unit generator,
05/29/2009	Confirmation of acceptance by the County Building Supervision Inspectorate for the City of Gliwice notification dated 15.5.2009, and no objections to the accession to the use of building. Starting the unit
20/04/2010	The KW S.A.'s Board voted a resolution to launch an unrestricted tender entitled:

	„Construction of installation for combustion of coal mine gas taken by surface methane recovery stations in KW S.A. Division Zachód, Departament „Knurów-Szczygłowice" Ruch „Szczygłowice" and KWK „ Sośnica-Makoszowy" Ruch Sośnica.
11/06/2010	Opening the tender for „Construction of installation for combustion of coal mine gas taken by surface methane recovery stations in KW S.A. Division Zachód, Departament „Knurów-Szczygłowice" Ruch „Szczygłowice" and KWK „ Sośnica-Makoszowy" Ruch Sośnica
20/07/2010	Signing of an agreement no. e-Ru nr 3310008813 for „Construction of installation for combustion of coal mine gas taken by surface methane recovery stations in KW S.A. Division Zachód, Departament „Sośnica-Makoszowy" Ruch „Sośnica" with consortium consisting of„OPA-ROW" Spółka z o.o. with headquarters in Rybnik and ZPiDT „Gorprojekt" Spółka z o.o. with headquarters in Gliwice.
1/05/2011	The flare stack starts operating.

A.3. Project participants:

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Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Poland (Host Party)	Kompania Węglowa S.A. (Kompania Coal Company)	No
	Kopalnia Węgla Kamiennego „Sośnica-Makoszowy" – Ruch Sośnica (The SOSNICA Coal Mine)	
	Główny Instytut Górnictwa (The Central Mining Institute)	
Japan	The Chugoku Electric Power Co., Inc.	No

Kompania Węglowa S.A. (Kompania Coal Company) – project owner, and project implementation entity. State treasury sole propriety Company. Total mining area 718.2 km2, Operational coal deposits - 285.81 million tons, Share capital - PLN 497 620 100, employment – 66 thousands workers.

Kopalnia Węgla Kamiennego „ Sośnica-Makoszowy" – Ruch Sośnica (The SOSNICA Coal Mine) – owner of project site and responsible for project management. Coal mining plant, affiliate to KW SA. Mining area –32.4 km2**.** Operational coal deposits – 64,383 thous. tones, employment – 5,423 workers.

Główny Instytut Górnictwa (Central Mining Institute) – institute employed for JI procedure performance and implementation. Scientific institute directly subordinated to the Minister of Economy, working for the benefit of the mining industry.

The Chugoku Electric Power Co., Inc– Japanese Power Company pursuing implementation of the project, participates in preparation of the JI project. The company acquires all ERUs generated in this project.

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: Poland

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

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Slaskie Province (Województwo Śląskie)

Figure A-1. Map of Poland, indicating Slaskie Province

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

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Gliwice City

Geographical coordinates: N:50˚16’29.54” E:18˚42’49.00”

Figure A-2. Location of the project

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

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The SOSNICA Coal Mine's Mining Area is located in Upper Silesian Coal Basin (Górnośląskie Zagłębie Węglowe). Total of 60.8 km2 SOSNICA mining area is predominately rural with low-density housing, farmlands, meadows, and woodlands. Residential area with high-density housing or medium-density housing in Gliwice district occupies small part of the mining area.

Upper Silesian Coal Basin lies in the historical regions of Upper Silesia in southern Poland and Czech Republic. The basin constitute homogeneous geological and geographical area covering 5.4 thous. km2 and containing the largest coal deposit both in Czech and Poland. Deposit on level 1,000 m is estimated at 70 million tones of which around 10-15% have been extracted to date. Except coal zink and lead are mined in the region. Polish part of Upper Silesian Coal Basin is 4.5 thous. km2 being the most industrialized and urbanized part of Poland.

Division Sośnica is part Colliery "Sośnica- Makoszowy". Division Sośnica's coal reserves are estimated of around 121,935 million tones. Currently it employs about 2509 people (with Division Makoszowy, total 5423 people). Division Sośnica and his West Field is equipped with three shafts: the No 3 shaft (of 550 m) and the No 4 shaft (of 950 m) are used for the output extraction at the rate of up to 10 000 tones a day and also used for conveyance of men and materials. Mineral is extracted from levels of 550m, 750 m meters below ground. Shaft No 7(950 m) function to act as ventilation (fresh air). All seams are gassy and classified to the third and fourth level of methane explosion hazard.

A.4.2. Category(ies) of project activity:

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Sectoral Scope 8: Mining/mineral production,
Sectoral Scope 10: Fugitive emissions from fuels (solid, oil and gas)

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

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The recovered methane shall be utilized in a newly constructed CHP located in SOSNICA Coal Mine site, and three stages approach is being considered.

At stage 1 (since 11 March. 2007 - starting of operation: launching the surface methane recovery station), the ventilation system has been improved by building a Methane Recovery Station at the surface consisting 3 operational pumping units and 1unit in reserve. The maximum capacity of the pumps is 160m3/min.

At stage 2 (since 29 May. 2009 - starting of operation: the complete, final acceptance of works related to construction unit generator), a CMM powered newly constructed gas engine (Deutz Energy TCG 2020 V20) was installed as Combined Heat and Power System (CHP) to produce 1,934 kW of electrical and 1,937 kW of thermal power. Its expected annual power generation is 13,925MWh with the net electricity of 12,532MWh and annual heat generation is 50,207GJ with the net heat generation of 45,186GJ . As the result 2,267 tonnes of CH4 will be destroyed. Here for the purpose of enhancing the safety around the gas engine installation, heat utilization from the gas engine will be started in 2013, which is expected to reduce the temperature of the exhaust gas. Proposed gas engine is one of the best available gas engines in the world which can be run with low concentration of methane, and is designed to run on unprocessed CMM.

At stage 3 (since 1 May. 2011 - starting of operation of flare stack), CMM burns in a newly constructed flare stack with a maximum capacity of 20Nm3-CH4/min.

The improvement of the ventilation system has already been done and the CHP unit has been implemented yet.

A schematic for the CMM extraction and utilization is shown below:

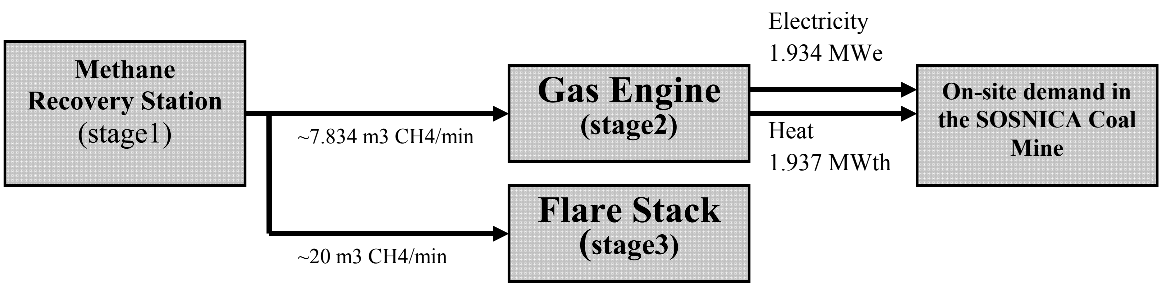

Figure A-3. Schematic view of the CMM collection and treatment system.

A.4.4. 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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Before the project implementation the captured CMM was totally emitted to the atmosphere (base line). The mine neither captures nor uses Coal Bed Methane (CBM). There are no national, local or sectoral legislation requiring compulsory extraction of the CMM.

Detailed explanation of why BAU is the most probable scenario representing the baseline is provided in

Section B "Application of a baseline methodology".

A.4.4.1. Estimated amount of emission reductions over the crediting period:

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Length of the crediting period	10 years (since 29 May. 2009 – 28 May 2019)
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2009	24,480
Year 2010	41,175
Year 2011	112,088
Year 2012	146,820
Total estimated emission reductions over the first commitment period (tones of CO_2 equivalent)	324,563
Annual average of estimated emission reductions over the first commitment period/period within which ERUs are to be generated (tones of CO_2 equivalent)	90,294
Year 2013	151,095
Year 2014	151,095
Year 2015	151,095
Year 2016	151,095
Year 2017	151,095
Year 2018	151,095
Year 2019	43,260
Total estimated emission reductions between 2013 and 2019 (tones of CO_2 equivalent)	949,830
Annual average of estimated emission reductions between 2013 and 2019/period within which ERUs are to be generated (tones of CO_2 equivalent)	148,284
Total estimated emission reductions over the crediting period (tones of CO_2 equivalent)	1,274,393
Annual average of estimated emission reductions over the crediting period/period within which ERUs are to be generated (tones of CO_2 equivalent)	127,439

A.5. Project approval by the Parties involved:

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The acceptance of the project by the host party, Poland with a Letter of Approval is expected.
The acceptance of the project by the investor party, Japan with a Letter of Approval was achieved on 16th December 2010.

SECTION B. Baseline

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

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B.1.1 Indication and description of the approach chosen regarding baseline setting

ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical and motive) and heat and/or destruction through flaring or flameless oxidation" version 07 approved by CDM Executive Board on 30 July 2010.

Methodological Tool "Tool for the demonstration and assessment of additionality (version 5.2)" agreed by the Executive Board.

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

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	Excluded
Underground boreholes in the mine to capture pre mining CMM	Included
Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM	Included
Ventilation air methane that would normally be vented.	Included

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 flameless oxidation	Excluded
The methane is captured and destroyed through utilisation 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	CMM is collected and destructed by combustion in the process of heat and power production.
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	The CMM collected in the project will be destroyed through flaring as well as utilized for heat and power production.

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	SOSNICA Coal Mine is 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 virgin coal bed methane, e.g. methane of high quality extracted from coal seams independently of any mining activities	Extraction activities are concomitant with coal production
Use CO2 or any other fluid/gas to enhance CBM drainage before mining takes place.	No CBM extraction activities are involved in the project

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.

B1.2 Application of the approach chosen

ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical and motive) and heat and/or destruction through flaring or flameless oxidation" version 07 is applied to the SOSNICA 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 CBM or CMM or VAM

Step 1a. Options for CBM and CMM or VAM extraction

The baseline scenario Scenarios should include all possible options that are technically feasible to handle CBM and CMM or VAM to comply with safety regulations. These options could include:

A. Pre mining CMM extraction including CBM to Goaf drainage and/or Indirect CBM to Goaf only;
B. Post mining CMM extraction;
C. Possible combinations of options A, B, and C with the relative shares of gas specified.

Option A (pre mining CMM), and Option B (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. Therefore, option A and B are the technically feasible options for CMM extraction.

In SOSNICA Coal Mine the coal seams have a very low permeability. Therefore it is not possible to extract CBM before strata is de-stressed due to mining of the coal unless applying special measure to enhance CBM drainage. This is confirmed by the following statement. *"On account of low gas* *permeability of polish coals (around 1mD and lower) coal bed degasification are performed mainly in excavation headings through surface or underground injector recovery stations."*[1]

Therefore in the case of SOSNICA Coal Mine, option A excluding CBM and option B are options that are technically feasible to extract CMM for utilizing purpose, which is the current situation at the SOSNICA Coal Mine.

Step 1b. Options for extracted CMM treatment

Several approaches can be taken to treat the captured CMM at SOSNICA Coal Mine:

(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.

Some of these options were considered as possible alternatives for the baseline scenario. In Step 3 of this section some of these options will be further developed into baseline scenario alternatives. The generation of own energy is one of the requirements for developing this project. The project is covered by the option (viii) – the combination of option (iii), (v) and (vi).

Step 1c. Options for energy production
Realistic and credible alternatives available for the relevant forms of energy production are:

<u>Electricity</u>
E1. Continue to use electricity from the National Power Grid
E2. Electricity from gas engine on CMM, the National Power Grid

<u>Heat</u>
H1. Continue to use heat from the existing coal boilers.
H2. Heat from the gas engine on CMM and the existing coal boilers.

Step 2. Eliminate baseline options that do not comply with legal or regulatory requirements

All options are comply with Polish legal or regulatory requirements. (There is no law 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

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[1] Source: Paweł KRZYSTOLIK , "UTILIZATION OF COALMINE METHANE IN COMBINED POWER MANAGEMENT –OPPORTUNITY FOR COAL MINING COST-CUT.", Chapter 2, Course materials 2002 of School of Underground Mining.

As mentioned Step 1a.pre mining CMM extraction is the only option that is technically feasible to extract CMM for utilizing purpose.

The following Scenarios can be considered for implementation at the SOSNICA Coal Mine and these Scenarios are in compliance with the options as listed in step 1b and step 1c. For all possible Scenarios the mine has to extract the CMM from the mine for safety reasons. Therefore the Scenarios below assume extraction as described in step 1a and describe in detail the Scenarios for treatment and utilization.

Scenarios for CMM treatment includes:

Scenario 1.Venting of CMM, continue to use electricity from the National Power Grid and to use heat from the existing coal boilers (i+E1+H1)
The CMM will be vented to the atmosphere. The SOSNICA Coal Mine continues to use electricity from the Power Grid and heat from the existing coal boilers. This is a Business As Usual scenario in the SOSNICA Coal Mine.

Scenario 2. Destroying ventilation air methane, continue to use electricity from the National Power Grid and to use heat from the existing coal boilers (ii+E1+H1)
The Ventilation Air Methane may simply be destroyed through Thermal Flow Reversal Reactor (TFRR). The SOSNICA Coal Mine continues to use electricity from the Power Grid and heat from the existing coal boilers.

Scenario 3. Flaring of CMM, continue to use electricity from the National Power Grid and to use heat from the existing coal boilers (iii+E1+H1)
The CMM may simply be destroyed through flaring. The SOSNICA Coal Mine continues to use electricity from the Power Grid and heat from the existing coal boilers.

Scenario4 . Using CMM for additional new captive power generation (v+E2+H1)
The CMM will be consumed in a gas engine that generates electricity for use directly at the SOSNICA coal mine. The shortage of electricity will be supplied from the Power Grid and heat continues to be supplied totally from the existing coal boilers.

Scenario 5. Using CMM for additional new captive combined heat and power generation (CHP).(v+vi+E2+H2)
The CMM will be consumed in a gas engine for electricity generation and heat generation. Generated electricity and heat are used directly at the SOSNICA coal mine and the shortage of electricity and heat will be supplied from the Power Grid and the existing coal boilers respectively.

Scenario 6. Using CMM for additional captive new power generation *and feeding CMM into a gas pipeline for electricity and/or heat generation (v+vii+E2+H1)*
The CMM will be consumed in a gas engine for electricity generation and also supplied to a gas pipeline for electricity and/or heat generation for commercial//household use. Generated electricity from a gas engine is used directly at the SOSNICA coal mine and the shortage of electricity will be supplied from the Power Grid. Heat continues to be supplied from the existing coal boilers.

Scenario 7. Flaring of CMM and Using CMM for additional new captive combined heat and power generation. (iii + v+E2+H2)
This scenario is the combination of Scenarios 2 and 4. In this case generated electricity and heat are used directly at the SOSNICA coal mine. The shortage of electricity and heat will be supplied from the Power Grid and from the existing coal boilers respectively. This Scenario constitutes the proposed JI project activity without the incentive of the project as a JI.

Scenario8. Feeding CMM into a new gas pipeline for electricity and/or heat generation (vii +E1+H1)
The CMM will be supplied to a gas pipeline for electricity and/or heat generation for commercial/household use. The SOSNICA Coal Mine continues to use electricity from the Power Grid and heat from the existing coal boilers.

Step 4. Eliminate baseline scenario alternatives that face prohibitive barriers

Barriers that are specific to alternative scenario are as follows:

Scenario 1.Venting of CMM (i+E1+H1)
This is BAU scenario. No barrier exists for this Scenario.

Scenario 2. Destroying ventilation air methane, continue to use electricity from the National Power Grid and to use heat from the existing coal boilers (ii+E1+H1)
Using/Destroying ventilation air methane is not required by the existing Polish regulation. Also the destruction of ventilation air methane was not considered as the concentration of methane in the ventilation air is too low to make destruction technically feasible. So obviously, this scenario faces technological barriers.

Scenario 3. Flaring of CMM, continue to use electricity from the National Power Grid and to use heat from the heat grid (iii+E1+H1)
Flaring of the CMM is not required by the existing Polish regulation. Flaring also requires additional cost without any revenue can be created. So obviously, it faces barriers from investment.

Scenario 4. Using CMM for additional captive new power generation (v+E2+H1)
In Poland, there is no favorable regulation on tax reduction for CMM power generation. In addition, the capital cost will be huge and then the IRR for this Scenario is quite low as shown in Section B.2 of this PDD. Without the financial assistance from JI, such investment in Poland is obviously not feasible. Therefore this Scenario faces financial barrier.

Scenario 5. Using CMM for additional new captive combined heat and power generation (CHP).(v+vi+E2+H2)
In Poland, there is no favorable regulation on tax reduction for CMM power and heat generation. In addition, the capital cost will be huge and then the IRR for this Scenario is quite low as shown in Section B.2 of this PDD. Without the financial assistance from JI, such investment in Poland is obviously not feasible. Therefore this Scenario faces financial barrier.

Scenario 6. Using CMM for additional captive new power generation *and feeding CMM into a gas pipeline for electricity and/or heat generation (v+vii+E2+H1)*
In Poland, there is no favorable regulation on tax reduction for CMM power generation. In addition, a new connection to an existing pipeline has to be made. So the capital cost and the costs of the lacking piping infrastructure make this Scenario economically not viable as shown in Section B.2 of this PDD. Therefore this Scenario faces financial barrier.

Scenario 7. Flaring of CMM and Using CMM for additional new captive combined heat and power generation. (iii + v+E2+H2)
Flaring of the CMM is not required by the existing Polish regulation. Flaring also requires additional cost without any revenue can be created. In Poland, there is no favorable regulation on tax reduction for CMM power generation. In addition, the capital cost will be huge and then the IRR for this Scenario is quite low as shown in Section B.2 of this PDD. Without the financial assistance from JI, such investment in Poland is obviously not feasible. Therefore this Scenario faces financial barrier.

Scenario8. Feeding CMM into a new gas pipeline for electricity and/or heat generation (vii +E1+H1)
At the SOSNICA coal mine, a new gas pipeline would have to be constructed. So the capital cost and the costs of the lacking piping infrastructure make this Scenario economically not viable as shown in Section B.2 of this PDD. Therefore this Scenario faces financial barrier.

As a result, a continuation of the existing situation which is to vent CMM into the atmosphere, purchase of electricity from the grid , continue to use heat from the existing coal boilers (*Scenario 1*) is the only plausible baseline scenario candidates if without JI assistance. Please refer to the investment analysis described in B.2.

2. Calculation of emissions reductions

The emissions reduction 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 Emissions

According to ACM0008/Version 07 Equation (1), project emissions are defined in Equation (B.1.1).

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (B.1.1)$$

Where:

- PE_y - Project emissions in year y (tCO2e)
- PE_{ME} - Project emissions from energy use to capture and use methane (tCO2e)
- PE_{MD} - Project emissions from methane destroyed (tCO2e)
- PE_{UM} - Project emissions from un-combusted methane (tCO2e)

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 Equations (2) of ACM0008/Version 07. In the proposed project, there is no additional heat or fossil fuel consumption. Therefore additional heat consumption $CONS_{HEAT, PJ}$ and additional fossil fuel consumption $CONS_{FOSSFUEL, PJ}$ for capture and use or destruction of methane have been deleted from Equation (2) of the Methodology. The project activity needs electricity from the grid for operating the Methane Recovery Station and the CHP.

$$PE_{ME} = CONS_{ELEC, PJ} \times CEF_{ELEC} \quad (B.1.2)$$

Where:

- PE_{ME} - Project emissions from energy use to capture and use or destroy methane (tCO2e)
- $CONS_{ELEC, PJ}$ - Additional electricity consumption for capture and use or destruction of methane, if any (MWh)
- CEF_{ELEC} - Carbon emissions factor of electricity used by coal mine (tCO2e/MWh)

Here, the detailed calculation formula for $CONS_{ELEC, PJ}$ is shown in Annex 3.

2.1.2. Combustion emissions from use of captured methane

Project emissions from destructed methane are defined in ACM0008/Version 07 Equation (3) to (B.1.3).

Incidentally, methane destroyed through heat generation MD_{HEAT}, methane destroyed through flameless oxidation MD_{OX}, and methane destroyed after being supplied to the gas grid or used in vehicles MD_{GAS} have been deleted from ACM0008/Version 07 Equation (3) because corresponding equipment does not exist.

$$PE_{MD} = (MD_{FL} + MD_{ELEC}) \times (CEF_{CH4} + r \times CEF_{NMHC}) \quad (B.1.3)$$

With:

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

Where:

PE_{MD}	-	Project emissions from CMM/CBM destroyed (tCO2e)
MD_{FL}	-	Methane destroyed through flaring (tCH4)
MD_{ELEC}	-	Methane destroyed through power generation (tCH4)
CEF_{CH4}	-	Carbon emission factor for combusted methane (2.75 tCO2/tCH4)
CEF_{NMHC}	-	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO2/tNMHC)
r	-	Relative proportion of NMHC compared to methane
PC_{CH4}	-	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
PC_{NMHC}	-	NMHC concentration (in mass) in extracted gas (%)

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

Where:

MD_{FL}	-	Methane destroyed through flaring (tCH4)
MM_{FL}	-	Methane measured sent to flare (tCH4)
PE_{flare}	-	Project emissions of non-combusted CH4, expressed in terms of CO2e, from flaring of the residual gas stream (tCO2e)
GWP_{CH4}	-	Global warming potential of methane (21 tCO2e/tCH4)

Here, the project emissions from flaring ($PE_{flare,\,y}$) are determined as described in Annex 4.

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC} \quad (B.1.6)$$

Where:

MD_{ELEC}	-	Methane destroyed through power generation (tCH4)
MM_{ELEC}	-	Methane measured sent to power plant (tCH4)
Eff_{ELEC}	-	Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)

2.1.3. Un-combusted methane from project activity

Project emissions of non-combusted methane are defined in ACM0008/Version 07 Equation (10) to Equation (B.1.8). Incidentally, the measured amount of methane MM_i used for the objective of i in ACM0008/Version 07 Equation (10) shall be 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.

$$PE_{UM} = GWP_{CH4} \times [MM_{ELEC} \times (1-Eff_{ELEC})] + PE_{flare} \quad (B.1.7)$$

Where:

PE_{UM}	-	Project emissions from un-combusted methane (tCO2e)
GWP_{CH4}	-	Global warming potential of methane (21 tCO2e/tCH4)

MM_{ELEC}	-	Methane measured sent to power plant (tCH4)
Eff_{ELEC}	-	Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)
PE_{flare}	-	Project emissions on non-combusted CH4 expressed in terms of CO2e from flaring of the residual gas stream (tCO2e)

2.2 Baseline Emissions

In SOSNICA Coal Mine, there is no destruction from methane in the baseline scenario.
Therefore according to ACM0008/Version 07 Equation (11), baseline emissions are defined in Equation (B.2.1).

Here, the proposed project will contribute to GHG emissions reductions by replacement of power consumption from the grid with electricity generated in CHP, but these emission reductions can not be claimed as Emission reduction units (ERUs) for the purpose of avoiding indirect double-counting under EU-ETS.

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

Where:

BE_y	-	Baseline emissions in year y (tCO2e)
$BE_{MD,y}$	-	Baseline emissions from destruction of methane in the baseline scenario in year y (tCO2e)
$BE_{MR,y}$	-	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
$BE_{Use,y}$	-	Baseline emissions from the production of power, heat or supply to gas grid Replaced by the project activity in year *y* (tCO_2e)

Here, there was no CMM destruction/use in the baseline so that $BE_{MD,y}$ equals zero (0).

2.2.1. 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 07 Equation (16) to Equation (B.2.2). Incidentally, since CBM, PMM, and VMM in ACM0008/Version 07 Equation (16) are not pertinent to the project, the related equations are omitted.

$$BE_{MR,y} = GWP_{CH4} \times [(CMM_{PJ,ELEC,y} + PMM_{PJ,ELEC,y} + CMM_{PJ,FL,y} + PMM_{PJ,FL,y})] \quad (B.2.2)$$

Where:

$BE_{MR,y}$	-	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
$CMM_{PJ,ELEC,y}$	-	Pre-mining CMM captured, sent to and destroyed by power generation in the project in year y (expressed in tCH4)
$PMM_{PJ,ELEC,y}$	-	Post-mining CMM captured, sent to and destroyed by power generation in the project in year y (expressed in tCH4)
$CMM_{PJ,FL,y}$	-	Pre-mining CMM captured, sent to and destroyed by flaring in the project in year y (expressed in tCH4)
$PMM_{PJ,FL,y}$	-	Post-mining CMM captured, sent to and destroyed by flaring in the project in year y (expressed in tCH4)
GWP_{CH4}	-	Global warming potential of methane (21 tCO2e/tCH4)

2.2.2 Emission from heat generation replaced by project

Total baseline emissions from the production of heat replaced by the project activity in year y(tCO2) is defined by following expression based on expression (24),(26),of ACM0008/version 07.
In addition, terms related to VAM, CBM and PMM defined by ACM0008/version 07 are ignored since they are not applicable. Also terms related to power replacement can not be claimed as Emission reduction unit (ERUs) for the purpose of avoiding indirect double-counting under EU-ETS.

$$BE_{Use,y} = HEAT_y \times EF_{HEAT} \quad (B.2.3)$$

Where:

$BE_{Use,y}$ - Total baseline emissions from the production of heat replaced by the project activity in year y (tCO_2)
$HEAT_y$ - Heat generation by project activity(gas engine) in year y (GJ)
EF_{HEAT} - Emissions factor for heat production replaced by project activity (tCO_2/GJ)

2.2.2.1 Heat generation emissions factor
Heat generation emissions factor in year y is defined by following expression based on express(32) of ACM0008/version 07 .

$$EF_{heat,y} = \frac{EF_{CO2,j}}{Eff_{heat}} \cdot \frac{44}{12} \cdot \frac{1TJ}{1000GJ} \quad (B.2.4)$$

Where:

$EF_{heat,y}$ - Emissions factor for heat generation (tCO_2/GJ)
$EF_{CO2,I}$ - CO_2 emissions factor of fuel used in heat generation (tC/TJ)
Eff_{heat} - Boiler efficiency of the heat generation (%)
44/12 - Carbon to Carbon Dioxide conversion factor
1/1000 - TJ to GJ conversion factor

2.3 Leakage

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y}$$

Where:
LE_y: Leakage emissions in year y (tCO_2e)
$LE_{d,y}$: Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y(tCO_2e)
$LE_{o,y}$: Leakage emissions due to other uncertainties in year y (tCO_2e)

The leakage of a JI project activity could result from the following:
- ✓ Displacement of baseline thermal energy uses;
- ✓ CBM drainage from outside the de-stressed zone;
- ✓ Impact of JI project activity on coal production;
- ✓ Impact of JI project activity on coal prices and market dynamics;

Considering the following facts of the proposed project:
- ✓ In the absence of the project activity, all the LCM is released into the atmosphere without any utilization. Therefore, no baseline thermal energy demand from LCM and $LE_{d,y}$=0.
- ✓ No CBM drainage is involved
- ✓ The JI project activity is too small to have impact on coal production.

✓ This project is too small to have a impact on the coal prices and market dynamics.

Therefore, $LE_{o,y}$=0 and no leakage effects need to be accounted for under this proposed project, LE_y=0.

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 ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and project emissions (PE_y), as follows:

$$ER_y = BE_y - PE_y \quad \text{(B.4.1)}$$

Where:

- ER_y - Emissions reductions of the project activity during the year y (tCO2e)
- BE_y - Baseline emissions during the year y (tCO2e)
- PE_y - 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 version 5.2 of the "Tool for the demonstration and assessment of additionality" agreed by the Executive Board.*

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.

As a benchmark for judging the feasibility of investment (hurdle rate), a stockholder expected rate of return, which is calculated based on CAPM (Capital Asset Pricing Model) with reflecting a risk premium and is generally used abundantly in Discount Cash Flow Method (DCF Method), is used. In addition, since this project will be carried out as a self-financed project, it is not necessary to take into consideration a funding cost for debt.

The calculation formula of the stockholder expected rate of return based on CAPM is as follows.

$$Re = Rf + \beta \times (Rm - Rf)$$

Where:

Re : Expected rate of return (hurdle rate)

Rf: Rate of return against the investment considered to be risk-free (usually long-term government bond etc.)

β : Coefficient indicating a uncertain-return risk related to the enterprise characteristic

Rm : Average expected rate of return of a stock market

Each setting value and its explanation, and the result of a stockholder expected rate of return are shown in the following table.

Table B-4. Calculation of Expected rate of return

Factor	Value	Explanation
Rf	6.75%	Assumed as the interests of the ten-year national bond of Poland as 6.75%. This value is calculated by averaging the value of January and February in 2004.
β	1.0	Generally "β" of the power industry is set as 1 or less. However, since this project will utilize CMM which has uncertainty in supply, I think this β setting is conservative enough.
Rm	11.31%	Cited Average expected rate of return of Warsaw Stock Exchange Market from Mizuho Research Institute's report[2]
Re	11.31%	hurdle rate

Reference: http://www.bloomberg.com/, http://www.obligacjeskarbowe.pl/

Thus a hurdle rate that might be assumed for this project using this method is 11.31%.

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 income (electricity tariff, etc). Table B-5 presents key economic parameters and the Project IRRs of the project scenario without a JI incentive (Scenario 7) and other Scenarios which generate financial benefits (Scenario 4, 5, 6 and 8).

Table B-5. Key economic parameters and the Project IRRs of the relevant Scenarios

Indicator	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Total initial Cost	20,987(thou. PLN)	22,623(thou. PLN)	29,603(thou. PLN)	29,598(thou. PLN)	21,674(thou. PLN)
Install Capacity					
- Gas Engine	1,934(kWe)	1,934(kWe)+ 1,937(kWth)	1,934(kWe)	1,934(kWe) + 1,937(kWth)	-
-Flare Stack	-	-	-	20m3-CH4/min	-
-CMM Sales	-	-	MAX65m3-CH4/min	-	MAX65m3-CH4/min
Electrical energy saving cost	199.61(PLN/MWh)	-	199.61(PLN/MWh)	199.61(PLN/MWh)	199.61(PLN/MWh)
Heat energy saving cost (In case of replacing the gas boiler's heat)	-	26.37(PLN/GJ)	-	26.37(PLN/GJ)	-
CMM sales unit price	-	-	0.04(PLN/m3-CH4)	-	0.04(PLN/m3-CH4)
Project IRR(Pre tax)	-10.8%	-0.2%	-5.5%	-3.5%	-

Remarks: "-" in the Project IRR (Pre tax) row means that the profitability is too low to calculate the Project IRR with excel function.

Reference: The total initial cost, the install capacity, the electrical energy saving cost, the heat energy saving cost and the CMM sales unit price were provided from the Sosnica coalmine.

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[2] MIZUHO Report(11th, May, 2006)「Global comparison on stock markets -Change of the growth possibility and the scale of world stock market, and performance after risk adjustment-」

The results indicate that the above scenarios in Table B-5 are not financially attractive when compared to the benchmark value of 11.31%.

Sub-step 2d: Sensitivity analysis
In the case of the scenarios 4, 5, 6, 7 and 8, total initial cost, operating cost and income (cost saving) 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 10%.

Table B-6. IRR (Pre tax) sensitivity analysis for the expected parameters

Scenario	Sensitivity factors	−10%	−5%	0%	5%	10%
Scenario 4	Initial cost	−9.7%	−10.3%	−10.8%	−11.3%	−11.8%
	Operating Cost	−7.1%	−8.8%	−10.8%	−13.5%	−
	Income(Cost Saving)	−	−14.2%	−10.8%	−8.4%	−6.3%
Scenario 5	Initial cost	1.1%	0.4%	−0.2%	−0.8%	−1.3%
	Operating Cost	1.2%	0.5%	−0.2%	−1.0%	−1.8%
	Income(Cost Saving)	−3.2%	−1.6%	−0.2%	1.1%	2.3%
Scenario 6	Initial cost	−4.3%	−4.9%	−5.5%	−6.0%	−6.5%
	Operating Cost	−3.8%	−4.6%	−5.5%	−6.4%	−7.5%
	Income(Cost Saving)	−8.8%	−7.0%	−5.5%	−4.1%	−2.8%
Scenario 7	Initial cost	−2.2%	−2.9%	−3.5%	−4.0%	−4.5%
	Operating Cost	−2.0%	−2.7%	−3.5%	−4.2%	−5.0%
	Income(Cost Saving)	−6.4%	−4.8%	−3.5%	−2.2%	−1.0%
Scenario 8	Initial cost	−	−	−	−	−
	Operating Cost	−	−	−	−	−
	Income(Cost Saving)	−	−	−	−	−

Remarks: "-" means that the profitability is too low to calculate IRR with excel function.

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

In Poland there are about 30 active coal mines and, according to State Mining Authority, 27 of them were classified as plants methane. Methane Recovery Installations operate in 20 mines, but much of the methane release to the atmosphere. As the most vulnerable methane is emitted from the coalmines belonging to JSW (Pniówek, Zofiówka, Krupiński) and KW S.A (Sośnica-Makoszowy). CHP systems that use coal mine methane are built only in less than 10 mines (including Mine Knurów – Szczygłowice and Sośnica – Makoszowy).

Table B-7. Selected information for domestic use coalmine gas to gas engines.

Mine	Fuel	Coal Company	Power [MW_{el}]	Year of starting	Amount of engines
Krupiński	Coal mine gas	JSW S.A	3.0/3.9	1997/2005	2
Bielszowice	Coal mine gas	KW S.A	0.54	1999	1
Halemba	Coal mine gas	KW S.A	0.54	1999	1
Pniówek	Coal mine gas	JSW S.A	3.2/3.2 3.9	2000 2006	2 1
Borynia	Coal mine gas	JSW S.A	1.8	2008	1

JSW S.A – Jastrzębska Spółka Węglowa S.A
KW S.A – Kompania Węglowa S.A

One of the latest cogeneration installations (2010), which produces electricity and heat from mine methane (2.8 MW_{el}) is located in Mine Mysłowice-Wesoła belonging to the Katowicki Holding Węglowy. The investment was partially funded by Regional Fund Environmental Protection and Water Management in Katowice.

Investments in the use of methane from drainage of the above mines were implemented with the support of the PHARE Program (Halemba coalmine, Bielszowice coalmine), National Fund Environmental Protection and Water Management - in the form of grants and concessional loans (Pniówek coalmine, Krupiński coalmine) and funding from other mechanisms related to environmental protection such as Joint Implementation(Borynia coalmine).

In addition, there is no flare stack installation fueled with CMM.

In conclusion, it is obvious that the scenarios 4, 5, 6, 7 and 8 are not baseline scenarios. Therefore without additional support possible from JI, the project scenario (Scenario 7) 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:

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A schematic overview of the special project boundary is presented in Figure B-1 below.

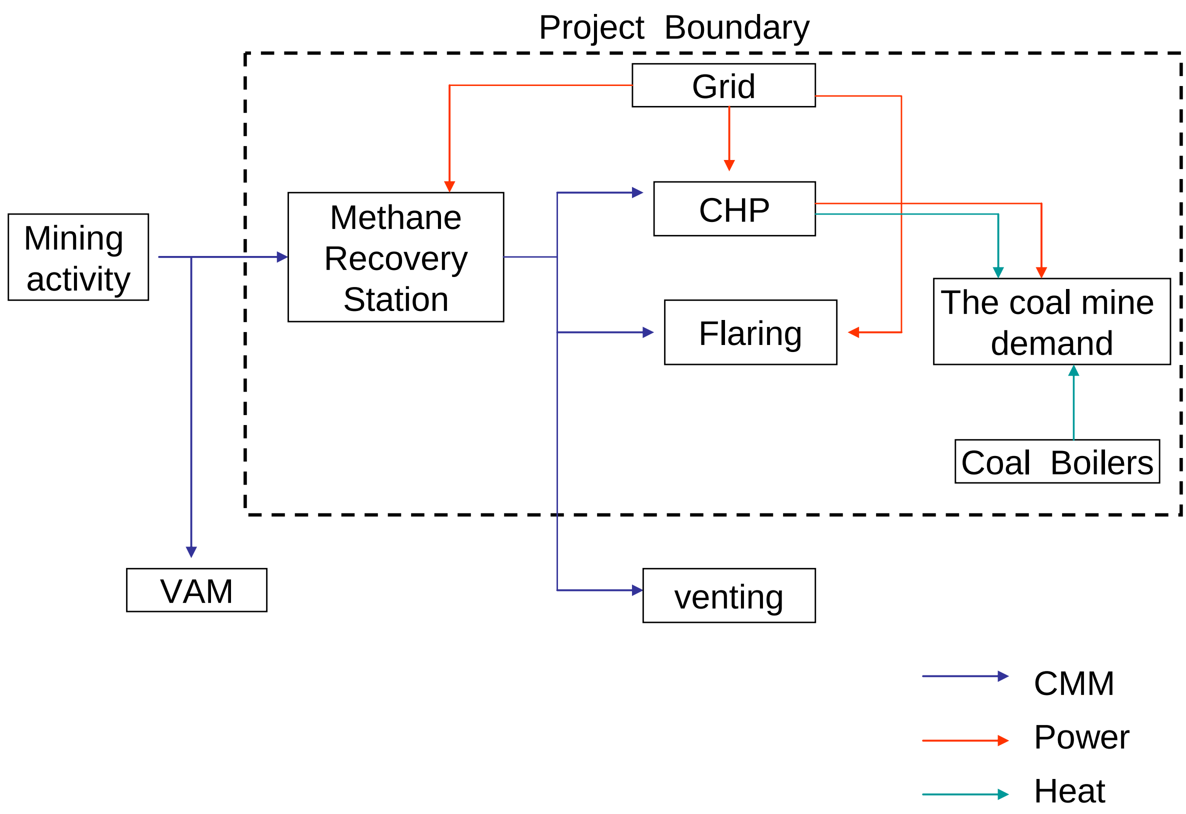

Figure B-1. Project boundaries

Table B-7 below, taken from ACM0008, illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

Table B-7 Overview on emission sources included on or excluded from the project boundary

	Source	**Gas**	**Include or exclude**	**Note**
Baseline Emissions	Emissions of methane as a result of venting	CH_4	Included	Main emission source.
	Emission from destruction of methane in the baseline	CO_2	Excluded	There is neither flaring nor use for heat and power in the baseline scenario.
		CH_4		
		N_2O		
	Grid electricity generation (electricity	CO_2	Excluded	Excluded for avoiding the indirect double counting under the EU-ETS.

	provided by the gird)	CH_4		This is conservative.
		N_2O		
	Captive power and/or heat, and vehicle fuel use	CO_2	Included	From the combustion of coal in heat generation.
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Emissions	Emissions of methane as a result of continued venting	CH_4	Excluded	Only the change in CMM emission release will be taken into account by monitoring the methane used or destroyed by the project activity.
	On-site fuel consumption due to the project activity, including transport of the gas	CO_2	Included	If additional equipments such as compressors are required on top of what is required for purely drainage, energy consumption from such equipment should be accounted for.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from methane destruction	CO_2	Included	From the combustion of methane in heat/power generation.
	Emissions from NMHC destruction	CO_2	Included	Only if NMHC exceeds 1% by volume of extracted CMM.
	Fugitive emissions of unburned methane	CH_4	Included	Small amount of methane will remain unburned in heat/power generation.
	Fugitive methane emissions from on-site equipment	CH_4	Excluded	Excluded for simplification.
	Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles	CH_4	Excluded	Excluded for simplification, but taken into account in leakage.
	Accidental methane release	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.

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 information are included in Annex 2.

Date of completion: 20/06/ 2011.

The baseline was determined by:

Name/origination Project participant	Project Participate Yes/No
Hideo Yata 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
Teruyuki Okada Renewable Energy and Carbon Business Team Global Structured Finance Division Mizuho Corporate Bank, Ltd. 4th Floor, Marunouchi 2-chome Building 5-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100-8333, JAPAN TEL +81-3-5220-7179 FAX +81-3-3201-6582	No

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

>>
The starting date of project implementation (Procurement of the first pipeline) is on 30/12/ 2004

C.2. Expected operational lifetime of the project:

>>
15 years 0 months

C.3. Length of the crediting period:

>>
10 years (from 29/05/2009 to 28/05/2019)

Breakdown of the length of the crediting period:
- 3years and 7months and 3 days (From 29/05/2009 till 31/12/2012, during the first commitment period)
- 6years and 4months and 28 days (From 1/1/2013 till 28/05/2019, after the first commitment period)

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 07 approved by CDM Executive Board on 30 July 2010. The title of the methodology: **"Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation"**

Also Methodological "Tool to determine project emissions from flaring gases containing methane" agreed by the Executive Board is refereed and then modified as described in Annex 4 as per the measurement and monitoring equipment.

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
Surface drainage wells to capture CBM associated with mining activities	Excluded
Underground boreholes in the mine to capture pre mining CMM	Included
Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM	Included
Ventilation air methane that would normally be vented.	Included

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 flameless oxidation	Excluded
The methane is captured and destroyed through utilisation 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	CMM is collected and destructed by combustion in the process of heat and power production.
The remaining share of the methane, to be diluted	Part of CMM is still vented in the proposed

for safety reason, may still be vented	project
All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented	The CMM collected in the project will be utilized for heat and power production as well as destroyed through flaring.

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

ACM0008 Applicability	**Proposed project activities**
Operate in open cast mines	SOSNICA Coal Mine is 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 virgin coal bed methane, e.g. methane of high quality extracted from coal seams independently of any mining activities	Extraction activities are concomitance with coal production
Use CO2 or any other fluid/gas to enhance CBM drainage before mining takes place.	No CBM extraction activities are involved in the project

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:

(1) Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination regarding the PDD

Data / Parameter:	**$CEF_{ELEC, PJ}$**
Data unit:	$tCO2/MWh$
Description:	Carbon emissions factor of electricity used by coal mine
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	The calculation was conducted based on the Eurostat Energy Monthly statistics.
Value of data applied (for ex ante calculations/determinations)	0.728 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Calculated as per "Tool to calculate the emission factor for an electricity system"
QA/QC procedures (to be) applied:	N/A
Any comment:	**$CEF_{ELEC, PJ}$** has been calculated by the PDD author.

Data / Parameter:	**$EF_{OM,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	The calculation was conducted based on the Eurostat Energy Monthly statistics.
Value of data applied (for ex ante calculations/determinations)	0.945 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Calculated as per "Tool to calculate the emission factor for an electricity system"
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

Data / Parameter:	**$EF_{BM,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	The calculation was conducted based on the Eurostat Energy Monthly statistics.
Value of data applied (for ex ante calculations/determinations)	0.511 tCO_2/MWh

Justification of the choice of data or description of measurement methods and procedure (to be) applied	Calculated as per "Tool to calculate the emission factor for an electricity system"
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

Data / Parameter:	**Eff_{ELEC}**
Data unit:	-
Description:	Efficiency of methane destruction/oxidation in power plant
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	IPCC
Value of data applied (for ex ante calculations/determinations)	Set at 99.5%
Justification of the choice of data or description of measurement methods and procedure (to be) applied	N/A
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO2e/tCH4
Description:	Global warming potential of methane
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	IPCC
Value of data applied (for ex ante calculations/determinations)	21
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Constant value define by IPCC
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

Data / Parameter:	**CEF_{CH4}**
Data unit:	tCO2e/tCH4
Description:	Carbon emission factor for combusted methane
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	IPCC
Value of data applied (for ex ante calculations/determinations)	2.75 (=44/16)
Justification of the choice of data or description of measurement methods and procedure (to be) applied	N/A
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

(2) Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are not available already at the stage of determination regarding the PDD

Not applicable

(3) Data and parameters that are monitored throughout the crediting period

Data / Parameter:	**$CONS_{ELEC, PJ}$**
Data unit:	MWh
Description:	Additional electricity consumption for capture and use or destruction of methane, if any
Time of determination/monitoring	Continuous measurement of electricity used by electricity meters. The monitored data is recorded electrically. But if the electrical recording equipment is not available, the data is recorded manually. Recorded values will be aggregated monthly and annually.
Source of data (to be) used:	Electricity meters installed on site
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by electricity meter.
QA/QC procedures to be applied:	Power meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 8 years according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

Data / Parameter:	**MM_{FL}**
Data unit:	tCH_4
Description:	Methane measured sent to flare
Time of determination/monitoring	Continuous
Source of data (to be) used:	Flow meters installed on site
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and calibration to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	Flow meters will record gas volumes, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.67kg/m3(2006 IPCC Guidelines for National Greenhouse Gas Inventories)

Data / Parameter:	**$PE_{flare, y}$**
Data unit:	tCO2e
Description:	Project emissions from flaring of the residual gas stream in the year y
Time of determination/monitoring	$PE_{flare,y}$ will be calculated at each verification

Source of data (to be) used:	Direct measurements of methane supplied and methane destroyed in the flare stack installation
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	According to the monitoring procedures PM-2 or PM-7.
QA/QC procedures to be applied:	See parameters VG, Wsp, kCH4 and kCH4sp
Any comment:	$PE_{flare, y}$ is determined as described in Annex 4

Data / Parameter:	$\eta_{flare, h}$
Data unit:	Percentage
Description:	Flare efficiency in the hour h
Time of determination/monitoring	$\eta_{flare, h}$ will be calculated at each verification
Source of data (to be) used:	Calculated on the basis of monitoring data, i.e. amounts of supplied/uncombusted methane or heat produced in the flare stack
Value of data applied (for ex ante calculation/determinations)	90%
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Evaluation of the flare efficiency $\eta_{flare, h}$ basing on the monitoring data is the most accurate approach
QA/QC procedures to be applied:	See parameters VG, Wsp, kCH4 and kCH4sp
Any comment:	-

Data / Parameter:	**VG**
Data unit:	m3/h
Description:	Volumetric flow rate of the residual gas in dry basis in the hour h
Time of determination/monitoring	Continuously. Values to be averaged hourly or at a shorter time interval
Source of data (to be) used:	Measurements by project participants using a flow meter.
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Measured on wet basis
QA/QC procedures to be applied:	The flow meter will be subject to a regular maintenance and testing regime to ensure its accuracy. Besides, it will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications by an officially accredited entity.
Any comment:	

Data / Parameter:	**Wsp**
Data unit:	m/s
Description:	Velocity of the exhaust gas of the flare in the hour h
Time of determination/monitoring	Continuously. Values will be averaged hourly or at a shorter time interval.
Source of data (to be) used:	Measurements by project participants using a continuous gas velocity sensor

Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Two pressure-based velocity sensors STA-300 of high accuracy, for the applications in high temperature environments. Additional improvement of accuracy is obtained by the application of two sensors in parallel
QA/QC procedures to be applied:	Velocity sensors will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications. A zero check and a typical value check will be performed by comparison with a standard gas.
Any comment:	2 velocity sensors (Wsp1 and Wsp2) are equipped and Wsp is calculated by averaging of the measurement data from both sensors.

Data / Parameter:	**kCH4**
Data unit:	%
Description:	Concentration of methane in the residual gas supplied to the flare in the hour h
Time of determination/monitoring	Continuously. Values will be averaged hourly or at a shorter time interval.
Source of data (to be) used:	Measurements by project participants using a continuous gas analyzer
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Extractive sampling analysers with water and particulates removal devices or in situ analyser for wet basis determination. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
QA/QC procedures to be applied:	Analyzers will be periodically calibrated according to manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard gas.
Any comment:	N/A

Data / Parameter:	**kCH4sp**
Data unit:	%
Description:	Concentration of methane in the exhaust gas of the flare in the hour h
Time of determination/monitoring	Continuously. Values will be averaged hourly or at a shorter time interval.
Source of data (to be) used:	Measurements by project participants using a continuous gas analyzer
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Extractive sampling analysers with water and particulates removal devices or in situ analyser for wet basis determination.
QA/QC procedures to be applied:	Analyzers will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications. A zero check and a typical value check will be performed by comparison with a standard gas.
Any comment:	N/A

Data / Parameter:	$\mathbf{T_{flare}}$
Data unit:	℃
Description:	Temperature in the exhaust gas of the flare
Time of	Continuously.

determination/monitoring	
Source of data (to be) used:	Measurements by project participants
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Measure the temperature in the flare by a Type S or N thermocouple
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated every year according to the polish regulations and/or the manufacturer's specifications.
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter:	**Mw**
Data unit:	kg/h
Description:	Mass flow of water of the flare stack cooling system in the hour h
Time of determination/monitoring	Continuously.
Source of data (to be) used:	Measurements by project participants using a continuous water flowmeter
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Water flow meter consisting of high accuracy pressure-based sensor (accuracy 0.1 %)
QA/QC procedures to be applied:	Water flowmeters will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

Data / Parameter:	**twz**
Data unit:	℃
Description:	Inlet water temperature in the flare stack cooling system in the hour h
Time of determination/monitoring	Continuously. Values will be averaged hourly or at a shorter time interval.
Source of data (to be) used:	Measurements by project participants using a continuous water temprature analyzer
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Doubled inlet temperature sensor of high accuracy (0.4 %) coupled with transducer
QA/QC procedures to be applied:	Analyzers will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

Data / Parameter:	**twc**
Data unit:	℃
Description:	Outlet water temperature from the flare stack cooling system in the hour h
Time of determination/monitoring	Continuously. Values will be averaged hourly or at a shorter time interval.
Source of data (to be) used:	Measurements by project participants using a continuous water temperature

	analyzer
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Doubled outlet temperature sensor of high accuracy (0.4 %) coupled with transducer
QA/QC procedures to be applied:	Analyzers will be periodically calibrated once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

Data / Parameter:	**MM_{ELEC}**
Data unit:	tCH4
Description:	Methane sent to power plant
Time of determination/monitoring	Continuous
Source of data (to be) used:	Flow meters installed on site
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	Flow meters will record gas volume, pressure and temperature. Density of methane under normal conditions of temperature and pressure is 0.67kg/m3 (2006 IPCC Guidelines for National Greenhouse Gas Inventories)

Data / Parameter:	**CEF_{NMHC}**
Data unit:	tCO2e/tCH4
Description:	Carbon emission factor for combusted non methane hydrocarbon (various)
Time of determination/monitoring	Annually
Source of data (to be) used:	To be obtained through annual analysis of the fractional composition of captured gas. If the NHMC concentration is less than 1%, its emissions can be ignored.
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Annually monitoring and analyzing NHMC concentration. If it is above 1%, determining each carbon emission factor of different components.
QA/QC procedures to be applied:	Instruments will be subject to a regular maintenance regime before analyzing gas components to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	To be obtained through periodical analysis of the fractional composition of captured

Data / Parameter:	**PC_{CH4}**
Data unit:	%
Description:	Concentration (in mass) of methane in extracted gas (%), measured on wet

	basis
Time of determination/monitoring	Daily
Source of data (to be) used:	Concentration meters, optical and calorific
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Monitoring concentration using optical and calorific meters.
QA/QC procedures to be applied:	Concentration meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	To be measured on wet basis

Data / Parameter:	**PC_{NMHC}**
Data unit:	%
Description:	NMHC concentration (in mass) in extracted gas
Time of determination/monitoring	Annually
Source of data (to be) used:	To be obtained through annual analysis of the fractional composition of captured gas. If the NHMC concentration is less than 1%, its emissions can be ignored.
Value of data applied (for ex ante calculation/determinations)	0
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Annually monitoring NHMC concentration to determine whether its emissions to be included in the calculation.
QA/QC procedures to be applied:	Gas analyzing instruments will be subject to a regular maintenance regime before analyzing gas components to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

Data / Parameter:	**GEN_y**
Data unit:	MWh
Description:	Electricity generation by the gas engine
Time of determination/monitoring	Continuous measurement of electricity generation by electricity meters. Recorded values will be aggregated monthly and annually.
Source of data (to be) used:	Electricity meters installed on site
Value of data applied (for ex ante calculation/determinations)	N/A
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by electricity meter
QA/QC procedures to be applied:	Electricity meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 8 years according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

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:

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

Where:

PE_y	-	Project emissions in year y (tCO2e)
PE_{ME}	-	Project emissions from energy use to capture and use methane (tCO2e)
PE_{MD}	-	Project emissions from methane destroyed (tCO2e)
PE_{UM}	-	Project emissions from un-combusted methane (tCO2e)

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

$PE_{ME} = CONS_{ELEC, PJ} \times CEF_{ELEC}$

Where:

PE_{ME}	-	Project emissions from energy use to capture and use or destroy methane (tCO2e)
$CONS_{ELEC, PJ}$	-	Additional electricity consumption for capture and use or destruction of methane, if any (MWh)
CEF_{ELEC}	-	Carbon emissions factor of electricity used by coal mine (tCO2e/MWh)

Here, the detailed calculation formula for $CONS_{ELEC, PJ}$ is shown in Annex 3.

Combustion emissions from use of captured methane:

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

With:

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

Where:

PE_{MD}	-	Project emissions from CMM/CBM destroyed (tCO2e)
MD_{FL}	-	Methane destroyed through flaring (tCH4)
MD_{ELEC}	-	Methane destroyed through power generation (tCH4)
CEF_{CH4}	-	Carbon emission factor for combusted methane (2.75 tCO2/tCH4)
CEF_{NMHC}	-	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO2/tNMHC)
r	-	Relative proportion of NMHC compared to methane
PC_{CH4}	-	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
PC_{NMHC}	-	NMHC concentration (in mass) in extracted gas (%)

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

Where:

MD_{FL}	-	Methane destroyed through flaring (tCH4)
MM_{FL}	-	Methane measured sent to flare (tCH4)
PE_{flare}	-	Project emissions of non-combusted CH4, expressed in terms of CO2e, from flaring of the residual gas stream (tCO2e)
GWP_{CH4}	-	Global warming potential of methane (21 tCO2e/tCH4)

Here, the project emissions from flaring ($PE_{flare, y}$) are determined as described in Annex 4.

$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$

Where:

MD_{ELEC} - Methane destroyed through power generation (tCH4)
MM_{ELEC} - Methane measured sent to power plant (tCH4)
Eff_{ELEC} - Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)

Un-combusted methane from project activity:

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

Where:

PE_{UM} - Project emissions from un-combusted methane (tCO2e)
GWP_{CH4} - Global warming potential of methane (21 tCO2e/tCH4)
MM_{ELEC} - Methane measured sent to power plant (tCH4)
Eff_{ELEC} - Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)
PE_{flare} - Project emissions of non-combusted CH4 expressed in terms of CO2e from flaring of the residual gas stream (tCO2e)

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:

(1) Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination regarding the PDD

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO2e/tCH4
Description:	Global warming potential of methane
Time of determination /monitoring	*ex ante*
Source of data (to be) used:	IPCC
Value of data applied (for ex ante calculations/determinations)	21 (IPCC)
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Constant value define by IPCC
QA/QC procedures (to be) applied:	N/A
Any comment:	N/A

Data / Parameter:	**$EF_{CO2,i}$**
Data unit:	tC/TJ
Description:	CO_2 emission factor of coal used for captive heat
Time of determination/monitoring	*Ex ante*
Source of data (to be) used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value of data applied (for ex ante calculation/determinations)	25.8
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Constant value defined by IPCC
QA/QC procedures to be applied:	N/A
Any comment:	N/A

Data / Parameter:	**Eff_{heat}**
Data unit:	%
Description:	Energy efficiency of the existing coal boilers
Time of determination/monitoring	Ex ante
Source of data (to be) used:	ACM0008
Value of data applied (for ex ante calculation/determinations)	100%
Justification of the choice of data or description of measurement methods and procedure (to be) applied	The approved methodology provides two different options. Option B is selected whereby the boilers are assumed to convert 100% of the heat value of the coal into heat for the mine air. This is a conservative assumption because no data on efficiency of conversion is available.
QA/QC procedures to be	N/A

applied:	
Any comment:	N/A

(2) Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are not available already at the stage of determination regarding the PDD

Not applicable

(3) Data and parameters that are monitored throughout the crediting period

Data / Parameter:	**CMM** $_{PL,ELEC}$
Data unit:	tCH4
Description:	Pre-mining CMM captured, sent to and destroyed by gas-engine in the project activity in year y
Time of determination/monitoring	Continuous
Source of data (to be) used:	Estimated as described in E.4.
Value of data applied (for ex ante calculation/determinations)	Estimated value of MM_{ELEC} is used in the calculation of emission reduction in section E.4.
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	**CMM** $_{PL,ELEC}$ **+ PMM** $_{PL,ELEC}$ **is equivalent to** MM_{ELEC} **CMM** $_{PL,ELEC}$ can be measured together with **PMM** $_{PL,ELEC}$ when the common extraction system is located in the underground mine

Data / Parameter:	**PMM** $_{PL,ELEC}$
Data unit:	tCH4
Description:	Post-mining CMM captured, sent to and destroyed by gas-engine in the project activity in year y
Time of determination/monitoring	Continuous
Source of data (to be) used:	Estimated as described in E.4.
Value of data applied (for ex ante calculation/determinations)	Estimated value of MM_{ELEC} is used in the calculation of emission reduction in section E.4.
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	**CMM** $_{PL,ELEC}$ **+ PMM** $_{PL,ELEC}$ **is equivalent to** MM_{ELEC} **PMM** $_{PL,ELEC}$ can be measured together with **CMM** $_{PL,ELEC}$ when the common extraction system is located in the underground mine

Data / Parameter:	**$CMM_{PL,FL}$**
Data unit:	tCH_4
Description:	Pre-mining CMM captured, sent to and destroyed by flare in the project activity in year y
Time of determination/monitoring	Continuous
Source of data (to be) used:	Estimated as described in E.4.
Value of data applied (for ex ante calculation/determinations)	Estimated value of MM_{FL} is used in the calculation of emission reduction in section E.4.
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	**$CMM_{PL,FL}$ + $PMM_{PL,FL}$ is equivalent to MM_{FL}** **$CMM_{PL,FL}$** can be measured together with **$PMM_{PL,FL}$** when the common extraction system is located in the underground mine

Data / Parameter:	**$PMM_{PL,FL}$**
Data unit:	tCH_4
Description:	Post-mining CMM captured, sent to and destroyed by flare in the project activity in year y
Time of determination/monitoring	Continuous
Source of data (to be) used:	Estimated as described in E.4.
Value of data applied (for ex ante calculation/determinations)	Estimated value of MM_{FL} is used in the calculation of emission reduction in section E.4.
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Continuously monitored by gas flow meters adjusted by temperature and pressure.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	**$CMM_{PL,FL}$ + $PMM_{PL,FL}$ is equivalent to MM_{FL}** **$PMM_{PL,FL}$** can be measured together with **$CMM_{PL,FL}$** when the common extraction system is located in the underground mine

Data / Parameter:	**$HEAT_y$**
Data unit:	GJ
Description:	Net heat generated by the gas engine
Time of determination/monitoring	Continuous
Source of data (to be) used:	Measurements by project participants
Value of data applied (for ex ante calculation/determinations)	45,186.3(GJ)
Justification of the choice of data or description of measurement methods and procedure (to be) applied	Calorimeter is adopted to continuously monitor the amount of heat supplied from the gas engine.

QA/QC procedures to be applied:	Calorimeter will be subject to a regular maintenance regime to ensure accuracy. Calibration will be done once every 12 months according to the polish regulations and/or the manufacturer's specifications.
Any comment:	N/A

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:

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

Where:

- BE_y - Baseline emissions in year y (tCO2e)
- $BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
- $BE_{Use,y}$ - Total baseline emissions from the production of power or heat replaced by the project activity in year *y* (tCO_2)

Methane released into the atmosphere:

$BE_{MR,y} = GWP_{CH4} \times [(CMM_{PL,ELEC,y} + PMM_{PJ,ELEC,y} + CMM_{PL,FL,y} + PMM_{PJ,FL,y})]$

Where:

- $BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
- $CMM_{PL,ELEC,y}$ - Pre-mining CMM captured, sent to and destroyed by power plant in the project in year y (expressed in tCH4)
- $PMM_{PJ,ELEC,y}$ - Post-mining CMM captured, sent to and destroyed by power generation in the project in year y (expressed in tCH4)
- $CMM_{PL,FL,y}$ - Pre-mining CMM captured, sent to and destroyed by flare stack in the project in year y (expressed in tCH4)
- $PMM_{PJ,FL,y}$ - Post-mining CMM captured, sent to and destroyed by flaring in the project in year y (expressed in tCH4)
- GWP_{CH4} - Global warming potential of methane (21 tCO2e/tCH4)

Emission from heat generation replaced by project

$BE_{Use,y} = HEAT_y \times EF_{HEAT}$

Where:

- $BE_{Use,y}$ - Total baseline emissions from the production of heat replaced by the project activity in year *y* (tCO_2)
- $HEAT_y$ - Heat generation by project activity in year *y* (GJ)
- EF_{HEAT} - Emissions factor for heat production replaced by project activity (tCO_2/GJ)

$$EF_{heat,y} = \frac{EF_{CO2,j}}{Eff_{heat}} \cdot \frac{44}{12} \cdot \frac{1TJ}{1000GJ}$$

Where:

- $EF_{heat,y}$ - Emissions factor for heat generation (tCO_2/GJ)
- $EF_{CO2,I}$ - CO_2 emissions factor of fuel used in heat generation (tC/TJ)
- Eff_{heat} - Boiler efficiency of the heat generation (%)

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.):

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

Not applicable

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.1.3.2. 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 ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and project emissions (PE_y), as follows:

$$ER_y = BE_y - PE_y$$

Where:
ER_y - Emissions reductions of the project activity during the year y (tCO2e)
BE_y - Baseline emissions during the year y (tCO2e)
PE_y - 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.

Please refer to the each table in Section D1.1.1. and D.1.1.3..

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 and paper 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 equipments is a Power Engineering Department of the SOSNICA Coal Mine. In the staff of this department, a person will be assigned responsible for a data monitoring. It is assumed to implement automatic and manual monitoring, collection and processing of data every hour. In any case all automatic measuring equipment has at least half a year independent (including energy independent) archive of measured data, which can be extracted and processed any time.

- The SOSNICA Coal Mine 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 automatic 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.

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

>>

Name/origination Project participant	Project Participate Yes/No
Hideo Yata 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
Teruyuki Okada Mizuho Corporate Bank 5-1, Marunouchi 2-chome, Chiyodaku, Tokyo 100-8333, Japan	No

Tel +81-3-5220-7179 Fax +81-3-3201-6582	

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

>>

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

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

$$PE_{ME} = CONS_{ELEC,\,PJ} \times CEF_{ELEC}$$

Where:

PE_{ME}	-	Project emissions from energy use to capture and use or destroy methane (tCO2e)
$CONS_{ELEC,\,PJ}$	-	Additional electricity consumption for capture and use or destruction of methane, if any (MWh)
CEF_{ELEC}	-	Carbon emissions factor of electricity used by coal mine (tCO2e/MWh)

The project emission from additional electricity required for CMM capture and use is very small compared with the emission reductions from the whole project. This emission will be monitored and calculated during the project activity, however, is not included in the estimation of this Section.

Project emissions from methane destroyed:

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

With:

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

Where:

PE_{MD}	-	Project emissions from CMM/CBM destroyed (tCO2e)
MD_{FL}	-	Methane destroyed through flaring (tCH4)
MD_{ELEC}	-	Methane destroyed through power generation (tCH4)
CEF_{CH4}	-	Carbon emission factor for combusted methane (2.75 tCO2/tCH4)
CEF_{NMHC}	-	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO2/tNMHC)
r	-	Relative proportion of NMHC compared to methane
PC_{CH4}	-	Concentration (in mass) of methane in extracted gas (%), measured on wet basis
PC_{NMHC}	-	NMHC concentration (in mass) in extracted gas (%)

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

Where:

MD_{FL}	-	Methane destroyed through flaring (tCH4)
MM_{FL}	-	Methane measured sent to flare (tCH4)
PE_{flare}	-	Project emissions of non-combusted CH4, expressed in terms of CO2e, from flaring of the residual gas stream (tCO2e)
GWP_{CH4}	-	Global warming potential of methane (21 tCO2e/tCH4)

#In this project

Annual operating time	8000 hour
Mass equivalent factor for CH_4	0.67 kg/Nm3
Gas volume to be utilized	20Nm3CH4/min
Flare efficiency	90%

MM_{FL}= 0.67(kg/Nm3) x 20(Nm3CH4/min) x 60(min) x 8000(hour) /1000=6,432(tCH4)
PE_{flare}=6,432 (tCH_4) x (1-90%) x 21=13,507 (tCO2e)
MD_{FL} =6,432 (tCH_4) - (13,507/21) = 5,788.8 (tCH4)

$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$
Where:

- MD_{ELEC} - Methane estroyed through power generation (tCH4)
- MM_{ELEC} - Methane measured sent to power plant (tCH4)
- Eff_{ELEC} - Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)

#In this project

Annual operating time	7200 hour
Mass equivalent factor for CH_4	0.67 kg/Nm3
Gas volume to be utilized	7.834 Nm3CH4/min

MM_{ELEC}=0.67(kg/Nm3) x 7.834(Nm3CH4/min) x 60(min) x 7200(hour) /1000=2,267 (tCH4)
MD_{ELEC} = 2,267(tCH_4) * 99.5% = 2,256.2 (tCH4)

#In this project PC_{NMHC} is less than 1(%), therefore actual measurements

Calculus (2009 .5.29-2011. 4.30)
$PE_{MD} = (MD_{FL} + MD_{ELEC}) \times CEF_{CH4}$
PE_{MD} = (0(tCH4) + 2,256.2 (tCH4)) * 2.75 =6,204.4 (tCO_2e)

Calculus (2011.5.1-2019.5.28)
$PE_{MD} = (MD_{FL} + MD_{ELEC}) \times CEF_{CH4}$
= (5,788.8(tCH_4) + 2,256.2 (tCH_4)) * 2.75 =22,123.6 (tCO_2e)

Un-combusted methane from flaring and end uses:

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

- PE_{UM} - Project emissions from un-combusted methane (tCO2e)
- GWP_{CH4} - Global warming potential of methane (21 tCO2e/tCH4)
- MM_{ELEC} - Methane measured sent to power plant (tCH4)
- Eff_{ELEC} - Efficiency of methane destruction/oxidation in power plant (taken as 99.5% from IPCC)
- PE_{flare} - Project emissions on non-combusted CH4 expressed in terms of CO2e from flaring of the residual gas stream (tCO2e)

Calculus (2009 .5.29–2011.4.30)

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

＝21* [2,267 (tCH_4)*（1-99.5%）]+0(tCO_2e)=238.1(tCO_2e)

Calculus (2011.5.1–2019.5.28)

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

= 21*[2,267 (tCH_4)*（1-99.5%）] + 13,507 (tCO_2e) = 13,745 (tCO_2e)

Estimated project emissions:

$PE = PE_{ME} + PE_{MD} + PE_{UM}$

Calculus (2009 .5.29–2011.4.30)

PE= PE_{ME} +PE_{MD}+PE_{UM}

=0(tCO_2e)＋6,204.4 (tCO_2e)+ 238.1(tCO_2e) =6,442.5 (tCO_2e)

Calculus (2011.5.1–2019.5.28)

PE= PE_{ME} +PE_{MD}+PE_{UM}

=0(tCO_2e)＋22,123.6 (tCO_2e)+ 13,745 (tCO_2e)=35,869 (tCO_2e)

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

Year	PE_{MD}	PE_{UM}	PE
2009	3,688	141	3,829
2010	6,204	238	6,442
2011	16,890	9,304	26,194
2012	22,124	13,745	35,869
2013	22,124	13,745	35,869
2014	22,124	13,745	35,869
2015	22,124	13,745	35,869
2016	22,124	13,745	35,869
2017	22,124	13,745	35,869
2018	22,124	13,745	35,869
2019	8,971	5,573	14,544

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 CH_4 and CO_2 emissions produced from the utilization activities.

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

Year	Leakage	PE
2009	0	3,829
2010	0	6,442
2011	0	26,194
2012	0	35,869
Sub Total (2009-2012)	0	72,334
2013	0	35,869
2014	0	35,869
2015	0	35,869
2016	0	35,869
2017	0	35,869
2018	0	35,869
2019	0	14,544
Sub Total (2013-2019)	0	229,758
Total	0	302,092

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.

Methane released into the atmosphere:

$$BE_{MR,y} = GWP_{CH4} \times [(CMM_{PL,ELEC,y} + CMM_{PL,FL,y})]$$

Where:

- $BE_{MR,y}$ - Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO2e)
- $CMM_{PL,ELEC,y}$ - Pre-mining CMM that would have been captured, sent to and destroyed by power plant in the project in year y (expressed in tCH4)
- $CMM_{PL,FL,y}$ - Pre-mining CMM that would have been captured, sent to and destroyed by flare stack in the project in year y (expressed in tCH4)
- GWP_{CH4} - Global warming potential of methane (21 tCO2e/tCH4)

Calculus (2009 .5.29−2011.4.30)

$BE_{MR} = GWP_{CH4}$ x [($CMM_{PL, ELEC, y}$ + $CMM_{PL, FL, y}$)]

=21 * [2,267(tCH4)) +0(tCH4)]=47,617 (tCO_2e)

Calculus (2011.5.1−2019.5.28)

$BE_{MR} = GWP_{CH4}$ x [($CMM_{PL, ELEC, y}$ + $CMM_{PL, FL, y}$)]

=21 * [2,267(tCH4)+6,432tCH4)]=182,689(tCO_2e)

Emission from power/heat generation replaced by project

$BE_{Use,y} = HEAT_y$ x 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)
- $HEAT_y$ - Heat generation by project activity in year *y* (GJ), including through the use of CBM
- EF_{HEAT} - Emissions factor for heat production replaced by project activity (tCO_2/GJ)

$$EF_{heat,y} = \frac{EF_{CO2,j}}{Eff_{heat}} \cdot \frac{44}{12} \cdot \frac{1TJ}{1000GJ}$$

Where:

- $EF_{heat,y}$ - Emissions factor for heat generation (tCO_2/GJ)
- $EF_{CO2,I}$ - CO_2 emissions factor of fuel used in heat generation (tC/TJ)
- Eff_{heat} - Boiler efficiency of the heat generation (%)
- *44/12* - Carbon to Carbon Dioxide conversion factor
- *1/1000* - TJ to GJ conversion factor

$EF_{HEAT,y}$=25.8/100% * 44/12/1000 = 0.095(tCO_2/GJ)

$BE_{Use,y} = HEAT_y$ x EF_{HEAT} =45,186.3GJ *0.095(tCO_2/GJ) = 4,275 tCO_2

Baseline Emission:

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

Calculus (2009 .5.29−2011.4.30)

$BE_y = BE_{MR,y} + BE_{Use,y}$ = 47,617 (tCO_2e)+0(tCO_2e) = 47,617 (tCO_2e)

Calculus (2011.5.1−2012.12.31)

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

= 182,689 (tCO_2e) +0 (tCO_2e) = 182,689 (tCO_2e)

Calculus (2013.1.1−2019.5.28)

$BE_y = BE_{MR,y} + BE_{Use,y}$ = 182,689 (tCO_2e)+ 4,275tCO_2 = 186,964(tCO_2e)

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

Year	BE_{MD}	BE_{MR}	BE_{Use}	BE
2009	0	28,309	0	28,309
2010	0	47,617	0	47,617
2011	0	138,282	0	138,282
2012	0	182,689	0	182,689
Sub Total (2009-2012)	0	396,897	0	396,897
2013	0	182,689	4,275	186,964
2014	0	182,689	4,275	186,964
2015	0	182,689	4,275	186,964
2016	0	182,689	4,275	186,964
2017	0	182,689	4,275	186,964
2018	0	182,689	4,275	186,964
2019	0	56,071	1,733	57,804
Sub Total (2013-2019)	0	1,152,205	27,383	1,179,588
Total	0	1,549,102	27,383	1,576,485

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
2009	28,309	3,829	24,480
2010	47,617	6,442	41,175
2011	138,282	26,194	112,088
2012	182,689	35,869	146,820
Sub Total (2009-2012)	396,897	72,334	324,563
2013	186,964	35,869	151,095
2014	186,964	35,869	151,095
2015	186,964	35,869	151,095
2016	186,964	35,869	151,095
2017	186,964	35,869	151,095

2018	186,964	35,869	151,095
2019	57,804	14,544	43,260
Sub Total (2013-2019)	1,179,588	229,758	949,830
Total	1,576,485	302,092	1,274,393

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

>>

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
Year 2009	3,829	0	28,309	24,480
Year 2010	6,442	0	47,617	41,175
Year 2011	26,194	0	138,282	112,088
Year 2012	35,869	0	182,689	146,820
Sub Total (2009-2012)	72,334	0	396,897	324,563
Annual average(2009-2012)				90,294
Year 2013	35,869	0	186,964	151,095
Year 2014	35,869	0	186,964	151,095
Year 2015	35,869	0	186,964	151,095
Year 2016	35,869	0	186,964	151,095
Year 2017	35,869	0	186,964	151,095
Year 2018	35,869	0	186,964	151,095
Year 2019	14,544	0	57,804	43,260
Sub Total (2013-2019)	229,758	0	1,179,588	949,830
Annual average(2013-2019)				148,284
Total (tonnes of CO_2 equivalent)	302,092	0	1,576,485	1,274,393
Annual average(2009-2019)				127,439

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:

>>

According to the Environment Protection Law in Poland, Environmental Impact Assessment on this project is not required to conduct and report.

However GORPROJECT, which was entrusted by Sosnica Coalmine to assess this project, carried out a preliminary environmental impact assessment and they obtained the result that there is no remarkable negative influence in implementation of this project.

The outline of the result of the preliminary environmental impact assessment (in English) is shown below.

The emission reduction installations implemented in the Coalmine Sosnica were assessed as concerns their environmental impact in the following scope: air pollution, noise emission, water and wastewater, waste management as well as landscape/visual impact. The assessment was carried out taking into account requirements of the following national regulations:

- Environmental Protection Act from April 27th, 2001.
- Regulation of Council of Ministers from November 9th, 2004 on specific types of projects which could have significant environmental impact and the specific conditions to qualify a project for preparation of environmental impact report with further amendments (Regulation of Council of Ministers from May 10th, 2005 and from August 21st, 2007).
- Regulation of Council of Ministers from August 21st, 2007 amending the regulation on specific types of projects which could have significant environmental impact and the specific conditions to qualify a project for preparation of environmental impact report.
- Regulation of Ministry of Environment from March 3rd, 2008 on reference values of some substances in the air.
- Regulation of Ministry of Environment from December 20th, 2005 on emission standards from installations.

Air emission

According to the regulation from December 20th, 2005 (see above) installations powered by gas engines are not classified as installations of fuel combustion, so emission coefficients for engine were taken basing on data obtained from the manufacturer's specification. Gas engine is fuelled with CMM gas purified in the methane recovery station and additionally in front of engine's container and by a filter installed on the engine inlet. Due to this three stage dust purification system, emission of particulate matter from the engine installation can be neglected. Sulphur content in the recovered methane gas is at trace level, and as a consequence sulfur oxides emission also is not considered. Impact of the gas engine installation on the atmosphere can be considered only in respect to the nitrogen oxides emissions. Air emission data for the gas engine is presented in the following table:

Air pollutant	Maximum concentration level, at O_2 content 6% [mg/Nm^3]	Emission rate [kg/h]
NO_2	460,0	3,70
CO	650,0	4,52

SO_2	-	-
Particulate matter	-	-

In the case of flaring system, the applied technical solution for combustion chamber allows to obtain air emission levels specified in the following table:

Air pollutant	Maximum concentration level, at O_2 content 6% [mg/Nm^3]	Emission rate [kg/h]
NO_2	200	3,072
CO	14,8	0,228
SO_2	35,0	0,5376
Particulate matter	5,0	0,0768

Noise

Analysis of impact of the gas engine on the acoustic climate shown, that level of the noise caused by installations is neglectable low, when comparing to the existing noise background. In the case of gas engine, increase in the noise level is estimated as 2,71% and it is far lower than a maximum reference level of 20 % according to regulation of Council o Ministers from November 9th 2004. Flare stack installation also fulfills all requirements of the regulation.

Wastes

Operation of the installations will not cause generation of wastes. Wastes will be produced only during maintenance works and can include: oils, smears, used gas filters. All wastes will be disposed by specialized external service.

Wastewater

Installations will not have any impact on water-sewage management of the coalmine. Sanitary sewage will not be produced as well as technological wastewater, since all water circulations are closed and tight. Only periodical supplementations of the water circulations are planned.

Transboundary impacts

Due to location of the installation dozens kilometers from the boundaries of Poland and due to low scope of environmental impact of the installations, the undertaking will not cause transboundary environmental impacts.

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:

>>

Kompania Węglowa S.A. and SOSNICA Coal Mine explained this project to The Municipal Council of Gliwice City and labour unions of SOSNICA Coal Mine to receive each stakeholder's comment by the method shown in the following table.

Stakeholders	Time Table	How comments were invited	Nature of the comments
The Municipal Council of Gliwice	Meeting Date: 15th October 2009	SOSNICA Coal Mine explained the project outline and their intention of JI to the Municipal Council of Gliwice City and asked for comment from Gliwice City in written document.	Positive
	Answer Date: 15th October 2009	SOSNICA Coal Mine received a positive comment in written document from Gliwice City.	
Labor Unions	Meeting Date: 12th October 2009	SOSNICA Coal Mine carried out the briefing session on implementation of this project for 8 labour unions of SOSNICA Coal Mine and asked for their opinion in written document from them.	Positive
	Answer Date: 12th October 2009	SOSNICA Coal Mine received a positive comment in written document from the Labor Unions.	

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Project Participant 1

Organisation:	Kompania Węglowa S.A.
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Annex 2

BASELINE INFORMATION

1. Summary of coal production from 2004 to 2012 (t/year)

Year	Actual/future output [t]	Remarks
2004	1 938 960 2 837 900 4 776 860	Coal Mine Sosnica Coal Mine Makoszowy Total
2005	5 277 600	Coal Mine Sosnica - Makoszowy
2006	5 096 800	Coal Mine Sosnica – Makoszowy
2007	5 171 100	Coal Mine Sosnica – Makoszowy
2008	4 574 000	Coal Mine Sosnica – Makoszowy
2009	4 309 400(Plan)	Coal Mine Sosnica – Makoszowy
2010	4 309 200(Plan)	Coal Mine Sosnica – Makoszowy
2011	4 410 000(Plan)	Coal Mine Sosnica – Makoszowy
2012	4 410 000(Plan)	Coal Mine Sosnica – Makoszowy

2. Historical data for the baseline calculation

Table 3 CMM collection data for the period from March 2007 till December 2008

Month	Average mine gas volume (mixture) [m^3/min]	Average pure methane volume [m^3/min]	Amount of collected mine gas (mixture) [m^3]	Amount of collected CH_4 [m^3]	Concentration, % CH_4
2007					
March	92,6	44,8	2800224,0	1354752,0	48,4
April	84,6	42,3	3656786,0	1827360,0	50,0
May	88,5	49,5	3951287,0	2211217,0	56,0
June	79,5	36,8	3436308,0	1588808,0	46,2
July	67,4	28,7	3008036,5	1283271,6	42,7
August	65,1	27,7	2906170,2	1234525,7	42,5
September	65,5	28,8	2828041,6	1244160,0	44,0
October	68,4	27,0	3053111,0	1203744,0	39,4
November	71,5	31,7	3087383,0	1369947,0	44,4
December	72,4	31,4	3230335,0	1401912,0	43,4
2008					
January	73,0	29,8	32606553,8	1329594,0	40,8
February	76,0	30,4	3174453,9	1267982,4	39,9
March	91,6	40,6	4087410,0	1814572,0	44,4
April	92,1	43,0	3979611,0	1857175,0	46,7
May	82,3	37,1	3674479,0	1657457,0	45,1
June	72,6	33,5	3136172,0	1448899,0	46,2
July	55,1	26,2	2460559,6	1167501,1	47,4
August	52,1	25,8	2324212,0	1150410,0	49,5

September	64,9	32,2	2802346,0	1392766,0	49,7
October	66,8	32,9	2980557,0	1468123,0	49,3
November	71,4	31,6	3083702,0	1365808,0	44,3
December	68,0	27,7	3037546,0	1235431,0	40,7

3. Grid emission factor

The data source of electricity production and fuel consumption is Eurostat Energy Monthly Statistics.

3.1 Operating Margin

2004(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	4,194						
Conventional Thermal	149,839						
Hard coal		929,190	96.301	89,482,236	26.8	3.67	98.0
Lignite		514,052	99.176	50,981,621	27.6	3.67	98.0
Natural gas		39,816	55.820	2,222,509	15.3	3.67	99.5
Derived gases		9,366	47.428	444,214	13.0	3.67	99.5
Imports	5,313	0					

2005(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	5,302						
Conventional Thermal	151,567						
Hard coal		907,337	96.301	87,377,763	26.8	3.67	98.0
Lignite		533,605	99.176	52,920,809	27.6	3.67	98.0
Natural gas		41,351	55.820	2,308,192	15.3	3.67	99.5
Derived gases		8,040	47.428	381,324	13.0	3.67	99.5
Imports	5,004	0					

2006(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	5,186						
Conventional Thermal	156,753						
Hard coal		962,648	96.301	92,704,286	26.8	3.67	98.0
Lignite		525,428	99.176	52,109,847	27.6	3.67	98.0
Natural gas		40,460	55.820	2,258,457	15.3	3.67	99.5
Derived gases		9,550	47.428	452,941	13.0	3.67	99.5
Imports	4,789	0					

2007(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	5,946						
Conventional Thermal	153,486						
Hard coal		968,467	96.301	93,264,663	26.8	3.67	98.0
Lignite		500,851	99.176	49,672,399	27.6	3.67	98.0
Natural gas		39,572	55.820	2,208,889	15.3	3.67	99.5
Derived gases		11,206	47.428	531,482	13.0	3.67	99.5
Imports	7,829	0					

2008(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	7,174						
Conventional Thermal	147,324						
Hard coal		878,152	96.301	84,567,208	26.8	3.67	98.0
Lignite		514,293	99.176	51,005,523	27.6	3.67	98.0
Natural gas		39,797	55.820	2,221,449	15.3	3.67	99.5
Derived gases		10,304	47.428	488,702	13.0	3.67	99.5
Imports	5,313	0					

$\Sigma F_{i,j,2004-2008} * COEF_{i,j}$	(tCO2)	717,604,514
$\Sigma GEN_{j,2004-2008}$	(GWh)	758,969
$EF_{OM,2004-2008}$	(tCO2/GWh)	945

3.2 Build Margin

Fuel Consumption rate by source (kJ/kWh)		Total consumption in 2006 (TJ)	Power generation in 2006 (GWh)
Hard Coal	12,481	1,150,009	92,144
Lignite	13,375	716,356	53,559
Gas	11,936	54,227	4,543

2008(1-12) Source	Electricity Production (GWh)	Fuel Consumption (TJ)	Emission Coeficient (tCO2/TJ)	Emissions (tCO2)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO2/tC)	Oxidation Factor (%)
Hydro and wind	7,174						
Conventional Thermal	147,324						
Hard coal	70,362	878,152	96.301	84,567,208	26.8	3.67	98.0
Lignite	38,452	514,293	99.176	51,005,523	27.6	3.67	98.0
Natural gas	3,334	39,797	55.820	2,221,449	15.3	3.67	99.5
Derived gases	863	10,304	47.428	488,702	13.0	3.67	99.5
Imports	5,313	0					

	Electricity production (GWh)	Fuel consumption rate (kJ/kWh)	Fuel consumed (TJ)	Emission Coefficient (tCO2/TJ)	Emissions (tCO2)
Polish grid	125,497				
20% of Polish grid	25,099				
Imports is included	5,313				
Hydro and wind is included	7,174				
All gas is included	3,334	11,936	39,797	55.820	2,221,449
	863	11,936	10,304	47.428	488,702
20% is completed with hard coal	8,415	12,481	105,026	96.301	10,114,144
Build margin emissions					12,824,294

$\Sigma F_{i,m,2008}*COEF_{i,m}$	(tCO2)	12,824,294
$\Sigma GEN_{m,2008}$	(GWh)	25,099
$EF_{BM,2004-2008}$	(tCO2/GWh)	511

3.3 Combined Margin

EF_{CMCP}	(tCO2/GWh)	728

4. Key input data

The following data and factors were used for baseline analysis. This information relates to the practical application of a new proposed baseline.

Data	Unit	Value	Source
Methane factors			
Methane GWP	-	21	IPCC 2006
CEF_CH_4	tCO_2/tCH_4	2.75	Molecular mass ratio
Methane density	t/m^3	0.00067	IPCC 2006
Equipment parameters			
Installed electric capacity	kW_{el}	1934	Producer
Installed thermal capacity	kW_{th}	1937	Producer
Electric efficiency	%	42.2	Producer
Thermal efficiency	%	42.3	Producer

5. CMM Gas analysis

Przedsiębiorstwo Odmetanowania Kopalń "Zachód" Sp. z o.o.
41-707 Ruda Śląska 7, ul. Ks.L.Tunkla 147 b

Badanie analityczne próbek gazów

Strona 3 z 3
20-10-2009

Data Badania	Kod próby ddmmrrZm/inicjały/nrpipety/L.dz.lab.	Miejsce pobrania próbki gazu	Wyniki analizy próbki gazu (V/V)							
			O_2	CO_2	CO	CH_4	H_2	C_2H_4	C_2H_6	N_2
			%	%	ppm	%	%	%	%	%
1	2	3	4	5	6	7	8	9	10	11
20/10/09	201009 / /294/79710	Gaz podawany do agregatu prądotwórczego	3,19	5,57	14	44,46	0,00	0,00	0,13	-
20/10/09	201009 / /2332/79810	Gaz podawany do agregatu prądotwórczego	3,54	5,39	14	43,96	0,00	0,00	0,13	-

Próby dostarczono dnia: 20.10.2009r.

Analizy sprawdził:

Kierownik Laboratorium
Jacek Winiarski

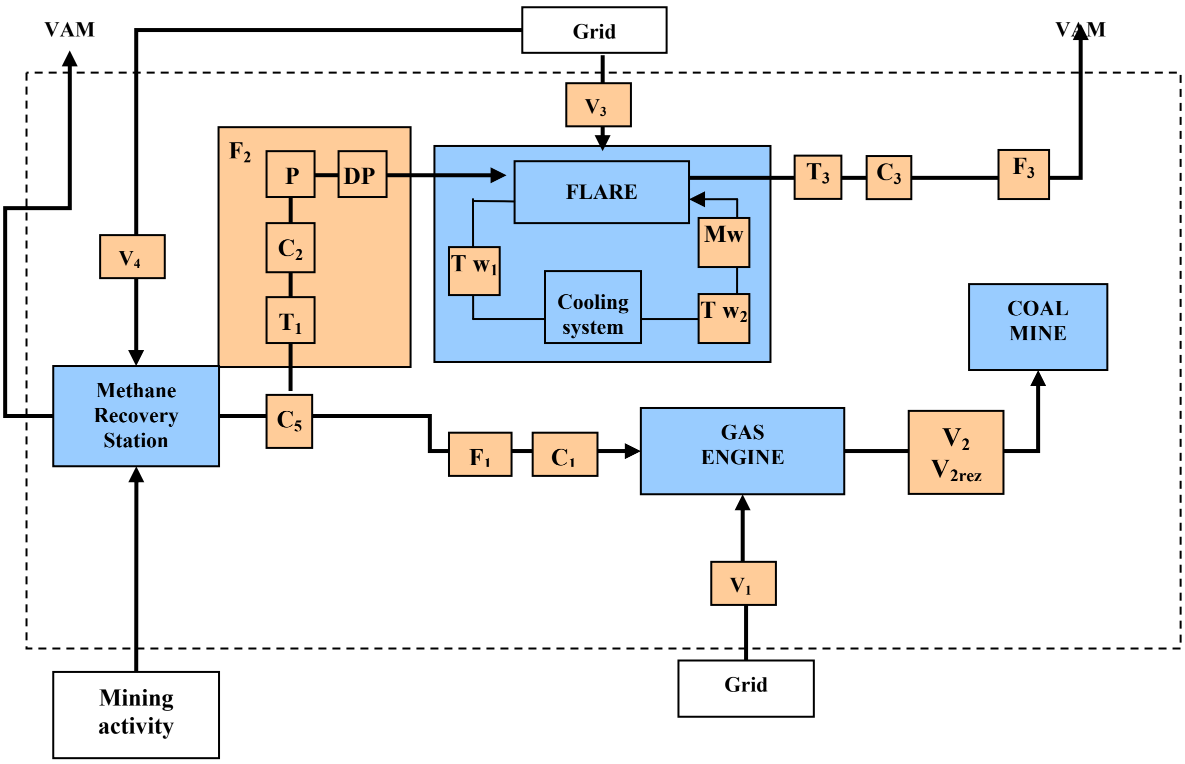
Annex 3

MONITORING PLAN

The detailed monitoring structure is described in another paper: ”Monitoring and Reporting” and the detailed monitoring procedure is described in another paper: “Monitoring and Procedure Book”. But outline for the monitoring plan for this project is summarized as below.

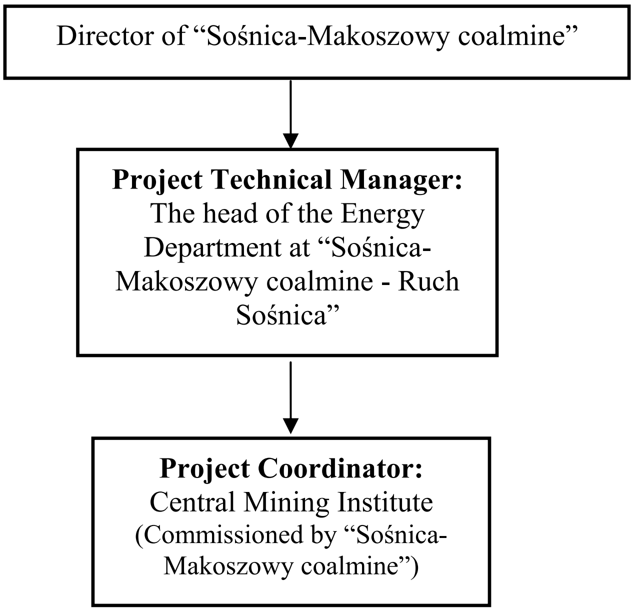
The implementation of the monitoring plan is to ensure that real, measurable, long-term Greenhouse Gas Emission Reduction can be monitored, recorded and reported. It is a crucial procedure to identity the final ERUs of the proposed project. This monitoring plan for the proposed project activity will be implemented by the project owner, Kompania Węglowa S.A. – Coalmine Sośnica.

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. Organization Structure to implement the monitoring

The project management structure is presented in the following scheme:



Project management is made up of the **project technical manager** and the **project coordinator**.

Responsibilities of the project technical manager are carried out by the head of the Energy Department at KWK “Sośnica-Makoszowy” - Ruch Sośnica. The Head is responsible for the project management. His tasks include assignments related directly to the operation of equipment, including:

- appointing technical personnel to operate of equipment and monitoring system;
- direct training of the technical personnel;
- direct supervision over the personnel operating of equipment together with terminals;
- direct supervision over the work of the system monitoring the emission reductions;
- supervision over the conducted monitoring documentation;
- supervision over the monitoring equipment;
- cooperation and communication with KWK “Sośnica-Makoszowy” - Ruch Sośnica departments involved in project;
- cooperation with the project coordinator.

Responsibilities of the **project coordinator** are carried out by an external institution – Central Mining Institute(GIG) from Katowice, hired by KWK “Sośnica-Makoszowy” - Ruch Sośnica to be in charge of the JI project. GIG’s basic duties are:

- formal, comprehensive support for the project;
- supervision over the monitoring process of emission reduction;
- writing of annual and periodic reports;
- verification of the annual reports made by the Accredited Independent Entity (AIE);
- performing internal audits;
- introduction of corrective and preventive actions;

- training of the personnel engaged in the project.

Project coordinator appoints a person responsible for all activities related to the supervision of the monitoring system and reporting the reduced emission.

Measurement system is equipped with an automatic collecting, processing and storage system of measured data. The results are additionally archived in the paper form as well as in the electronic form. Project technical manager is responsible for archiving the necessary data. Monitoring data is gathered in the office of the project technical manager.

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

According to Section D, the control and monitoring system can be divided into a gas part, and an electrical part.

A. Monitoring of gaseous components

Measurements of CMM destruction

For the purpose of monitoring the emission reduction of CMM, the following parameters are to be measured:

1. CMM consumed at the gas engine unit ($MM_{ELEC}/CMM_{PJ,ELEC,,y}$): the quantity of the methane sent to the gas engine, the concentration of the methane in gas sent to the gas engine
2. CMM supplied to the flare stack capacity of 20 Nm^3/h boiler: the quantity of the methane sent to the flare, the concentration of the methane in gas sent to the flare
3. Amount of heat generated in the flare: Amount of heat received by the cooling system of the flare stack installation
4. Non destroyed CMM in the flare stack installation: the concentration of the methane in the exhaust gas from the flare, the volume of the exhaust gas from the flare

The amounts of consumed methane in the CHP unit are calculated on the basis of the CMM volumes supplied to the installation, and the average CH_4 concentrations and efficiency of the installation. The amount of CMM combusted in the flare stack is calculated from the CH_4 balance basing on direct measurements of CMM supplied to the flare and amounts of methane in the exhaust gas (principal method). In the alternative method the emission reduction in the flare stack is estimated from the energy balance, basing on amount of CMM supplied and heat generated in the flare stack(alternative method). The total volumes of CMM supplied to the gas engine and the flare stack as well as methane concentrations are measured directly at each module by flow meters and gas analyzers respectively. Total heat generated by the flare stack installation is a sum of heat received by the cooling system and heat emitted with exhaust gas. Amounts of heat produced by the particular elements of flare stack installation are measured by appropriate heat metering systems. In the table below the methane metering equipment and adequate monitoring procedures were presented.

Table 1 Monitoring Data for Measurements of CMM destruction

	Measured parameter	Figure reference	Data variable	Measuring instrument	Uncertainty level	Monitoring procedure
Gas Engine	Volume of coal methane gas supplied to the gas engine	F_1	MM_{ELEC}	Volume flow meter INMAT 51 type 451	1,5%	Procedure PM-1
	Methane concentration at gas engine pipeline	C_1	PC_{CH4}	Continuous gas analyzer MTA GUARDIAN 4030	2 %	Procedure PM-1
Flare stack	Volume of coal methane gas supplied to the flare stack based on the temperature and pressure measurement	F_2	VG	VG = 1,283.02 x sqrt (DP) / sqrt (Gg)	-	Procedure PM-2
	Absolute gas pressure of coal methane gas supplied to the flare stack	P	pg	Pressure meter Aplisens APC-2000ALW/Ex	0,075%	Procedure PM-2
	Difference of pressure in pressure based gas flowmeter	DP	DP	Differential pressure meter Aplisens APR-2000ALW/Ex	0,1%	Procedure PM-2
	Temperature of coal methane gas supplied to the flare stack	T_1	TGb	Thermocouple Aplisens CTGN-1-140-M20	0,4%	Procedure PM-2
	Velocity of the exhaust gas from the flare stack	F_3	Wsp	Flowmeter ZAM Kety MTA-20 with STA-300	1,5 m/s	Procedure PM-2
	Gas density of coal methane gas	-	Gg	[(1-kCH4/100) x 1.293 + (kCH4/100) x 0.716] x pg/Pn(101.315) x Tn(273.15) /TGb	-	Procedure PM- 2
	Methane concentration at flare stack pipeline	C_2	kCH4	CH_4 continuous concentration analyzer ZEG S.A. CMW-10ca with PSM	5%	Procedure PM-2
	Mass flow rate of water of the flare stack cooling system	M_w	M_w	Pressure flowmeter Aplisens APR-2000ALW with APC-2000ALW	0,1%	Procedure PM-7
	Outlet water temperature from the flare stack cooling system	T_{W1}	twc	Doubled heat sensor Aplisens CTGN-1-200-M20 with ATL/Pt-100	0,4%	Procedure PM-7
	Inlet water temperature to the flare stack cooling system	T_{W2}	twz	Doubled heat sensor Aplisens CTGN-1-200-M20 with ATL/Pt-100	0,4%	Procedure PM-7
	Methane concentration in the exhaust gas from the flare stack	C_3	kCH4sp	Analyzer ELJACK maMos 200	3%	Procedure PM-2

Remarks: “sqrt” means “square root of”.

In case of malfunctions or maintenance breaks of the aforesaid measurement instruments, amounts of the methane destroyed can be evaluated basing on the other data monitored in the project. For these reasons the following emergency procedure was prepared:

1. **Procedure PM-6**: Estimating the amount of methane utilized in the gas engine, based on data received from electricity measurement

The procedure is used to calculate the amount of CMM, which is destroyed in the gas engine, basing on data of generated electricity. Amount of the methane utilized in gas engine is calculated using the following formula:

$$MM_{ELEC} = d_{CH_4} \cdot \frac{GEN_V \cdot 3,6 \cdot 100}{W_{CH_4} \cdot \eta_V}$$

where:
MM_{ELEC} – amount of methane utilized in the gas engine [t CH_4],
d_{CH4} – specific gravity of methane 0,000670 [t/m^3],
GEN_V – amount of electricity generated in the gas engine [kWh] (PM-4 procedure),
W_{CH4} – calorific value of methane [MJ/Nm^3],
η_V – ampere-hour efficiency of CHP [%].

Manufacturer's guaranteed ampere-hour efficiency of the gas engine - η_V is 42,2.%. The factual ampere-hour efficiency of gas engine will be assessed during the engine operation on the basis of data obtained from monitoring.

Measurements of NMHC content

Apart from measurements of the CMM destruction, amount of non-methane hydrocarbons (NMHC) is to be monitored. The NMHC analysis frequency is once a year. The measurement characteristics are presented in the table below:

Table 2 Monitoring Data for Measurements of NMHC content

Measured parameter	Figure reference	Data variable	Measuring technique	Uncertainty level	Monitoring procedure
Concentration of non-methane hydrocarbons	C_5	PC_{NMHC}	Direct sampling at pipeline and chromatographic determination	2%	Procedure PM-3

B. Electrical measurements

For the purpose of monitoring the emission reduction the following parameters are to be measured:

1. Electricity consumption of the gas engine
2. Electricity generation of the gas engine (GEN_V).
3. Net electricity consumption of the flare stack
4. Net electricity consumption of the Methane Recovery Station

In the table below the applied electricity meters and corresponding monitoring procedures were presented:

Table 3 Monitoring Data for Electrical measurements

Measured parameter	Figure reference	Data variable	Measuring instrument	Uncertainty level	Monitoring procedure
Electricity consumed by the gas engine	V_1	$CONS_{ELEC, PJ}$	Landis + Gyr Dialog ZMD405CT44.0459S2	0,1%	Procedure PM-4
Electricity generated in the gas engine	V_2 V_{2rez}	GEN_V	Landis + Gyr Dialog ZMD405CT44.0459S2	0,11%	Procedure PM-4
Electricity consumed by the flare stack	V_3	$CONS_{ELEC, PJ}$	Landis + Gyr Dialog ZMD405CT44.0459	0,5%	Procedure PM-5

Measured parameter	Figure reference	Data variable	Measuring instrument	Uncertainty level	Monitoring procedure
Electricity consumed by the Methane Recovery Station	V_4	$CONS_{ELEC, PJ}$	Three-phase electricity meter mater – 2 units type. 2 E C 6 a t d g r	Accuracy class: Active energy: 1 Passive energy: 2	Procedure PM-8

Here, the Proposed Project does not claim the ERU from the Electricity Generation by the Gas Engine to avoid the double count under the EU-ETS.
Therefore, the project emission from additional energy required for CMM capture and use is calculated by the formula shown below.

$CONS_{ELEC,PJ}$ = Electricity consumed by the Methane Recovery Station(V4) + Electricity consumed by the gas engine(V1) + Electricity consumed by the flare stack(V3) - Electricity generated in the gas engine(V2).

But If $CONS_{ELEC,PJ} < $ zero(0), $CONS_{ELEC,PJ}$ shall be deemed zero(0).

C. Other parameters

For the purpose of monitoring the operating of the flare stack, the following parameters are to be monitored:

1. Temperature in the exhaust gas of the flare
2. Oxygen concentration in the exhaust gas from the flare stack

In the table below the applied meters and corresponding monitoring instrument were presented:

Table 4 Monitoring Data for monitoring the flare stack's proper operation

Measured parameter	Figure reference	Data variable	Measuring instrument	Uncertainty level	Threshold condition	Monitoring procedure
Temperature in the exhaust gas of the flare	T_3	T_{flare}	Analyzer ELJACK maMos 200 with ZAM Kety: MTA-20 and STA-300	0,15 ºC	Above 500 ºC	Procedure PM-7

All meters installed in the proposed project are accorded with national standards. All measuring equipment of the monitoring system is covered by a supervision system according to requirements of standard PN-EN ISO/IEC 17025:2005 and rules of Polish measurement legislation. All elements of the monitoring system are included in an equipment register which contains labeling and meter location. Each apparatus has its own card file, in which all important events concerning reparations, maintenance and excluding from the operation are noted (*Monitoring and Reporting Book*, Chapter 5).

All the equipment used will be maintained and serviced in accordance with the original manufactures instructions. Technical conditions of the particular elements of the monitoring system undergo periodical technical survey according to established plan of surveys. Frequency of surveys is set once a month. Results of the survey are recorded in the technical survey form (*Monitoring and Reporting Book,* Chapter 7).

Frequency of the monitoring data recording depends on measured parameter and measuring technique and are included in the particular monitoring procedures (PM 1 – PM 8). For meters equipped with data memory, the collected data will be stored electronically by installed data logger as well as an excel file and on paper in appropriate monitoring form (FMs). In remaining cases the collected data will be stored as an excel file and on paper as monitoring form (FMs). All responsibilities related to the project monitoring plan realization belong to the Project Technical Manager. He appoints the personnel in charge of monitoring tasks and supervises its work.

The collected data should be stored and archived in a central data base. The administrator of the data base is responsible for proper work of the data base, routine backups and save storage. The Project Technical Manager is responsible for correctness of the logged data and administration of the data base. He should regularly verify the recorded data and check the stored data plausibility, errors and deviations. All inconsistencies should be discussed with the service and the operation teams.

All stored data will be kept during the whole operation period of the plant and furthermore for 5 years.

The Project Technical Manager is responsible for preparation of the standardized monthly reports, which should be revised by the Project Coordinator (GIG). On the basis of the monthly reports detailed annual report should be prepared by the Project Coordinator and confirmed by the verifier.

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 above list. Their equipments have enough accuracy for this project. Therefore, manufacture will change these models, functionally-equivalent equipments will be adopted. .

Annex 4
Project Emissions from flaring ($PE_{flare, y}$)

In the proposed project, the project emissions from flaring ($PE_{flare, y}$) are calculated by the following steps.

STEP 1: Determination of the mass flow rate of methane in the residual gas that is flared

STEP 2: Determination of methane mass flow rate of the exhaust gas on a dry basis

STEP 3: Determination of the hourly flare efficiency

STEP 4: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiency.

The calculation procedure in Annex 4 determines the flow rate of methane before and after the destruction in the flare, taking into account the amount of air supplied to the combustion reaction and the exhaust gas composition (methane). The flare efficiency is calculated for each hour of a year based either on measurements or default values plus operational parameters. Project emissions are determined by multiplying the methane flow rate in the residual gas with the flare efficiency for each hour of the year.

The following data are continuously monitored to use this calculation methodology:

kCH4	%	Concentration of CH4 in the residual gas
VG	m^3/h	Volumetric flow rate of the residual gas in dry basis in the hour h
Wsp	m/s	Velocity of exhaust gas
kCH4sp	%	Concentration of CH4 in the exhaust gas
T_{flare}	℃	Temperature in the exhaust gas of the enclosed flare

The detail of the calculation steps is as follows:

STEP 1: Determination of the mass flow rate of methane in the residual gas that is flared

$$FM_{RG,h} = \rho_{CH4,n} * VCH4n$$

Where:

Variable	SI Unit	Description
$FM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in hour *h*
VCH4n	Nm3/h	Volumetric flow rate of methane in the residual gas at normal condition in hour *h*
$\rho_{CH4,n}$	kg/m3	Density of methane gas at normal conditions (0.716)

$$VCH4n = VG \times kCH4/100 \times pg/pN \times Tn/TGb$$

Where:

Variable	SI Unit	Description
VCH4n	Nm3/h	Volumetric flow rate of methane in the residual gas at normal condition in hour

		h
VG	m^3/h	Volumetric flow rate of the residual gas in dry basis in the hour *h*
kCH4	%	Concentration of CH4
pN	kPa	Normal pressure (101.315)
pg	kPa	Absolute gas pressure
Tn	K	Temperature at normal conditions (273.15)
TGb	K	Absolute residual gas temperature
Mw	kg/h	Mass flow of water of the flare stack cooling system
twc	℃	Outlet water temperature in the flare stack cooling system
twz	℃	Inlet water temperature in the flare stack cooling system

STEP 2: Determination of methane mass flow rate of the exhaust gas on a dry basis

$TM_{FG,h} = \rho_{CH4,n} * VCH4spn$

Where:

$TM_{FG,h}$	kg/h	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
VCH4spn	Nm3/h	Volumetric flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
$\rho_{CH4,n}$	kg/m3	Density of methane gas at normal conditions (0.716)

VCH4spn = VCH4sp x Tn/ Tspb

Where:

VCH4spn	Nm3/h	Volumetric flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
VCH4sp	m^3/h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis in hour *h*
Tn	K	Temperature at normal conditions (273.15)
Tspb	K	Absolute exhaust gas temperature ($Tspb = T_{flare} + Tn$)

VCH4sp = 3600 x A x Wsp x kCH4sp

Where:

VCH4sp	m^3/h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis in hour *h*
A	m2	Exhaust gas channel diameter
Wsp	m/s	Velocity of exhaust gas
kCH4sp	%	Concentration of CH4 in the exhaust gas

Wsp = (Wsp1 + Wsp2)/2

Where:

Wsp1	m/s	Velocity of exhaust gas measured by sensor 1
Wsp2	m/s	Velocity of exhaust gas measured by sensor 2

STEP 3: Determination of the hourly flare efficiency

For enclosed flares, the temperature T_{flare} in the exhaust gas of the flare is measured to determine whether the flare is operating or not. And either of the following two options can be used to determine the flare efficiency $\eta_{flare, h}$.

Option (a): To use a 90% default value. Continuous monitoring of compliance with manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations for this specific hour.

Option (b): Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

Option (b) is adopted for the proposed JI project, where the flare efficiency in the hour h ($\eta_{flare, h}$) is:

#0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 15 minutes during the hour h.

#determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 45 minutes during the hour h:

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Where:

Variable	SI Unit	Description
$\eta_{flare,h}$	-	Flare efficiency in the hour h
$TM_{FG,h}$	kg/h	Methane mass flow rate in exhaust gas averaged in the hour h
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h

In case of the continuous monitoring system is unavailable for maintenance or failure, Option (a) will be used:

#0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 15 minutes during the hour h.

#50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 45 minutes during the hour h.

#90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 45 minutes during the hour h.

However, if the temperature in the exhaust gas of the flare (T_{flare}) and/or Volumetric flow rate of methane in the residual gas(VG) are unavailable for failure, the emergency procedure (option c) described below will be used.

Option (c):

The amount of destroyed methane in the hour h is calculated according to the following equation:

$$\eta_{flare,h} = \frac{Q_c}{H_u}$$

, where

Variable	SI Unit	Description
$\eta_{flare,h}$	-	Flare efficiency in the hour h
Q_c	MJ/h	Total amount of heat from methane combustion in the hour h
H_u	MJ/h	Heating value of methane in the residual gas in the hour h

The total amount of heat is calculated according to the following equation:

$$Q_c = (Q_w + Q_s) + Q_o$$

, where

Variable	SI Unit	Description
Q_w	MJ/h	Heat energy generated by the flare stack cooling system in the hour h
Q_s	MJ/h	Heat emitted with exhaust gas (chimney loss) in the hour h (Q_s is assumed as zero (0). This is conservative.)
Q_o	MJ/h	heat loss (convection and radiation) through the flare stack insulation (Q_o is assumed as zero (0). This is conservative.)

Qw = Mw * cw * (twc – twz)
, where

Variable	SI Unit	Description
Q_w	MJ/h	Heat energy recovered by the flare stack cooling system in the hour h
Mw	kg/h	Mass flow of water of the flare stack cooling system
cw	kJ	Specific heat of water
twc	℃	Outlet water temperature into the burner in the flare stack cooling system
twz	℃	Inlet water temperature from the burner in the flare stack cooling system

STEP 4: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiency.

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000}$$

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	t_{CO2e}	Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h
GWP_{CH4}	t_{CO2e}/t_{CH4}	Global Warming Potential

The following fixed constants will be used for the calculation.

Parameter	SI Unit	Description	Value
Pn	Pa	Atmospheric pressure at normal conditions	101,325
T_n	K	Temperature at normal conditions	273.15
GWP_{CH4}	tCO2/tCH4	Global warming potential of methane	21
$\rho_{CH4,n}$	kg/m3	Density of methane gas at normal conditions	0.716