



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

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**SECTION A. General description of the project.****A.1. Title of the project:****CMM utilisation on the former 1 Maja (1st of May) Coal Mine in Upper Silesian Basin, Poland**

Project acronym is 1st of May (1 Maja, as a correct name will be used in contacts with the Polish authorities).

Sectoral scopes 8, 10

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A.2. Description of the project:

The Upper Silesian Basin is the largest industrial region of Poland with coal, metallurgic and chemical industries. After the long term industrial use Upper Silesia is one of the most hazardous regions of Poland in terms of environmental pollution. The main contributor of methane emissions to the atmosphere is the coal industry.

Degassing of Coal Mine Gas (CMM) is an unavoidable occurrence of hard coal mining. CMM mainly consists of the harmful greenhouse gas methane (GWP 21), so that using of CMM becomes more important particularly with regard to the world-wide consensus of reducing green-house-gas emissions.

The coal mine 1 Maja (1st of May) is abandoned since 1999. It was a gassy mine with a specific geological structure. There is a continuous evaluation of a possible methane migration from the mine 1 Maja to neighbouring mine Marcel. This migrating methane can only be moved outside the mine together with the ventilation air. The shafts of the mine 1 Maja are not sealed and methane deliberates continuous through several of those openings.

There is also a methane migration to the surface possible. The possible gas migration to the surface was proven for the Ruhr Basin, Ostrava-Karvina Basin and also Upper Silesia as a result of abandoning of the mines. Simulations especially for the area above the gob of the mine 1 Maja show the likely migration to the surface.

Prior to the project operation methane deliberating from the abandoned mine 1 Maja (1st of May) was released to the atmosphere without utilisation.

In this project CMM captured from the abandoned coal mine 1 Maja (1st of May) in Poland should be first utilised in flares. The project developer (LNG Silesia, LNG) buys the CMM from a consortium of gas licence owners.

If the amounts of CMM able to be captured would be appropriate and stable in the future, there is possible to install CHP units aiming utilisation of for power and heat. This further development depends on the technical conditions, as feed-in conditions to the grid in the rural areas, where the locations are at present in evaluation and on heat users to attract.



If the amounts of CMM able to be captured would increase, there is also possible to install a liquefaction plant aiming utilisation of methane by means of using it as a substitute of natural gas or other fuels.

The combustion of methane in flares results in a significant emissions reduction. The conversion of the harmful greenhouse gas methane with a GWP of 21 into less harmful CO₂ with a GWP of 1 reduces the global warming potential of the emissions by 87%.

ERUs resulting from the displacement of fossil fuels for energy production are not included in the project.

A.3. Project participants:

Table A- 1 – Project participants

Party involved (*)	Legal entity <u>project participant</u> (as applicable)	Please indicate if the <u>Party involved</u> wishes to be considered as <u>project participant</u> (Yes/No)
Poland (host)	<ul style="list-style-type: none"> ▪ LNG Silesia sp.z o.o. (LNG) 	No
Netherlands	<ul style="list-style-type: none"> ▪ Carbon-TF B.V. 	No
((host) indicates a host Party)		

- Carbon-TF B.V.
Consultant and investor, buyer of the emission reduction certificates; Dutch company trading emissions reduction certificates. Authorised to participate in the project.
- LNG Silesia sp.z o.o. (LNG)
The project developer (LNG Silesia, LNG) buys the CMM from the gas licence owners. Owner of the plant.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project will have several locations. First of them is in Mszana in south Poland (Silesian Voivodship). The second is envisaged in Marklowice. Other locations will be developed later.

The first locations in the Upper Silesian are shown on the maps below.

A.4.1.1. Host Party(ies):

Host Party: Poland

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

Figure A- 1: Location of the Upper Silesian Basin in Poland

A.4.1.3. City/Town/Community etc.:**Location of project:**

Location no. 1:

The first location of the project is in Mszana within the area nearby to the drilling M3 sank at present.

Land parcel: 1488/43

Boundary: Mszana

The geographical coordinates:

49°58'16.81648"N, 18°31'07.27731"E



Because of the complicated geology of the area or other relevant reasons and risks associated with the project it is possible that a different location within the concession field will be needed to be developed instead of the now envisaged one. It is also possible that a further location will be enforced in order to ensure a sustainable CMM removal and use from the underground. The environmental effects of the proposed project will not be negative affected.

The emission reduction estimated in the project considers the entire project consisting of the present location and those planned in the future. The estimation of the emission reduction potential for the project is based on the appraisal of the CMM amounts, which are supposed to migrate from the abandoned mine 1 Maja (1st of May) into the atmosphere. These amounts do not increase through capturing at new locations. New locations aim the ensuring of sustainable methane removal from the abandoned mine.

Location no. 2, 3

A possible further drilling needed for a sustainable CMM removal and use from the underground would be located within the concession field. The second location is supposed in the north concession, in the near of the neighbouring mine's border. Supposed location would be at an abandoned drilling in the near of the landmark with geographical coordinates:

50°00'22"N, 18°30'28"E

Another option is to capture the gas from abandoned not sealed shafts of the mine or other post mining openings in the future. The options are at present in evaluation.

The enhancement of the project is possible not earlier as in 2013. The installation plan for the project is given in the table A2.

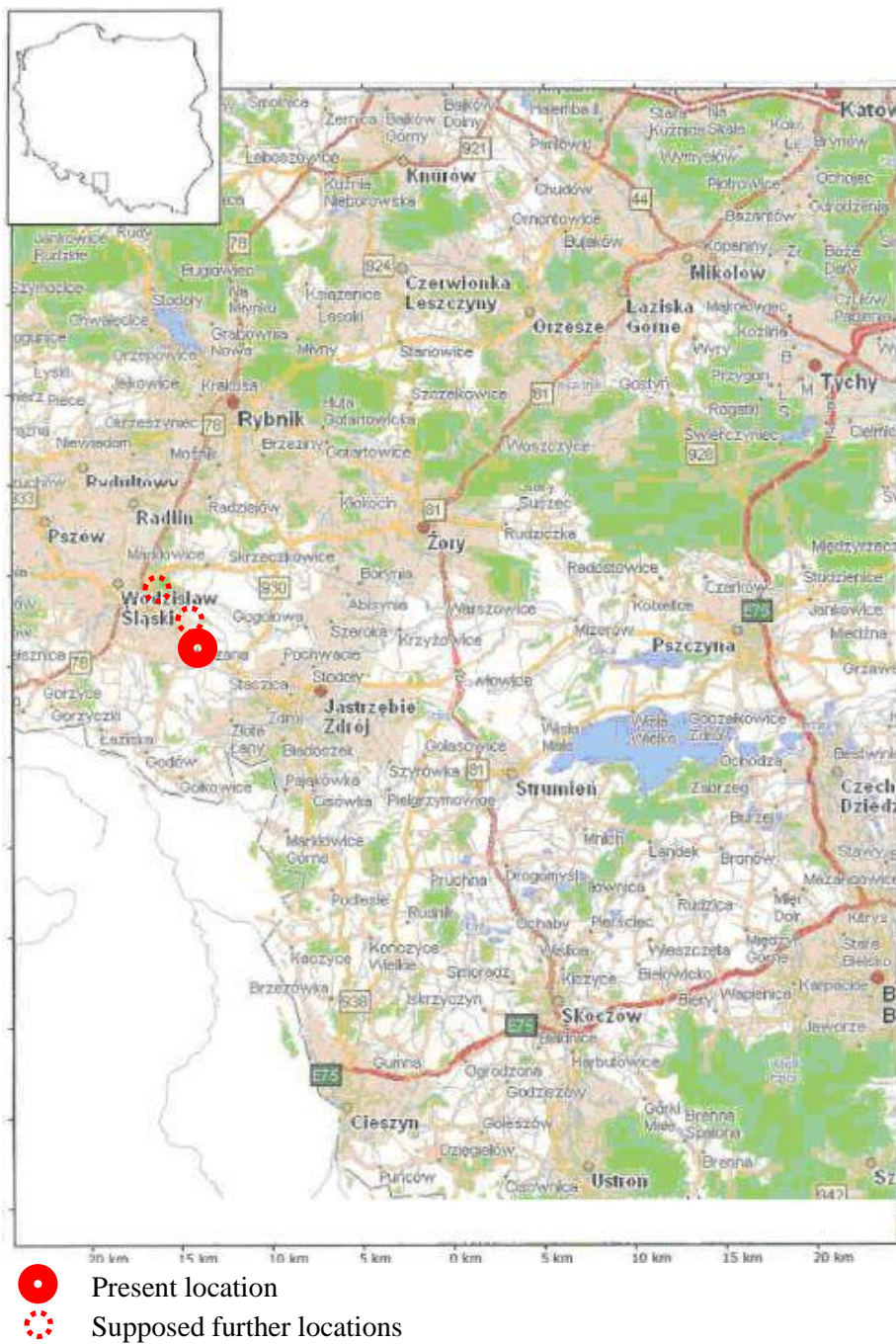


Figure A-3: Location of the Project 1 Maja.



There are no national regulations or legal requirements for treatment and utilisation of the captured CMM whether from active or abandoned mines. The presented project is the first of its kind in Poland aiming the utilisation of CMM from an abandoned mine through flaring as a standalone technology.

Project activities - Utilisation of CMM

In the case of this project a part of the CMM from the drillings or other openings is utilised through flaring. This part of methane is destroyed by burning.

Utilisation of the methane captured (the project)

The utilisation of the CMM is provided through:

1. installation of a flare
The methane flow from the capture system is supposed to be up to 1200m³/h pure methane. The CMM is to burn in a flare in order to reduce GHG emission. The utilisation plan is shown in table A-2.
2. installation of a flare within the further locations
The methane flow from the capture system is supposed to be up to 1200m³/h pure methane. The CMM is to burn in a flare in order to reduce GHG emission. The utilisation plan is shown in table A-2.
3. installation of cogeneration units for power and heat production
4. Installation of a liquefaction plant, if the amounts of captured CMM increase

Table A-2 – Installation plan of the project

unit	installation date	firing capacity	product	efficiency
1 Flare	July 2012	5,000-7,000 kWth	Methane destruction	99.5%
1 Flare	Planned for autumn 2013	5,000-10,000 kWth	Methane destruction	99.5%
cogeneration units (1-2)	Planned not earlier as for autumn 2013	750-2,000- kWel	power and heat	Electrical 38-42.8 % Thermal 43% Total up to 85.8%

CMM Supply

The particular utilisation unit is connected to the pipeline from a drilling or other opening. The pressure generated by the vacuum pumps is sufficient to supply the utilisation unit. The total amount of CMM sent to the utilisation unit is measured by flow meters. The unit is provided with a deflagration flame arrester which prevents backfiring from the utilisation unit into the underground building system of the coal mine.

Flare

A flare with a firing capacity of approx. 5,000 kWth was installed. The roots compressor was integrated in the same container unit. The enlargement of the flare is envisaged.



Cogeneration unit

Cogeneration units with a firing capacity of approx. 1,500 to 4,705 kW could be installed. The cogeneration units would generate power with an output of up to ca. 2,014 kW per unit, and hot water with an output of up to 2,024 kW per unit.

This technology would displace or complement the flaring at a chosen location in a way, which will not lead to increased emission reductions. According to the current Polish regulation a request for an amendment of the letter of approval will not be necessary, unless other reasons will occur.

The CMM would be fed into the gas engine, where the methane will be burned completely with low exhaust emissions. The cogeneration unit is to operate fully automatically and all essential measured data are to gather and record.

Cogeneration units like this have been tested at various sites in Western Europe and are now approved. Especially in the Ruhr District in Germany a large amount of units (approx. 150) is installed on active and abandoned coal mines.

Proved safety-related equipment is used to minimize the risks of the plant.

The following characteristics are given for the largest assumed one

Technical data per unit	cogeneration unit for combined heat and power generation completely build in a container, including all necessary equipment, control and data collection system
Installed firing capacity	4,075 kWth *
Power output	max. 2,014 kWel *
Heat output	max. 2,024 kWth *
Efficiency (electricity)	max. 42.8 %
Maximum methane amount required	560 m ³ /h CH ₄
Average annual operation time	7,500 h/a
Average heat generation	2,625 MWh/a
Average power generation	15,000 MWh/a
Average methane destruction	4,175,435 m ³ CH ₄ per year = 2,993 t CH ₄ per year
Average power own consumption	525 MWh/a

*) firing capacity, efficiency and power and heat output depend on the gas quality, methane concentration and load.

Electricity utilisation

The electricity to generate by the power generator of the CHP installed in the project will be fed into the Polish grid. In this way the power amount which is produced from fossil fuels is reduced.



The cogeneration unit is actually supposed to be not economically viable and not feasible from the technological point of view.

Heat utilisation

The heat supply of the users in the area nearby of the unit locations is provided by coal boilers. In the case of further development it could be possible to displace a part of this energy by the heat generation of the project. This amount of emission reductions is not included in the PDD.

Maintenance program

The maintenance and operation of the project equipment will be provided by the personnel of the plant operator (LNG). The maintenance of the flares and engines will be carried out by the service division of the equipment provider.

Risks of the project

The following risk could be identified:

Table A- 3: Risk and mitigation to the project

Risk	Mitigation
Lower CMM utilisation than expected	The amount of CMM possible to extract is at the beginning higher than the demand of the project. It is very likely that the amount to extract at a particular drilling will be smaller. The further locations should ensure the biggest possible CMM extraction and utilisation in order to reduce the methane emission to the atmosphere.
Malfunctioning of the plant.	Training of the staff and regular maintenance of equipment.
Lower concentration of methane in extracted gas	The flare has a wide regulation range. A minimum concentration of 20% CH ₄ is required.

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

The emissions reduction is based on the conversion of CMM with its main component methane (GWP 21) into CO₂ (GWP 1) in combustion processes. In absence of the project the whole CMM amount, which should be converted into CO₂ in the flare or later in progress of the project also in the heat and power generation units would otherwise be released unused to the atmosphere as more harmful methane.

The power generated by the project can displace conventionally generated power and reduce the greenhouse gas emissions of the Polish grid. This amount emission reduction is not included in this PDD



The heat generated by the project could displace conventionally generated heat by coal combustion by small local heat providers in the nearest area of the plant. This amount emission reduction is not included in this PDD.

The project is not "business-as-usual" and faces several barriers, both in terms of prevailing practice and the economic attractiveness of the project. In section B of this PDD, it is shown that the emission reductions would not occur in absence of the project.

**A.4.3.1. Estimated amount of emission reductions over the crediting period:**Table A- 4 —*Emission reductions during the first crediting period (2008-2012) resulting from the first already developed location*

1st Crediting Period 2008- 2012	
	Years
Length of the crediting period	0.5
Start date of the project 01/07/2012	
2008	0
2009	0
2010	0
2011	0
2012	28,306
Total estimated emission reductions over the crediting period (tonnes of CO ₂ equivalent)	28,306
Annual average of estimated emission reductions over the crediting period (tonnes of CO ₂ equivalent)	56,612

There are no special conditions for small scale projects defined by the host party. The following information is given for the purpose of the project registration.

According to the data given above the project falls under:

Type III of JI SSC projects (Other projects that result in emission reductions of less than or equal to 60 kilotonnes (kt) of carbon dioxide (CO₂) equivalent annually) as defined in “Provisions for joint implementation small-scale projects” developed by the JISC

The proposed JI SSC project is not a debundled component of a large project as there is no a JI (SSC) project with a publicly available determination in accordance with paragraph 34 of the JI guidelines:

- (a) Which has the same project participants; and
- (b) Which applies the same technology/measure and pertains to the same project category; and
- (c) Whose determination has been made publicly available in accordance with paragraph 34 of the JI guidelines within the previous 2 years; and
- (d) Whose project boundary is within 1 km of the project boundary of the proposed JI SSC project at the closest point.



Table A- 5 — *Prospected emission reductions during the second crediting period (2013-2017) considering the already developed location and the assumed project enhancement*

2013-2017	
	Year
Length of crediting Period	5
2013	175,961
2014	248,428
2015	248,428
2016	248,428
2017	248,428
Total estimated emission reductions over the period (tonnes of CO ₂ equivalent)	1,169,672
Annual average of estimated emission reductions over second crediting periods (tonnes of CO ₂ equivalent)	233,934
Total estimated emission reductions over the <u>project lifetime 2012-2027</u> (tonnes of CO ₂ equivalent)	2,936,972

A.5. Project approval by the Parties involved:

The parties involved will support the project. The great impact for reduction of green house gas is one motivation to drive the system.

The Project Idea Note was submitted in July 2011 due to obtain the Letter of Endorsement before the project implementation. The Letter of Endorsement was issued in August 2011.

The PDD is a part of a request for the Letter of Approval by Poland within the first track according to the current Polish law.

The Letter of Approval ref. no 2012JI45 of The Netherlands as of the investor country was issued 03rd October 2012.

**SECTION B. Baseline****B.1. Description and justification of the baseline chosen:**

The JI specific approach for baseline setting and monitoring has been used to identify the baseline scenario of the proposed JI project. According to the most recent guidelines for baseline setting and monitoring (JISC18) elements of approved CDM baseline and monitoring methodologies or approved CDM methodological tools can be used, as appropriate.

Systemic analysis

A project specific methodology determined by DMT will be applied. This methodology has been determined by the German Institute DMT (Deutsche Montan Technologie <http://www.dmt.de>) for two projects DE1000014 and DE1000015 utilising CMM out of abandoned coal mines.

In this methodology, which has been determined on behalf of a German Mining Authority “Bezirksregierung Arnsberg, Abteilung 8, Bergbau und Energie in NRW” (District Government Arnsberg, Dept. 8 - Mining and Energy - in North Rhine-Westphalia), DMT concludes, that CMM in the hard coal mining regions of Germany, is always finding a way through open shafts, cracks in the overburden and existing degassing wells directly or diffusely into the atmosphere.

DMT also declares that the total amount of burned CMM captured out of abandoned coal mines has to be considered as avoided emissions. The conscious suction at a chosen spot doesn't induce an increased production of methane; in fact only the particular time of when the methane reaches the surface is been brought forward for a few weeks or months. However the suction is technically essential for the collection of the CMM at a chosen spot, because only with an external pressure gradient applied, the gas is flowing to the withdrawal point. Without the pressure gradient the CMM migrates diffusely to the surface and can possibly accumulate there to explosive mixtures. Such incidents already occurred in many coal mining areas (e.g. Germany, Poland, Czech Republic, Ukraine and Kazakhstan et al.).

Local analysis

The occurrence of CMM migration is ascertained also for the Polish Upper Silesian Basin.

The coal mine 1 Maja is abandoned since 1999. It was a gassy mine with a specific geological structure. There is a continuous evaluation of a possible methane migration from the mine 1 Maja to neighbouring mine Marcel. This migrating methane can only be moved outside the other mines together with the ventilation air.

The shafts of the mine 1 Maja are not sealed and methane deliberates continuous through several of those openings.

The additional matter is methane migration to the surface above the abandoned exploration area of the mine, which can occur similar as in the Ruhr Basin, the coal basins in the UK and Ostrava-Karvina region. It is verified through investigation of the Polish scientific institutions and authorities. A very efficient method of the surface endangerment verified in the Ruhr Basin is capturing of post mining



methane from the gob area. Especially for the area above the gob of the mine 1 Maja simulations show the likely migration to the surface.

The gas migration from abandoned mines to the surface was described in many scientific publications concerning coal mining regions in Poland, Germany and the Czech Republic or in the UK. It is also local proven for Upper Silesia through experiments and theoretical investigations.

The evidence for the systemic and local analysis was provided to the AIE.

**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:**

The additionality was proven by applying the "Tool for demonstration and assessment of additionality", (version 06), EB65.

The result is given below.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations**Sub-step 1a Identification of technically feasible options for using CMM****Options for CMM treatment**

Several approaches can be taken to treat the captured CMM of the project:

- i. No treatment – venting through the nearby mines and the migration to the surface
- ii. Flaring of CMM
- iii. Use for additional grid power generation
- iv. Use for additional captive power generation
- v. Use for additional heat generation
- vi. Feed into gas pipeline (to be used as fuel for vehicles or heat/power generation)
- vii. Use for liquefaction of methane
- viii. Possible combinations of options i to vii with the relative shares of gas treated under each option specified

All of these options are 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 project activity is covered by the option ii. – flaring.

Options for energy production

The options for energy production are included in the options iv. to viii. listed in step above.

The project activity is covered by the option ii. flaring. In the next years a displacement or complementing of flares could be possible, if the solution would be feasible from technological point of view, which would result in the alternative viii. – the combination of option ii. flaring, vi. heat generation, option iv use for additional grid power generation.



Formulation of the baseline scenario alternatives

The following alternatives can be considered for implementation at the project site and are in compliance with the options listed in step 1b and step 1c.

Alternative i. - Venting of CMM

Since there are no legal requirements for treatment and utilisation of the captured CMM, it is common practice at Polish coal mines to release the CMM into the atmosphere. The same situation is for abandoned coal mines. This alternative is the actual situation before project implementation – the CMM deliberating from the mine was released into the atmosphere.

The energy production in this scenario would continue in the following way:

- Electricity would be supplied by the national/regional grid
- Heat demand would be supplied by the coal fired boilers

Alternative ii. Flaring of CMM

The flaring of the captured methane is not required by any existing national regulations. The infrastructure for methane flaring does not exist at the project site, so that additional investment would be required. Without revenues from emissions trading this alternative would only generate costs and is economically not viable.

The energy needs of the mine would be supplied in the same way as described in alternative i. A flaring of CMM is a part of the project scenario.

Alternative iii. – use for additional grid power generation

The captured methane could be utilised in a power plant for power generation. Possible power plant alternatives are:

- a) conventional steam power plant, CMM fired
- b) combined gas-steam power plant, CMM fired
- c) gas turbine, CMM fired
- d) gas engine, CMM fired
- e) fuel cell, CMM fired

Alternative iv. – use for additional captive power generation

The captured methane could be utilised for captive power generation. A combined heat and power generation is possible and eligible:

- a) cogeneration unit, CMM fired

Alternative v. – use for additional heat generation



The captured methane could be utilised for additional heat generation. In this case a new heat generation plant should be constructed and connected to a heating system, e.g. a district heating system. Possible heat generation plant alternatives are:

- a) conventional steam boiler, CMM fired
- b) conventional hot water boiler, CMM fired or co-fired
- c) heat generation in the cogeneration unit

The energy needs would be supplied in the same way as described in alternative i.

Alternative vi. – feed into a gas pipeline (to be used as fuel vehicles or heat /power generation)

There are three possible ways to utilise the captured methane:

- a) feeding into a gas pipeline – in this case a new connection to an existing pipeline has to be made. Depending on the quality specification of the pipeline operator, most likely an additionally methane enrichment plant could be required
- b) compression of the gas and usage as fuel for vehicles
- c) liquefaction of the gas and transportation in tanks for utilisation by external users

The energy needs would be supplied in the same way as described in alternative i.

Alternative vii - Use for liquefaction of methane

The captured methane could be liquefied. In this case a new liquefaction plant should be constructed at the project site.

Alternative viii. – possible combinations of alternatives i. to vii.

There are numerous possible combinations of the alternatives i. to vii. described above, so that only the enhanced project scenario should be described in the following.

The CMM could be utilised in flares and for heat and additional power generation. Depending on the local heat demand the produced heat should be consummated by local facilities and the power should be fed in into the grid. The remaining amount of the CMM which cannot be utilised in flares or for heat and power generation should be vented.

There is a flare implemented as a project activity. The installation of a CHP unit depends on local feed-in conditions and possible connection to the grid.

Power would be produced by the cogeneration unit. The remaining available CMM amount, which cannot be utilised for heat and power production is to flare or to vent.

Sub-step 1b Eliminate baseline options that do not comply with legal or regulatory requirements

There are no particular regulations concerning the coal mine methane extraction after the coal mine abandoning. There is no regulation in place that would require any specific utilisation of the extracted methane. On the other hand, there is no national regulation in place that would prohibit the extraction or



any use of CMM, e.g. for heat and/or electricity generation. Therefore, all the alternatives listed in step 1b are in compliance with the existing regulations.

Outcome of Step 1

The proposed project activity is not the only alternative amongst the ones considered by the project participants that is in compliance with mandatory regulations with which there is general compliance.

Step 2. Investment analysis

In this step is to determine whether the proposed project activity is not

a) the most economically or financially attractive

or

b) economically or financially feasible, without the revenues from the sale of ERUs

Sub-step 2a. Determination of the analysis method

The proposed project activity to implement within the first crediting period would generate no other revenues than only those from JI. Therefore, simple cost analysis (Option I) is applicable.

Sub-step 2b. Application of the simple cost analysis

The investment costs for the refurbishing of the available equipment of the operator, an installation of a new flare for one further location together with the works at the project locations would cost ca. 860,000€. There are supposed yearly operating costs for two locations of over 300,000€. There are no other income supposed as only the revenues from JI.

The project is not financially viable without revenues from flexible mechanisms.

Sub-step 2c. Comparison with at least one alternative (Alternative i. Venting)

There are no legal requirements that prohibit venting or require stakeholders to utilise post mining CMM. This alternative represents the current situation in the absence of the proposed project activity. There are no barriers or external factors that prevent this alternative to be continued. Therefore, this scenario can be considered to be a realistic alternative.

Furthermore this alternative does not generate any costs, which makes the proposed project activity more costly than the commencing with the present situation alternative.

Conclusion after the investment analysis

The proposed project activity is not the most economically or financially attractive

Step 3. Barrier analysis

According to Tool for the demonstration and assessment of additionality (Version 06.0.0) EB 65, if it is concluded after the simple cost analysis that the proposed JI project activity is more costly than at least one alternative then is to proceed to Step 4 (Common practice analysis).



Step 4. Common practice analysis

The incentive from the selling of emission reduction was seriously considered in the decision to proceed with the project activity.

The CMM deliberating at the Coal Mine 1Maja was vented in the atmosphere through the ventilation of the nearby mines and the migration to the surface. Existing legislation is primary orientated on increasing safety of active coal mine operations thus facilitating and enforcing development of degasification and ventilation systems at coal mines. There are also no requirements for post mining CMM. Therefore current practices and economic conditions prevent the project from being implemented and clearly prevent the development of CMM utilisation activities. This is the first project in Poland which implement flaring of CMM from an abandoned mine as a standalone technology aiming emission reduction.

The project is a first of its kind activity according to the “Tool for the demonstration and assessment of additionality” (Version 06.0.0) EB 65 as there is no other examples within the applicable geographical area (Poland) delivering the same output within the calculated output range between 3.75 MWth and 11.25 MWth which the same

- (a) Energy source/fuel;
- (b) Feed stock;
- (c) Size of installation (firing capacity):
 - (i) Micro (as defined in paragraph 24 of Decision 2/CMP.5 and paragraph 39 of Decision 3/CMP.6);
 - (ii) Small (as defined in paragraph 28 of Decision 1/CMP.2);
 - (iii) Large

Furthermore as concluded after the barrier analysis there is an alternative remaining and it is not the proposed activity without JI, which proofs the barrier due to prevailing practice

This project is the “first of its kind” in Poland using CMM from an abandoned coal mine for flaring as a standalone technology aiming emission reduction.

The project is an activity first of its kind according to “Tool for the demonstration and assessment of additionality” (Version 06.0.0) EB 65 and so **not a common practice**.

The proposed activity is not a common practice and a first of its kind.

Conclusion

The impact of approval of the proposed project activity will allow the crossing of the financial hurdles and other barriers that otherwise would prevent the project from being implemented. The project is additional.

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

The baseline shall be established in accordance with the appendix B of the Guidance on criteria for baseline setting and monitoring.

Table B-4: Overview on emissions sources included in or excluded from the project boundary

Source	Gas		Justification / Explanation
Emissions of methane as a result of venting	CH ₄	Included	The main emission source. The amount of methane to be released depends on the amount of coal produced. The baseline scenario for the project activity not implemented as a JI project is taken into account.
Emissions from destruction of methane in the baseline	CO ₂	Excluded	There are no systems for heat and power in the applicable baseline scenario.
	CH ₄	Excluded	There are no systems for heat and power in the applicable baseline scenario.
	N ₂ O	Excluded	There are no systems for heat and power in the applicable baseline scenario.
Grid electricity generation (electricity provided to the grid)	CO ₂	Excluded	CO ₂ emissions associated to the same quantity of electricity than electricity generated (in case of later implementation) as a result of the use of methane are excluded.
	CH ₄	Excluded	Excluded for simplification. This is conservative
	N ₂ O	Excluded	Excluded for simplification. This is conservative
Captive power and/or heat, and vehicle fuel use	CO ₂	Excluded	In the baseline scenario heat would be generated by the coal boilers. CO ₂ emissions associated to the same quantity of heat than heat generated (in case of later implementation) , as a result of the use of methane are excluded.
	CH ₄	Excluded	Excluded for simplification. This is conservative
	N ₂ O	Excluded	Excluded for simplification. This is conservative



Table B-5: Overview on emissions sources included in or excluded from the project boundary

Project activity

Source	Gas		Justification / Explanation
Emissions of methane as a result of continued venting	CH ₄	Excluded	Only the change in CMM emissions 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	The own electricity consumption of the flares and in case of later implementation cogeneration units (cooling fans) is included.
	CO ₂	Excluded	The electricity consumption of the vacuum pumps is not included in the project boundary. There is assumed, that the efforts for venting and capturing of the methane by the bordering mines against the present extraction are comparable or higher. Thus the extraction is performed both in the baseline and project scenario.
	CO ₂	Excluded	The electricity consumption of flares and the CHP units (in case of later implementation) during the down time is not included in the project boundary as it is not significant. ¹
	CH ₄	Excluded	Excluded for simplification. This is conservative. This emission source is assumed to be very small.
	N ₂ O	Excluded	Excluded for simplification. This is conservative. This emission source is assumed to be very small.
Emissions from methane destruction	CO ₂	Included	From the combustion of methane.
Emissions from NMHC destruction	CO ₂	Included	Actually NMHC accounts less than 1% by volume of the extracted coal mine gas, so NMHC has been excluded for estimating the emission reductions. However the NMHC amount will be monitored on a regular basis and the emissions will be included if the NMHC concentration will exceed 1%.
Fugitive emissions of unburned methane	CH ₄	Included	A small amount of uncombusted methane, 0.5% for each unit, will be accounted to keep conservative.

¹ The average per year over the crediting period is less than 1% of the annual average and does not exceed the amount of 2,000 t CO_{2eq}. Reference JISC "Guidance on Criteria for Baseline Setting and Monitoring".

Fugitive methane emissions from on-site equipment	CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small.
Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles	CH ₄	Excluded	Not applicable to the project
Accidental methane release	CH ₄	Excluded	This emission source is assumed to be very small.

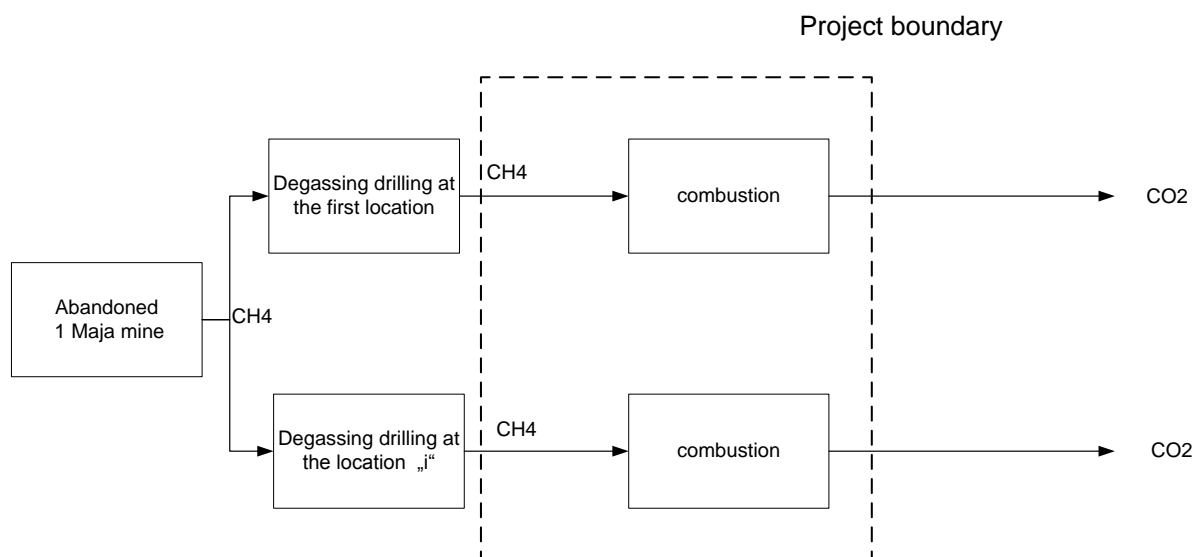


Figure B-3: Project boundary

Overlap of the project activity and the baseline

As there was no use of methane in the baseline, an overlap of the project activity is not possible.

Baseline Emissions

Baseline emissions are given by the following equation

$$BE_y = BE_{MDy} + BE_{MRy} + BE_{Use,y} \quad (1)$$

where



BE_y	=	baseline emissions in year y (t_{CO_2e})
BE_{MDy}	=	Baseline emissions from destruction of methane in the baseline in year y (t_{CO_2e})
BE_{MRy}	=	Baseline emissions from release of methane into atmosphere in year y (t_{CO_2e}) that is avoided by the project activity
$BE_{Use,y}$	=	Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (t_{CO_2e})

Use of methane for production of power, heat or supply to gas grid replaced by the project activity

CO₂ emissions associated to the same quantity of energy (power or heat) as energy generated (in case of later implementation) as a result of the use of methane are excluded.

$$BE_{Use,y} = 0 \quad (2)$$

Methane destruction in the baseline

The project activity uses methane which otherwise would be exhausted into the atmosphere. There is no use of this part of methane in the baseline.

$$BE_{MDy} = 0 \quad (3)$$

Methane released in the atmosphere

The baseline emissions from release of methane into the atmosphere in the year y ($BE_{MR,y}$) is obtained by the following equation:

$$BE_{MR,y} = (CMM_{PJiy}) \times GWP_{CH_4} \quad (4)$$

$$CMM_{PJiy} = \sum MM_{Flare iy} \quad (5)$$

where

CMM_{PJiy}	=	CMM captured, sent to and destroyed by use i in the project activity in year y (expressed in t_{CH_4})
GWP_{CH_4}	=	Global warming potential of methane ($21 t_{CO_2e}/t_{CH_4}$)
$MM_{Flare iy}$	=	Methane destroyed in the flare i in year y (expressed in t_{CH_4})

Leakage

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y} \quad (6)$$

Where:

LE_y	=	Leakage emissions in year y (t_{CO_2e})
$LE_{d,y}$	=	Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (t_{CO_2e})
$LE_{o,y}$	=	Leakage emissions due to other uncertainties in year y (t_{CO_2e})

**Displacement of baseline thermal energy uses**

There is no use of methane in the baseline which could be displaced by the project activity.

Emission Reduction

$$ERy = BEy - PEy - LEy \quad (7)$$

where

- ERy = Emission reductions of the project activity during the year y (t CO₂)
 BEy = Baseline emissions during the year y (t CO₂)
 PEy = Project emissions during the year y (t CO₂)
 LEy = leakage emissions in year y (t CO₂) = 0

Data / Parameter:	BE _y
Data unit:	t CO _{2Eq}
Description:	baseline emissions in year y (t CO _{2e})
Time of determination/ monitoring	During the project implementation,
Source of data:	Monitored data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	Monthly recorded
Any comment:	Calculated using formulae in section B3

Data / Parameter:	BE _{MR,y}
Data unit:	t CO _{2Eq}
Description:	Baseline emissions from release of methane into atmosphere in year y (t CO _{2e}) that is avoided by the project activity
Time of determination/ monitoring	During the project implementation.
Source of data:	Monitored data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	Monthly recorded
Any comment:	Calculated using formulae in section B3 BE _{MR,y} = (CMM _{PJ,y}) _X GWP _{CH4}

Data / Parameter:	BE _{MDy}
Data unit:	t CO _{2Eq}



Description:	Baseline emissions from destruction of methane in the baseline in year y (t_{CO_2e})
Time of determination/monitoring	Ex ante
Source of data:	
Value of data applied	0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	There are no systems for heat and power in the applicable baseline scenario.
QA/QC procedures:	
Any comment:	

Data / Parameter:	PC_{NMHC}
Data unit:	%
Description:	Concentration (in mass) of NMHC in extracted gas (%), to be measured on wet basis
Time of determination/monitoring	yearly
Source of data:	Monitored data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Actually NMHC accounts less than 1% by volume of the extracted coal mine gas, so NMHC has been excluded for estimating the emission reductions. However the NMHC amount will be monitored on a regular basis and the emissions will be included if the NMHC concentration will exceed 1%.
QA/QC procedures:	The determination will be provided by an appropriate analysis.
Any comment:	

Data / Parameter:	$CMM_{PJ,i}$
Data unit:	tCH_4
Description:	CMM captured, sent to and destroyed by use i in the project activity in year y
Time of determination/monitoring	During the project implementation, monthly
Source of data:	Monitored data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane destroyed in flares will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	See Section D.2
Any comment:	

Data / Parameter:	GWP_{CH_4}
Data unit:	tCO_{2Eq} / tCH_4
Description:	Global warming potential of methane



Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	21 tCO _{2e} /tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

Data / Parameter:	CE _{FCH₄}
Data unit:	tCO _{2Eq} /tCH ₄
Description:	Carbon emission factor for combusted methane
Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	2.75 tCO _{2e} /tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

Data / Parameter:	CMM _{BL,y}
Data unit:	t CH ₄
Description:	CMM that would have been captured , sent to and destroyed by use <i>i</i> in the baseline scenario in year <i>y</i>
Time of determination/ monitoring	Ex ante at the start of the project
Source of data:	Project site
Value of data applied	0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	There are no systems for heat and power in the applicable baseline scenario.
QA/QC procedures:	
Any comment:	

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

Date of completion of the baseline study: 18 October 2012

Name of person / entity setting the baseline: Alina Mroz, / Carbon-TF B.V.

See Annex 1 for detailed contact information.



**SECTION C. Duration of the project / crediting period****C.1. Starting date of the project:**

The first test extraction and experiments on the CMM potential were made in summer 2012. The project activity started its operation in July 2012.

C.2. Expected operational lifetime of the project:

At least 15 years, equal to 180 months, if the CMM amounts will be appropriate and the possibility for claiming of incentives from achieving emission reduction will be given.

C.3. Length of the crediting period:

0.5 years (2010 – 2012), equal 6 months, within the Kyoto-period 2008-2012.

The crediting period can extend beyond 2012 subject to the approval by the host party. The crediting period will not extend beyond the operational lifetime of the project.

SECTION D. Monitoring plan**D.1. Description of monitoring plan chosen:**

A monitoring plan according to the JI approach after JISC and the Guidance on criteria for baseline setting and monitoring is applied for the project.

General remarks to the Monitoring Plan:

- Social indicators such as number of people employed, safety record, training records, etc, will be available to the verifier;
- IPCC default factors have been taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. [IPCC-2]

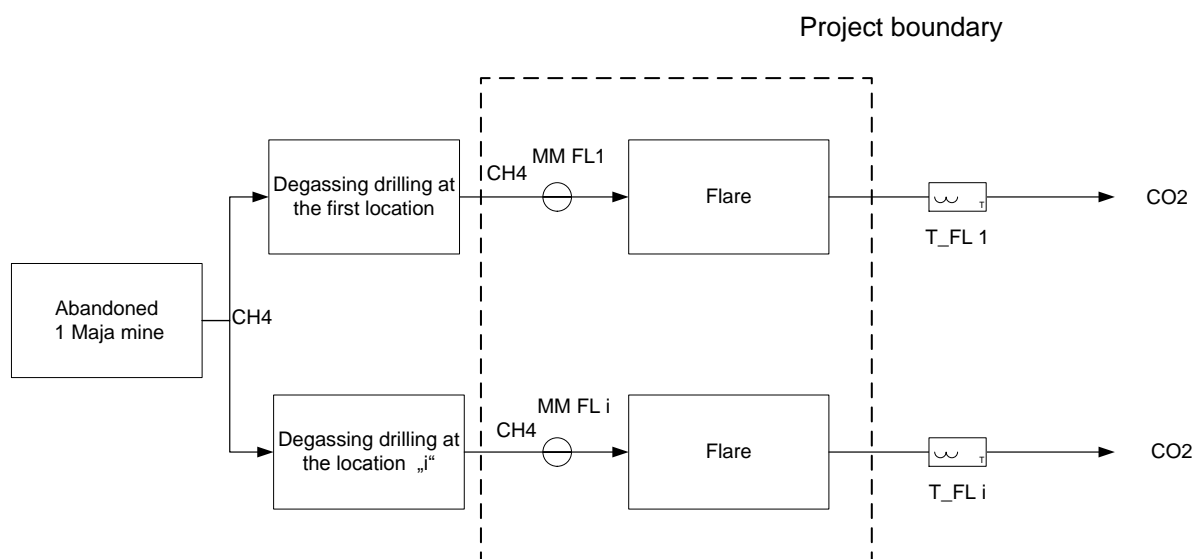


Figure D-1: Data collected for the monitoring

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

Data / Parameter:	NCV_M
Data unit:	TJ/Gg
Time of determination/ monitoring	Ex ante
Description:	Net calorific value of methane
Source of data:	Polish legal source: 2008/Dz.Ust 183/1142
Value of data applied	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	With $1MJ=0.2778 \text{ kWh}$ and $\rho_{CH_4}=0.717 \text{ kg/m}^3$ $NCV_M=9.96 \text{ kWh/m}^3$

Data / Parameter:	$MM_{Flare,i,y}$
Data unit:	tCH ₄
Description:	Methane destroyed in the flare I in year y
Time of determination/ monitoring	Continuous, recorded at least every 20 minutes
Source of data:	Measured / calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and	The amount of methane will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas



procedures (to be) applied	and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	
Any comment:	The amount of methane destroyed in the flare will be calculated under consideration of the evaluated flare efficiency as 99.5% of the estimated entire methane amount sent to the flare

Data / Parameter:	T_{FL}
Data unit:	K
Description:	Temperature of exhaust gas
Time of determination/ monitoring	Continuous, recorded at least every 20 minutes
Source of data:	Measurement
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	The run time of the flare is monitored by continuous measurement of the exhaust gas temperature. See Annex 3

Data / Parameter:	Eff_{Flare}
Data unit:	%
Description:	Efficiency of methane destruction/oxidation in the flare
Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	99.5%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	Combustion efficiency of 99.5%, according to the IPCC guidelines (see also ACM0008 Version 1 and Version 2), has been taken into account. The approach is already approved in the final determined project 0077. Annex 3 provides additional information.

Data / Parameter:	NCV_M
Data unit:	TJ/Gg
Description:	Ex ante
Time of determination/ monitoring	Net calorific value of methane
Source of data:	Polish legal source: 2008/Dz.Ust 183/1142
Value of data applied	50
Justification of the choice of data or description of	



measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	With $1MJ=0.2778 \text{ kWh}$ and $\rho_{CH_4}=0.717 \text{ kg/m}^3$ $NCV_M=9.96 \text{ kWh/m}^3$

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

Data / Parameter:	CEF_{NMHC}
Data unit:	
Description:	Carbon emission factor for combusted non methane hydrocarbons (various)
Time of determination/monitoring	Once a year
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	The determination will be provided by an independent laboratory or appropriate measurement
Any comment:	To be obtained through periodical analysis of the fractional composition of captured

Data / Parameter:	PC_{NMHC}
Data unit:	%
Description:	NMHC concentration (in mass) in extracted gas
Time of determination/monitoring	Annually
Source of data:	Concentration meters, optical and calorific
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	



Any comment:	To be obtained through periodical analysis of the fractional composition of captured gas
--------------	------------------------------------------------------------------------------------------

Data / Parameter:	GWP _{CH4}
Data unit:	tCO ₂ e/ tCH ₄
Description:	Global warming potential of methane
Time of determination/ monitoring	<i>Ex ante</i>
Source of data:	
Value of data applied	21 tCO ₂ e/tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

Data / Parameter:	EF _{elec-gen}
Data unit:	t CO ₂ / MWh
Description:	CO ₂ emission factor of the grid
Time of determination/ monitoring	Ex ante
Source of data:	KOBiZE/Poland
Value of data applied	0.812 tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures (to be) applied	A standardised carbon emission factor for the Polish Grid as determined by KOBiZE: http://www.kobize.pl/materialy/jicdm/JI-wskaznik_referencyjny_26sie2011_public.pdf
QA/QC procedures:	
Any comment:	



Data / Parameter:	CEF _{CH₄}
Data unit:	tCO _{2e} /tCH ₄
Description:	Carbon emission factor for combusted methane
Time of determination/ monitoring	<i>Ex ante</i>
Source of data:	
Value of data applied	44/16 = 2.75 tCO _{2e} /tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	



D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO₂ equivalent):

Project emissions are defined by the following equation

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (8)$$

All utilisation units are supplied with CMM from the CMM suction system. The CMM suction system is always in operation for safety reasons in the underground of the coal mine, in the case of the project through the venting systems of the neighbouring mines. The CMM suction system would be also in operation in the absence of the project; in this case the part of methane would be simply blown into the atmosphere. Thus the energy use for capture of the methane is outside the project boundaries and only the part for use methane is regarded.

The power generator and the cogeneration unit need additional power especially for the cooling fans. The power amount consumed by the power generation units lowers the amount of energy fed in into the grid.

Project emissions from methane destroyed (PE_{MD}) can be obtained by the equation

$$PE_{MD} = MM_{FI} \times (CE_{CH_4} + r \times CE_{NMHC}) \quad (9)$$

with:

$$r = PC_{NMHC} / PC_{CH_4} \quad (10)$$

where:

PE_{MD}	Project emissions from CMM destroyed (t CO ₂ eq)
CE_{CH_4}	Carbon emission factor for combusted methane (2.75 t CO ₂ eq/t CH ₄)
CE_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (various) (t CO ₂ eq/tNMHC)
r	Relative proportion of NMHC compared to methane
PC_{CH_4}	Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC}	NMHC concentration (in mass) in extracted gas (%)

Uncombusted methane from flaring and end uses (PE_{UM}) can be obtained through the equation:

$$PE_{UM} = GWP_{CH_4} \times MM_{FI} \times (1 - EffFI) \quad (11)$$



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:

Data / Parameter:	BE_y
Data unit:	t CO _{2eq}
Description:	Baseline emissions in year y
Time of determination/ monitoring	Monthly monitored
Source of data:	monitored data
Value of data applied	Calculated
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	calculated using formulae in Section D.1.1.4, see below

Data / Parameter:	$BE_{MR,y}$
Data unit:	t CO _{2eq}
Description:	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity
Time of determination/ monitoring	monthly
Source of data:	
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	Monthly recorded
Any comment:	Calculated using formulae in section B3 $BE_{MR,y} = (CMM_{PJ,y}) \times GWP_{CH_4}$

Data / Parameter:	$CMM_{PJ,iy}$
Data unit:	t _{CH₄}
Description:	CMM captured, sent to and destroyed by use <i>i</i> in the project activity in year y
Time of determination/ monitoring	During the project implementation, monthly
Source of data:	Monitored data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane destroyed in flares and engines will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.



QA/QC procedures:	See Section D.2
Any comment:	$CMM_{Pj,i,y} = \sum MM_{Flare\ i,y}$

Data / Parameter:	GWP_{CH_4}
Data unit:	t_{CO_2eq} / t_{CH_4}
Description:	Global warming potential of methane
Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	21
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

Data / Parameter:	CEF_{CH_4}
Data unit:	t_{CO_2eq} / t_{CH_4}
Description:	Carbon emission factor for combusted methane
Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	2.75
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	



D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO₂ equivalent):

$$BE_y = BE_{MR,y} + BE_{Use,y} \quad (12)$$

The baseline emissions from release of methane into the atmosphere in the year y (BEMR,y) is obtained by the following equation:

$$BE_{MR,y} = CMM_{PJ,y} \times GWP_{CH_4} \quad (13)$$

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

Data / Parameter:	
Data unit:	
Description:	
Time of determination/ monitoring	
Source of data:	
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

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 CO₂ equivalent):

not applicable

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

In accordance with methodological tools the following leakages should be considered:

1. Displacement of baseline thermal energy uses
2. CBM drainage from outside the de-stressed zone
3. Impact of the emission reducing project on coal production
4. Impact of the emission reducing project on coal prices

Leakage in the project is very unlikely as:

1. there is no use of methane in the baseline
2. There is no CBM involved hence no leakage occurs from CBM drainage from outside the de-stressed zone



3. There is no impact of the emission reducing project on coal production as the project is independent from any present coal production
4. There is no impact of the emission reducing project on coal prices as the project is independent from any present coal production.

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

not applicable

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO₂ 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 CO₂ equivalent):

The greenhouse gas emission reduction gained by the project over a period is the difference between the total baseline emissions over the period and the total project emissions over the period. This is given by the equation:

$$ER_y = BE_y - PE_y \quad (14)$$

where:

ER_y Emissions reductions of the project activity during the year y (t CO_{2eq})

BE_y Baseline emissions during the year y (t CO_{2eq})

PE_y Project emissions during the year y (t CO_{2eq})

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:

To maintain a consistent and reliable performance of the automatic controlling and monitoring system an adequate quality control and assurance procedures will be implemented that is regulated by the calibration standards and quality norms of the national legislation. Under these requirements of quality control system, regular maintenance and testing regime to ensure accuracy of flow meters, gas-analysers, electricity and heat measuring instruments will be provided. All measuring instruments will be calibrated periodically, according to the technical and legal requirements. The calibration protocols will be archived and provided for the purposes of project verification to the independent entity. A consistency check for all measurement data and the calculation of the emission reductions will be carried out and reported monthly.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
NMHC Concentration	low	The determination will be provided by an appropriate measurement.
Methane amount	low	The indication of the measurement instrument should be controlled one-time during the final inspection by the manufacturer. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration is according to the producer instructions, legal and operation requirements.

Irrespective the monitoring plan all installed aggregates and gauges should be controlled during the regular inspections, at least weakly, to assure a proper operation of the facility. Beside the monitored values any other values which are needed for the supervision of the plant should be logged.

Any gauge or apparatus which is detected as obviously out of order should be substituted.

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

The plants installed in the project are designed to run fully automatic, so that the operating personnel have only to supervise the correct operation of the plant and the plausibility of the collected and monitored data. In case of disturbances the plant will be shut down automatically and no unintended emissions are caused.

The operator of the capturing station is responsible for the measurement of the whole amount of captured methane, the amount of methane sent to the operator of proposed project. The measured amounts are relevant for invoices for the CMM used by the project operator.

The operator of the plant is responsible for the operation and maintenance of all measurement equipment. Calibration procedures are in accordance to the producer instructions, legal and operation requirements.

The protocols should be stored as a part of balance of the operating company.

All stored data will be kept during the whole operation period of the plant and furthermore for at least 5 years. All printed and validated reports and invoices are to be stored for at least two years after the last transfer of ERUs for the project. Storage of scanned reports is allowed, due to the internal quality guidelines of the project operator.

The relevant process data collected by the project operator are: methane input, methane concentration, exhaust gas temperature of the flare. The plant and all relevant process data are to be observed daily by the staff. The process data are to be collected and archived monthly.

All measuring equipment is to calibrate according to the producer instructions, legal and operation requirements.

The plant manager is responsible for the preparation of the standardised monthly report. He is also in charge for the preparation of the summarised monthly and yearly reports, which should be revised by the project manager.

The plant manager is keeping an operational journal which includes the following information:

- compilation and description of all data recorded, required for the calculation of the emission reductions
- description of all records to be kept during the regular inspections, including all corrective action undertaken
- manually logged data collected during the regular inspections
- particular events
- all calibrations carried out, incl. all calibration protocols

All data should be continuously checked for consistency, completeness and integrity by project developer. A detailed plausibility check should be carried out at least monthly.

Based on the procedure described above a detailed annual report should be prepared by LNG Silesia and confirmed by the verifier.

The responsible staff members of the project operator LNG Silesia have been trained on the handling with CMM-utilisation units and the applied monitoring systems by the plant producer. Those trained personnel of the operator is the basis and responsible for operating and monitoring of this project.

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

Date of completion of the monitoring plan: 18 October 2012

Name of person / entity setting the monitoring plan: Alina Mroz / Carbon-TF B.V.

See Annex 1 for detailed contact information.

**SECTION E. Estimation of greenhouse gas emission reductions****E.1. Estimated project emissions:**

The following calculations are based on the baseline determined in section B. All CMM which is burned in the cogeneration unit is concurrently avoided CMM, which would otherwise escape to the atmosphere in absence of the project.

The project emissions PE are calculated presuming that NMHC has not to be regarded ($r = 0$).

Table E-1 – Estimated project emissions

Estimated project emissions [t CO ₂ Eq]						
Year	2008	2009	2010	2011	2012	2013-2017
Methane destruction						
Flaring/combustion	0	0	0	0	4,265	163,040
heat generation	0	0	0	0	0	0
power generation	0	0	0	0	0	0
additional power consumption	0	0	0	0	0	0
sum	0	0	0	0	4,265	163,040

E.2. Estimated leakage:

There is no leakage estimated in this project.

**E.3. Estimated project emissions and leakage***Table E-3 – Estimated project emissions and leakage. The sum of E.1. and E.2.:*

Estimated project emissions and leakage [t CO _{2Eq}]						
Year	2008	2009	2010	2011	2012	2013-2017
Methane destruction						
flaring	0	0	0	0	4,265	163,040
heat generation	0	0	0	0	0	0
power generation	0	0	0	0	0	0
additional power consumption	0	0	0	0	0	0
sum	0	0	0	0	4,265	163,040

E.4. Estimated baseline emissions:*Table E-4 – Estimated baseline emissions*

Estimated baseline emissions [t CO _{2Eq}]						
Year	2008	2009	2010	2011	2012	2013-2017
Methane destruction						
flaring	0	0	0	0	28,306	1,245,032
heat generation	0	0	0	0	0	0
power generation	0	0	0	0	0	0
production of heat that is displaced by the project			0	0	0	0
Sum	0	0	0	0	28,306	1,245,032

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

See table E-6 in section E.6.

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

Table E-6 – Project emissions and emission reductions during the lifetime of the project (2008-2012)

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emissions reductions (tonnes of CO2 equivalent)
2008	0	-	0	0
2009	0	-	0	0
2010	0	-	0	0
2011	0	-	0	0
2012	4,265	-	32,571	28,306
Total t CO2 equiv.	4,265	-	32,571	28,306

prospected emissions for the years 2013-2017				
Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emissions reductions (tonnes of CO2 equivalent)
2013	26,515	-	202,476	175,961
2014	37,434	-	285,862	248,428
2015	37,434	-	285,862	248,428
2016	37,434	-	285,862	248,428
2017	37,434	-	285,862	248,428
Total t CO2 equiv	176,252	-	1,345,924	1,169,672

1 Maja (1st of May)

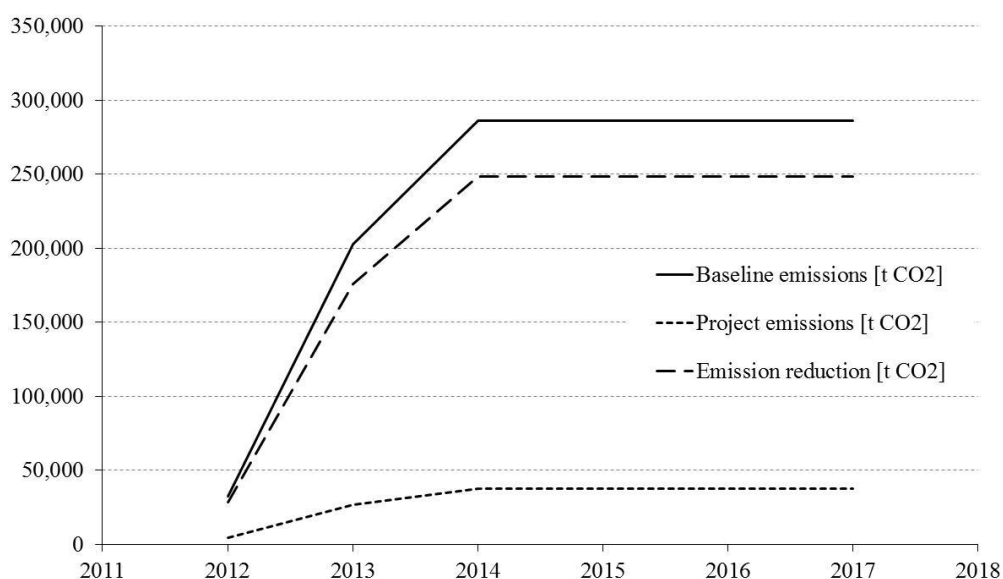


Figure E-1 - Baseline emissions, project emissions and emissions reduction; total project

**SECTION F. Environmental impacts****F.1. Documentation on the analysis of the environmental impacts of the project, including trans-boundary impacts, in accordance with procedures as determined by the host Party:**

The flare does not use the natural resources: water, ground and landscape, so that no impairment on nature or landscape is given. The facility does not produce any waste, sewage or condensate. Due to the very high operational safety standards supplied a very low accident hazard is given.

The plant requires an approval by the Polish Environmental Authorities. The combustion processes are designed to comply for the Polish emissions limits.

The facility causes no harmful environmental impacts. In fact the utilisation of otherwise unused CMM reduces in an active manner the amount of CMM which is released to the atmosphere and provides significant benefits for the global climate production by converting the harmful methane into the less harmful carbon dioxide.

Furthermore the operation of the plant creates additional jobs.

Beside the positive effect on the global climate protection, no trans-boundary impacts occur.

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

There are no significant environmental impacts expected. No environmental impact assessment is needed. The plant has to fulfil the requirements of the Polish regulations.

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

A local stakeholder consultation is required during the authorisation procedure, by the building law, the law of city and regional planning, environmental law. The stakeholder rights are described in the administrative law. The stakeholders were consulted according to the regulations.

The project operator LNG Silesia and the gas licence owners operate a flare for the advanced resource analysis. The operation is supervised by the District Mining Authority.

The building permit for the final plant operation will be requested in accordance with the current legislation. Parties involved in the procedure will be: District Building Supervision in Pszczyna, District Mining Authority. According to the Polish legislation every stakeholder can raise objection, if his rights and interests are put at risk.

During the plant building the stakeholders had to be informed about the character of the plant and all risks that could occur.

No objection was raised during administrative procedure or during the construction and operational time of the drilling and the operation of the flare for resource analysis.

Furthermore, a Project Idea Note was presented to the Polish Ministry of Environment due to obtain a Letter of Endorsement for the project. The Letter of Endorsement was issued in August 2011.

Annex 1CONTACT INFORMATION ON PROJECT PARTICIPANTS**Proposer and project operator**

Organization:	LNG Silesia
Street/P.O.Box:	ul.Leśna
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Represented by:	Artur Kostka
Title:	CEO
Salutation:	Mr.
Last Name:	Kostka
Middle Name:	
First Name:	Artur
Department:	
Phone(direct):	
Fax (direct):	
Mobile:	
Personal e-mail:	akostka@lngsilesia.pl

**Consultant and investor, buyer of the emission reduction certificates**

Organization:	Carbon-TF B.V.
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E-mail:	info@carbon-tf.com
URL:	www.carbon-tf.com
Represented by:	Clemens Backhaus
Title:	Managing Director
Salutation:	
Last Name:	Backhaus
Middle Name:	
First Name:	Clemens
Department:	
Phone(direct):	
Fax (direct):	
Mobile:	
Personal e-mail:	ba@carbon-tf.com

Contact person for the purpose of the project:

Organization:	Carbon-TF B.V.
Street/P.O.Box:	Kaldenkerkerweg 158
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City:	Tegelen (Venlo)
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Annex 2**BASELINE INFORMATION****Justification of the methane amount taken for the baseline estimation**

Evaluation of the geological documentation and the results of production tests were taken for the estimation of the size of the utilisation units. The first operational results of the installed equipment proved the correctness of the assumed amounts of methane to treat. The supporting documents regarding the assumption were provided to the AIE.

Power own consumption of the cogeneration units

The power own consumption of the power generation units in case of further development of the locations is estimated ex ante as of 3.5% of the generated power. This ratio is based on the experience made with over 100 CMM CHP modules in Germany.

Project emission

The project emissions during the down times of the plant are not considered in the calculation. As they are very small and not significant, they are not necessary to be encompassed by the project boundaries. This is in accordance with the JISC's Guidance on criteria for baseline setting and monitoring.

Efficiency of the cogeneration units

The firing capacity, efficiency, power and heat output of the cogeneration units depend mainly on the gas quality, especially the methane concentration. Average values, based on the experience made on comparable units in Germany have been taken into account.

Baseline Carbon Emission Factor for the Polish power grid

A standardised carbon emission factor for the Polish Grid as determined by KOBiZE
http://www.kobize.pl/materialy/jicdm/JI-wskaznik_referencyjny_26sie2011_public.pdf

Methane released in the atmosphere

The baseline described in the section B of the PDD can be modified for the case of further development of the project. The likely solution would be a displacement or complementation of flares installed at project locations. It is not assumed that the estimated amounts will increase through the implementation of the CHP units. The solution is at the moment not financial viable and is prevented by technological barriers.

The baseline emissions from release of methane into the atmosphere in the year y ($BE_{MR,y}$) is obtained by the following equation:

$$BE_{MR,y} = (CMM_{PJ,y}) \times GWP_{CH_4} \quad (15)$$

$$CMM_{PJ,y} = MM_{Flare, iy} + MM_{Elec, iy} \quad (16)$$

$$MM_{ELEC, Eng1} = EG_{Eng1} / \eta_{power} / NCV_M \times \rho_{CH_4} \quad (17)$$



where

CMM_{PJ}	=	CMM captured, sent to and destroyed by use i in the project activity in year y (expressed in tCH ₄)
GWP_{CH_4}	=	Global warming potential of methane (21 tCO _{2e} /tCH ₄)
$MM_{Flare\ i,y}$	=	Methane destroyed in the flare i in a year y
$MM_{ELEC\ Eng1}$	=	Methane destroyed in the power plant I (in case of later implementation)
EG_{Eng1}	=	Electricity generation (MWh) (in case of later implementation)
η_{power}	=	Efficiency of the power plant (in case of later implementation)
NCV_M	=	Net calorific value of methane
ρ_{CH_4}	=	Density of methane

Key elements of the baseline incl. possible further development

Data / Parameter:	BE_y
Data unit:	t CO _{2eq}
Description:	Baseline emissions in year y
Time of determination/ monitoring	Monthly monitored
Source of data:	monitored data
Value of data applied	Calculated
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	calculated using formulae in Section D.1.1.4, see below

Data / Parameter:	$BE_{MR,y}$
Data unit:	t CO _{2eq}
Description:	Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity
Time of determination/ monitoring	monthly
Source of data:	
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	Monthly recorded
Any comment:	Calculated using formulae in section B3 $BE_{MR,y} = (CMM_{PJ,y}) \times GWP_{CH_4}$

Data / Parameter:	$BE_{Use,y}$
Data unit:	t CO _{2Eq}
Description:	Baseline emissions from the production of power, heat or gas supply to grid replaced by the project activity in year y (tCO _{2e})



Time of determination/ monitoring	During the project duration
Source of data:	Monitored data
Value of data applied	0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	CO2 emissions associated to the same quantity of energy (power or heat) as energy generated (in case of later implementation) as a result of the use of methane are excluded.

Data / Parameter:	$MM_{ELEC Eng1}$
Data unit:	tCH ₄
Time of determination/ monitoring	monthly
Description:	Methane destroyed in the power plant
Source of data:	calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be estimated in dependence from the energy generation of the CHP installed in the project activity and the efficiency of the power production.
QA/QC procedures:	
Any comment:	$MM_{ELEC Eng1} = EG_{Eng1} / \eta_{power} / NCV_M \times \rho_{CH4}$

Data / Parameter:	η_{power}
Data unit:	%
Time of determination/ monitoring	in dependence from load of the plant and according to the manufacturer data of the plant
Description:	Energy efficiency of the plant
Source of data:	Calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The efficiency in dependence from load of the plant is provided by the manufacturer
QA/QC procedures:	
Any comment:	The energy efficiency of the plant depends on the achieved load of the plant and will be calculated for the given operational case as monthly average. The calculation of achieved efficiency in dependence of the load will be interpolated and based on the values given by the manufacturer

Data / Parameter:	NCV_M
Data unit:	TJ/Gg
Time of determination/	Ex ante



monitoring	
Description:	Net calorific value of methane
Source of data:	Polish legal source: 2008/Dz.Ust 183/1142
Value of data applied	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	With $1MJ=0.2778 \text{ kWh}$ and $\rho_{CH_4}=0.717 \text{ kg/m}^3$ $NCV_M=9.96 \text{ kWh/m}^3$

Data / Parameter:	Ti
Data unit:	hours
Time of determination/monitoring	During the project implementation
Description:	Operating hours of the plant
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of the operating hours is necessary for the determination of the load factor of the plants
QA/QC procedures:	Operating hours are daily and monthly reported by the staff
Any comment:	

Data / Parameter:	LF_{Engi}
Data unit:	%
Time of determination/monitoring	During the project implementation
Description:	The load factor of the plant
Source of data:	calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The achieved capacity is to calculate as a monthly average from of the operating hours and generated power versus the theoretical capacity of the plant. The load factor is necessary for the final efficiency of power production in the plant. The calculation of achieved efficiency in dependence of the load will be interpolated and based on the values given by the manufacturer.
QA/QC procedures:	Operating hours are daily and monthly reported by the staff.
Any comment:	$LF_{Engi} = EG_{Engi} / Ti / P_i$
Data / Parameter:	P_i
Data unit:	kWel
Time of determination/monitoring	Ex ante/ex post
Description:	Theoretical electrical capacity of the plant



Source of data:	Manufacturer's data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	The theoretical capacity is individual for each engine installed within the project capacity. The theoretical capacity can change subject to technical improvement and innovation made in cooperation with the engine manufacturer.

Data / Parameter:	$MM_{\text{Flare},i,y}$
Data unit:	tCH ₄
Description:	Methane destroyed in the flare i in year y
Time of determination/monitoring	Continuous, recorded at least every 20 minutes
Source of data:	Measured / calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be measured by measuring equipment consisting of flow meters, methane detectors, thermometers and pressure gauges. The equipment fulfils Polish requirements for billing within the gas and oil industry sector. Calibration according to the producer instructions, legal and operation requirements.
QA/QC procedures:	
Any comment:	The amount of methane destroyed in the flare will be calculated under consideration of the evaluated flare efficiency as 99.5% of the estimated entire methane amount sent to the flare

Data / Parameter:	T_{FL}
Data unit:	K
Description:	Temperature of exhaust gas
Time of determination/monitoring	Continuous, recorded at least every 20 minutes
Source of data:	Measurement
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	The run time of the flare is monitored by continuous measurement of the exhaust gas temperature. See Annex 3

Data / Parameter:	Eff_{Flare}
Data unit:	%
Description:	Efficiency of methane destruction/oxidation in the flare



Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	99.5%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	Combustion efficiency of 99.5%, according to the IPCC guidelines (see also ACM0008 Version 1 and Version 2), has been taken into account. The approach is already approved in the final determined project 0077. Annex 3 provides additional information.

Data / Parameter:	EG _{Engi}
Data unit:	MWh
Description:	Electricity generation
Time of determination/ monitoring	continuous
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Continuous measurement with summation, recorded hourly in the Vattenfall's control system
QA/QC procedures:	Calibration according to the producer instructions, legal and operation requirements. The power meters fulfil the requirements for billing. They allow an automatic reading from the Vattenfall's control room.
Any comment:	

Data / Parameter:	NCV _M
Data unit:	TJ/Gg
Description:	Ex ante
Time of determination/ monitoring	Net calorific value of methane
Source of data:	Polish legal source: 2008/Dz.Ust 183/1142
Value of data applied	50
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	With 1MJ=0.2778 kWh and $\rho_{\text{CH}_4}=0.717 \text{ kg/m}^3$ NCV _M =9.96 kWh/m ³

Data / Parameter:	Eff _{ELEC}
Data unit:	%
Description:	Efficiency of methane destruction/oxidation in power plant



Time of determination/ monitoring	Ex ante
Source of data:	IPCC
Value of data applied	99.5%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	Set at 99.5% (IPCC)

Data / Parameter:	CEF _{NMHC}
Data unit:	
Description:	Carbon emission factor for combusted non methane hydrocarbons (various)
Time of determination/ monitoring	Once a year
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	The determination will be provided by an independent laboratory or appropriate measurement
Any comment:	To be obtained through periodical analysis of the fractional composition of captured

Data / Parameter:	PC _{NMHC}
Data unit:	%
Description:	NMHC concentration (in mass) in extracted gas
Time of determination/ monitoring	Annually
Source of data:	Concentration meters, optical and calorific
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	To be obtained through periodical analysis of the fractional composition of captured

Data / Parameter:	GWP _{CH4}
Data unit:	tCO _{2e} / tCH ₄
Description:	Global warming potential of methane



Time of determination/ monitoring	<i>Ex ante</i>
Source of data:	
Value of data applied	21 tCO _{2e} /tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	

Data / Parameter:	EF _{elec-gen}
Data unit:	t CO ₂ / MWh
Description:	CO ₂ emission factor of the grid
Time of determination/ monitoring	<i>Ex ante</i>
Source of data:	KOBIZE/Poland
Value of data applied	0.812 tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures (to be) applied	A standardised carbon emission factor for the Polish Grid as determined by KOBIZE: http://www.kobize.pl/materialy/jicdm/JI-wskaznik_referencyjny_26sie2011_publik.pdf
QA/QC procedures:	
Any comment:	

Data / Parameter:	CEF _{CH₄}
Data unit:	tCO _{2e} /tCH ₄
Description:	Carbon emission factor for combusted methane
Time of determination/ monitoring	<i>Ex ante</i>
Source of data:	
Value of data applied	44/16 = 2.75 tCO _{2e} /tCH ₄
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	
Any comment:	



Annex 3

MONITORING PLAN

The monitoring plan is listed in section D. In this section additional information concerning the flaring technology used and monitoring of CHP within further development of the project is given.

Justification of the combustion efficiency of the chosen flare

Combustion efficiency of 99.5%, according to the IPCC guidelines (see also ACM0008 Version 1 and Version 2), has been taken into account. This approach was already approved in the registered 2 track project “CMM utilisation on the coal mine Shcheglovskaya-Glubokaya of the State Holding Joint-Stock”, unfccc ID 0077.

German regulations

The chosen flare is designed in Germany to fulfil the German regulations for flaring of landfill gas. In these regulations a minimum efficiency of 99.9 % is required. This efficiency is proved by a continuous measurement of the combustion temperature, which has to be above 1,000°C, whereas a minimum retention time of at least 0.3 s is required [TA-Luft]. Additionally the emissions of the flare have to be verified every three years by a measurement.

In case of flaring of landfill gas the German Authorities started with a required combustion temperature of 1,200°C. The temperature has been dropped to 1,000°C after first good experience in flaring of landfill gas has been made. This minimum temperature of 1,000°C is claimed for landfill gas or gas from waste utilisation plants only; in case of other gases e.g. CMM a temperature of 850°C is sufficient (there are no polycyclic aromatic hydrocarbons contained in CMM).

A combustion temperature of more than 850°C assures the complete conversion of hydro carbons contained in the fuel gas into carbon dioxide with minimum proportion of carbon monoxide and marginal, negligible fraction of other components containing carbon, so that an efficiency of minimum 99.9 % is reached. This is state of the art and has been proven in numerous combustion plants in Germany and throughout the world. There are no legal obligatory regulations about the monitoring of flares in Germany. According to the German [TA-Luft], these regulations have to be examined in every individual case by the Authorising Authority. Normally a periodical emissions measurement of the main components CO, NO_x and total carbon, which indicates the combustion efficiency of the flare, has to be carried out every three years by an approved expert laboratory, institute etc. At this the value of 20 mg/m³ total carbon in flue gas [TALuft] is taken.

Description of the flare equipment

The flare, which is supposed to be used in this project, is an enclosed flare with a controlled combustion process. The flare is designed for a combustion temperature of more than 850°C and a retention time of



about 0.3 sec. The flare is a further development of flares for landfill gas, which has been installed on numerous landfill sites in Germany, France, Belgium, Spain, Portugal, Hungary and Croatia. Characteristic for landfill gas flares is the continuous operation of the flaring process and the controlled combustion process. The German Regulations require a minimum temperature of 1,000°C for landfill gas flares and 850°C for CMM flares. To fulfil this legal requirement a special design of the burning system and an adequate controlling system is applied. The main difference to other flaring systems is the controlled combustion process – the combustion temperature and combustion output are controlled and regulated.

The fuel gas is fed in via a distribution system into the combustion chamber. The main pipe is split up in several distribution pipes fitted with nozzles, which are evenly distributed over the whole cross section of the combustion chamber. The uniform distribution of the fuel gas provides a smooth combustion over the whole cross section of the combustion chamber; generation of possible schlieren of uncombusted gas is minimised in that way.

The combustion air is sucked in into the combustion chamber by the natural draught of the chimney effect of the combustion pipe. The amount of the combustion air is regulated by lamellar lids in the supply air inlet, whereas the lid position is controlled by the temperature in the combustion chamber. In that way the desired value for the combustion temperature in the flare is kept constant. The retention time of 0.3 s is achieved by the height of the flare pipe. The amount of the fuel gas is regulated by a throttle in the main fuel gas conduit. Hereby the combustion output of the flare is controlled.

The given combustion output is automatically controlled by the control system. The flare has a minimum combustion output, at which the minimum combustion temperature of 850°C can be reached and a maximum combustion output, at which the minimum retention time can be reached. Both limiting values are monitored by the control system. If the combustion temperature falls under the minimal value or the combustion output exceeds the maximal value, the system is automatically shut down. The flare is provided with an automatic firing device and a flame detector. Both devices are standards from heating boilers section. All process and operation data, especially the combustion temperature and the CMM amount is monitored, stored and archived.

**Enhancement of the monitoring plan for further development of the project**

The monitoring plan described in the section D of the PDD can be enhanced for the case of further development of the project. The likely solution would be a displacement or complementation of flares installed at project locations.

The solution is at the moment not financial viable and prevented by technological barriers.

Data / Parameter:	$CONS_{ELEC,PI}$
Data unit:	MWh
Description:	Additional electricity consumption for use or destruction of methane, if any
Time of determination/monitoring	Ex post
Source of data:	Research, measurements
Value of data applied	0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The additional electricity consumption lowers the amount of electricity fed in into the grid. As the net electricity production is monitored during the monitoring of the own consumption is obsolete for the already installed location.
QA/QC procedures:	
Any comment:	

Data / Parameter:	$MM_{ELEC\ Engi}$
Data unit:	t_{CH4}
Time of determination/monitoring	monthly
Description:	Methane destroyed in the power plant
Source of data:	calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of methane will be estimated in dependence from the energy generation of the CHP installed in the project activity and the efficiency of the power production.
QA/QC procedures:	
Any comment:	$MM_{ELEC\ Engi} = EG_{Engi} / \eta_{power} / NCV_M \times \rho_{CH4}$

Data / Parameter:	η_{power}
Data unit:	%
Time of determination/monitoring	in dependence from load of the plant and according to the manufacturer data of the plant
Description:	Energy efficiency of the plant
Source of data:	Calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The efficiency in dependence from load of the plant is provided by the manufacturer



QA/QC procedures:	
Any comment:	The energy efficiency of the plant depends on the achieved load of the plant and will be calculated for the given operational case as monthly average. The calculation of achieved efficiency in dependence of the load will be interpolated and based on the values given by the manufacturer

Data / Parameter:	Ti
Data unit:	hours
Time of determination/ monitoring	During the project implementation
Description:	Operating hours of the plant
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The amount of the operating hours is necessary for the determination of the load factor of the plants
QA/QC procedures:	Operating hours are daily and monthly reported by the staff
Any comment:	

Data / Parameter:	LF_{Engi}
Data unit:	%
Time of determination/ monitoring	During the project implementation
Description:	The load factor of the plant
Source of data:	calculated
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The achieved capacity is to calculate as a monthly average from of the operating hours and generated power versus the theoretical capacity of the plant. The load factor is necessary for the final efficiency of power production in the plant. The calculation of achieved efficiency in dependence of the load will be interpolated and based on the values given by the manufacturer.
QA/QC procedures:	Operating hours are daily and monthly reported by the staff.
Any comment:	$LF_{Engi} = EG_{Eng1} / Ti / P_i$

Data / Parameter:	P_i
Data unit:	kWel
Time of determination/ monitoring	Ex ante/ex post
Description:	Theoretical electrical capacity of the plant
Source of data:	Manufacturer's data
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures:	



Any comment:	The theoretical capacity is individual for each engine installed within the project capacity. The theoretical capacity can change subject to technical improvement and innovation made in cooperation with the engine manufacturer.
--------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Data / Parameter:	EG_{Engi}
Data unit:	MWh
Description:	Electricity generation
Time of determination/ monitoring	continuous
Source of data:	measured
Value of data applied	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Continuous measurement with summation, recorded hourly in the Vattenfall's control system
QA/QC procedures:	Calibration according to the producer instructions, legal and operation requirements. The power meters fulfil the requirements for billing. They allow an automatic reading from the grid operators's control room.
Any comment:	

Project emissions are defined by the following equation

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (18)$$

Project emissions from energy use to capture and use methane (PE_{ME}), is obtained by the equation:

$$PE_{ME} = CONS_{ELEC,PJ} \times EF_{elec} \quad (19)$$

where $CONS_{ELEC,PJ} = 0$

as the resulting net energy produced (energy produced lowered by the own consumption) is monitored.

$$PE_{MD} = (MM_{FI} + MM_{ELEC}) \times (CEF_{CH4} + r \times CEF_{NMHC}) \quad (20)$$

with:

$$r = PC_{NMHC} / PC_{CH4} \quad (21)$$

where:

PE_{MD}	Project emissions from CMM destroyed (t CO ₂ eq)
CEF_{CH4}	Carbon emission factor for combusted methane (2.75 t CO ₂ eq/t CH ₄)
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (various) (t CO ₂ eq/tNMHC)
r	Relative proportion of NMHC compared to methane
PC_{CH4}	Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC}	NMHC concentration (in mass) in extracted gas (%)

Uncombusted methane from flaring and end uses (PE_{UM}) can be obtained through the equation:

$$PE_{UM} = GWP_{CH4} \times [MM_{FI} \times (1 - Eff_{FI}) + MM_{ELEC} \times (1 - Eff_{ELEC})] \quad (22)$$

**Additional procedures for further development of the project**

The operator of the plant is responsible for the operation and maintenance of all measurement equipment. Calibration procedures are in accordance to the producer instructions, legal and operation requirements. The power meters fulfil the requirements for billing. They allow an automatic reading from the grid operator's control room.

The protocols should be stored as a part of balance of the operating company.

All stored data will be kept during the whole operation period of the plant and furthermore for at least 5 years. All printed and validated reports and invoices are to be stored for at least two years after the last transfer of ERUs for the project. Storage of scanned reports is allowed, due to the internal quality guidelines of the project operator.

The relevant process data collected by the project operator are: methane input, methane concentration, CHP-worked hours, power production, exhaust gas temperature of the flare. The power plant and all relevant process data are to be observed daily by the staff. The process data are to be collected and archived monthly.

The power production is measured by measuring devices maintained by the grid operator, as they are relevant for invoicing. The readout of the measurement is automatically. The quality of the measurement is thereafter high.

All measuring equipment is to calibrate according to the producer instructions, legal and operation requirements.