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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Utilization of coal mine methane at the coal mine named after M.P. Barakov of JSC "Krasnodoncoal"

Sectoral Scope 8. Mining/mineral production

PDD version: 3.5

Date of the PDD: 23 November 2011.

A.2. Description of the project:

Coal mine named after M.P. Barakov (further referred to as Barakov Mine or the Mine) is one of the five coal mines owned by PJSC "Krasnodon Coal Company". It was commissioned in 1967 with a designed capacity 600,000 tonnes of coal annually. The mine field is accessed through three vertical shafts, operations are performed at 850 m depth. The Mine employs over 2000 people being one of the important job providers in the region. In 2008 the Mine was redesigned to increase its capacity to 760,000 tonnes of coal annually. According to the revised Mine's Project Design Document it is expected that it will be operating till 2025.
In order to reduce GHG emissions and other negative environmental impacts of the Mine the coal mine methane (CMM[1]) utilization project was realized.

Project objectives were:

- To cut GHG emissions by capturing CMM previously released into the atmosphere from the Mine's degasification system; to utilize it for thermal energy generation to cover the heating demand of the Mine;
- To avoid GHG emissions due to natural gas combustion for the purpose of heat generation which would have happened in the absence of the project activity.

In order to meet the above objectives, the mine degasification system was modernized, gas preparation station was installed and boiler house was reconstructed to allow the combustion of gases extracted by methane drainage techniques (average methane content is 49%). Because of the fact that CMM is not always available and its concentrations vary depending on the stage of mining, a coal fired boiler had to be installed to back up the system. Coal is a reserve fuel which is used when methane concentration in the captured gases is below 25%[2]. As a result of the implementation of the project 71% of CMM is utilized that allows covering the heating demand of the Mine. Thus, as a result of the project GHG emissions are reduced by decreasing the amount of CMM vented into the atmosphere and avoiding natural gas combustion for heat generation which would happen otherwise. The project scenario is combustion of CMM to generate thermal energy and venting the remaining CMM into the atmosphere.

Situation before project implementation

Before implementation of the proposed JI project activity the Mine's demand for heating was satisfied by on-site heat generation at the Mine's boiler house which operated 2 gas-oil fired boilers with total installed capacity of 13 tonnes of steam/hour. By considering alternatives for heat supply and CMM treatment, continuation of current practice was proved to be the baseline scenario which is natural gas

[1]In this document coal mine methane (CMM) is defined as methane component of gases captured in a working mine by methane drainage techniques.

[2]Captured gases with methane concentration between 5-15% are explosive, therefore for safety reasons when methane concentration is lower than 25% they are released straight into the atmosphere.

combustion for heat generation and venting CMM into the atmosphere.

History of the project
CMM utilization projects in the context of their GHG reduction potential were considered by the project owner back in 2001, which is reflected in the corresponding study by Partnership for Energy and Environmental Reform (PEER) "Coal Mine Methane in Ukraine: Opportunities For Production and Investment in the Donetsk Coal Basin", commissioned by the U.S. Environmental Protection Agency (EPA). The study evaluates potential GHG reductions from CMM utilization projects at four coal mines of Krasnodoncoal Coal Association: Molodogvardeyskaya Mine, Samsonovskaya-Zapadnaya Mine, Suhodolskaya-Vostochnaya Mine, 50 years of the USSR Mine. The possible reason why Barakov Mine is not listed there is that there were intentions to shut down this mine at the time when the study was being prepared. Later on it was decided to continue the operation at Barakov Mine and reconstruct the boiler house to allow CMM utilization. In other words, this possibility was considered by the mine management.

The project documentation was approved by the Makeevka SSI of Health and Safety in Mining on 6th of June 2001, which is considered to be the starting date of the project. The proposed project would not have been realized without the incentive provided by JI mechanism of Kyoto protocol because of its unprofitability which under the economic conditions of the Mine at the time of decision making was the key argument. No existing legislation obliged the Mine to utilize CMM. The project was implemented in 2001-2003, (its commission date is 18th of December 2003) when reconstruction of the boiler house took place. Overall cost of the project is 4 395 547 UAH. Implementation schedule and investment plan is in the table below.

Table 1.Investment plan (UAH).

	2001	2002	2003
Equipment	72 840	501 789	35 958
Construction works	1 655 289	1 628 885	137 529
Project Design	25 717	337 540	0
Total	**1 753 846**	**2 468 214**	**173 487**

The project is environmentally and socially beneficial. Its realization causes less pollution than in case of baseline scenario as it reduces methane emissions from the Mine. This improves the quality of working environment and reduces negative health effects for the employees of the Mine. To eliminate operational risks health and safety rules are strictly maintained; personnel is instructed every 12 hour, which corresponds to shift change, more detailed health and safety trainings are conducted each 3 month.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	PJSC "Krasnodon Coal Company"	No
The Netherlands	Global Carbon BV	No

PJSC "Krasnodon Coal Company" is the owner of the emission source/sink where the Joint Implementation project is implemented.PJSC "Krasnodon Coal Company" is among top three biggest coal mining enterprises in the Luhansk region and among the top ten largest coal mining companies in Ukraine. PJSC "Krasnodon Coal Company" includes five coal mining departments: two mines (Barakov and Duvanna) as well as three mine unions: Molodogvardiyske, Samsonivske-Zahidne, Sukhodilske-Shidne. The extracted coal is processed and concentrated in two processing divisions of the Company: Samsonivska Group Concentration Plant and Duvanska Central Concentration Plant. PJSC "Krasnodon Coal Company"is a project participant.

Global Carbon B.V. is a leading expert on environmental consultancy and financial brokerage services in the international greenhouse emissions trading market under the Kyoto Protocol. Global Carbon has developed the first JI project that has been registered at the United Nations Framework Convention on Climate Change (UNFCCC). The first verification under JI mechanism was also completed for Global Carbon B.V. project. The company focuses on Joint Implementation (JI) project development in Bulgaria, Ukraine, Russia. Global Carbon B.V. is responsible for the preparation of the investment project as a JI project including PDD preparation, obtaining Party approvals, monitoring and transfer of ERUs. Global Carbon B.V. is a potential buyer of the ERUs generated under the proposed project. Global Carbon B.V. is a project participant.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is implemented at Barakov Mine, located in Sukhodilsk, Luhansk oblast, in the Eastern Part of Ukraine.

A.4.1.1. Host Party(ies):

Ukraine

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

Luhansk oblast, Eastern Part of Ukraine

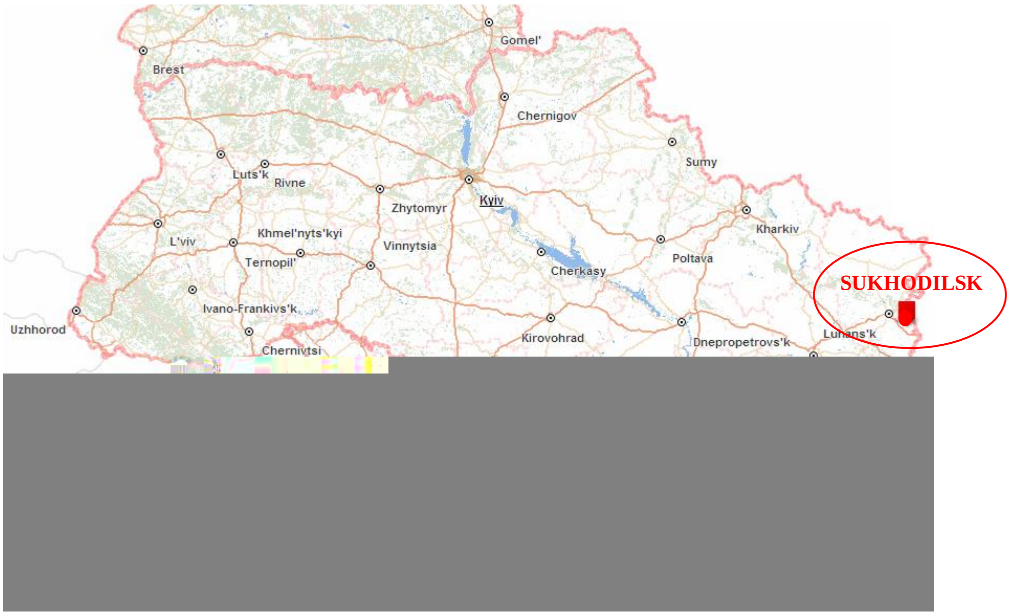


Fig. 1 Region of project location.

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

Sukhodilsk, Luhansk oblast

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

Fig.2 Project location.

Fig.3 A shaft of Coal Mine named after M.P. Barakov.

The project is located at the Central Site of Coal Mine named after M.P. Barakov not far from Sukhodilsk city. Geographical coordinates of the project site: 48°20'05" N 39°44'10" E.

Sukhodilsk is a city in Luhansk oblast of Ukraine. Population is 22 282 people (2005 estimate). The distance to Russian border is 16 km. The closest Ukrainian cities are:

Molodohvardiysk	2 km (kilometers) east	24 716 people
Krasnodon	6 km (kilometers) southeast	45 532 people
Luhansk	37 km (kilometers) northwest	452 789 people
Donetsk	145 km (kilometers) southwest	999 975 people

No natural protected areas exist on the territory of the project implementation.

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

Project activity

The following steps had been undertaken to make CMM utilization possible:

- A gas preparation station which reduces humidity of the gases captured by methane drainage techniques was built (see figure 4);
- Gas pipelines were built;
- Automatic control and actuating devices were installed;
- One new gas fired boiler was installed;
- Burners at the other existing boiler were replaced;
- Coal fired boiler was installed to back up the Mine's heat supply system when CMM is not available.

General overview of Barakov Mine degasification system

Mine degasification system removes the gas from coal-bearing strata during mining. Degasification allows mines to minimize ventilation costs, reduce mining delays, and enhance mine safety. The Mine is degasified through a degasification facility located at central industrial site of the Mine, its design characteristics are in Table 2. The methane containing gases are extracted through a pipeline installed in the main shaft. If not utilized, they are normally released with no destruction into the atmosphere through a stand installed at degasification facility (see Fig.5). Historic data on availability of CMM for utilization is in Table 3.

Table 2. Degasification system at Barakov Mine.

Parameter	Characteristics
Designed capacity, m^3/min	75
Type of vacuum pump	NV-50
Pump capacity	110 kW
Number of pumps	3 (1 working; 2 reserved)

Table 3. Amounts of available coal mine methane.

	2000 (Sept-Dec)	2001	2002
Quantity of CMM extracted, m^3	1 810 080.0	6 507 744.8	6 597 841.6
Average methane concentration, %	19.9	33.5	36.6

Fig. 4 Part of gas preparation station.

Fig. 5 Stand at degasification station releasing CMM into the atmosphere.

Reconstruction of Barakov Mine boiler house

Before the launch of the project the heating demand of the Mine was satisfied by a boiler house located in the central site of the Mine. In accordance with the specification it supplies heat to the consumers in forms of:

- Saturated steam;
- Overheated water t = 150-170 ^{0}C;
- Hot water with temperature 60 ^{0}C for the bathing facility.

At the moment of decision-making about the project implementation heat demand of the Mine was satisfied through operation of two natural gas fired steam boilers DKVR 6.5/13. First boiler (DKVR No. 4596) was restricted from further operation and had to be replaced. It is assumed that in baseline it would have been replaced by the similar one. Second boiler (DKVR No. 2983) was in good technical condition and could be operated for the period of time allowed by annual decisions of the State Boil Inspection. Operational lifetime of this type of boilers[3] is about 40 years provided that regular maintenance is undertaken. Therefore, it was assumed that this boiler would have been replaced by the similar one in 2007 as part of the baseline scenario as well.

Project activity was constituted of installation of automatic control and actuating devices to ensure the proper operation of the boiler house and minimize the risk of CMM explosion, replacement of burners and adapting the existing boiler DKVR No. 2983 for CMM combustion, replacement of DKVR No. 4596 to CMM-fired boiler DKVR No. 5246 and installation of coal fired boiler DKVR No. 9368 to back up the system.

As methane-air mixture with the methane concentration in the range 5-15% is self-explosive the CMM is not supplied to the boiler house when its concentration in the gases captured is close to critical. It is released in the atmosphere straight from the degasification system. This makes CMM not reliable energy

[3]http://www.suzmk.ru/kotel_dkvr.htm

source to ensure continuous heat supply. In the time when CMM concentration is too low for utilization coal as a reserve fuel is used. This makes installation of coal fired boiler a required part of the project activity.
Technical specifications of all the boilers are in the following tables.

Table 4. Technical specification of boiler DKVR 6.5/13 No. 4596 (dismantled in 2002).

Characteristics	Value
Commissioning date	March 2001
Fuel type	Gas/residual fuel oil
Steam output, tonnes/hour	6.5
Heating surface, m^2	197.4
Boiler cubing, m^3: water steam feed	 7.8 2.55 1.26

Table 5.Technical specification of boiler DKVR 6.5/13 No. 2983[4].

Characteristics	Value
Commissioning date	October 1974
Fuel type	Gas/residual fuel oil
Steam output, tonnes/hour	6.5
Heating surface, m^2	225.3
Boiler cubing, m^3: water steam feed	 7.8 2.55 1.38

Table 6. Technical specification of boiler DKVR 6.5/13 No. 5246 (installed as a part of project activity).

Characteristics	Value
Commissioning date	March 2001
Fuel type	Gas/residual fuel oil (works CMM)
Steam output, tonnes/hour	6.5
Heating surface, m^2	198
Boiler cubing, m^3: water steam feed	 7.38 2.43 1.04

[4]This boiler was dismantled on 19 May, 2010; a new gas-coal fired water boiler KVTG-10-150 No. 082 was installed instead.

Table 7. Technical specification of boiler DKVR 6.5/13 No. 9368 (installed as a part of project activity)

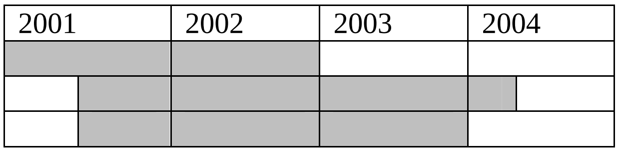
Characteristics	Value
Commissioning date	October 1977
Fuel type	Gas/residual fuel oil (works on coal)
Steam output, tonnes/hour	6.5
Heating surface, m^2	171
Boiler cubing, m^3: water steam feed	 7.38 2.43 1.04

Table 8. Technical specification of boiler KVTG-10-150 No. 082[5].

Characteristics	Value
Commissioning date	March 2011
Fuel type	Gas/coal (works on CMM)
Heat output, GJ/hour	41.9
Heating surface, m^2	267
Boiler cubing, m^3	3.5

Implementation schedule

Project design
Reconstruction of the boiler house
Modernization of gas preparation station



Results of the implementation of the project activity

As a result of implementation of the project activity an average 71% of extracted CMM is utilized, which allows generation of about 99% of thermal energy produced at Barakov Mine boiler house, see figure 7 and table 8 for more details. Emission reductions are only claimed for the share of energy generated by CMM utilization.

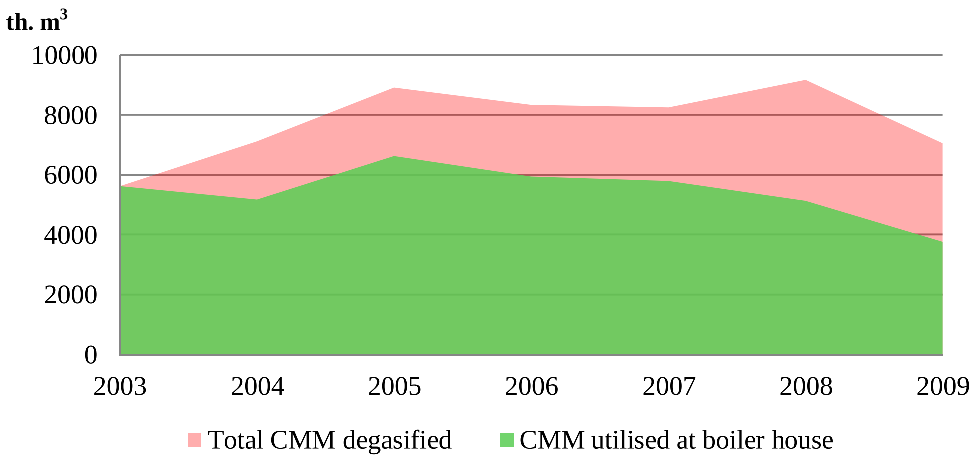


Fig.6 CMM utilization at Barakov Mine in 2003-2009, thousand m^3.

[5] This boiler is replacing boiler No. 2983.

Table 9. Barakov Mine post-project fuel mix.

	Heat generated by CMM utilization, GJ	Share of heat generated by CMM utilization	Heat generated by coal combustion, GJ	Share of heat generated by coal combustion, %
2004	160475	99%	1676	1%
2005	207301	100%	0	0%
2006	184652	100%	0	0%
2007	162478	100%	0	0%
2008	159208	92%	14650	8%
2009	116962	80%	29153	20%
2010	152434	100%	0	0%

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:

Anthropogenic GHG emissions are reduced by the project through capturing direct emissions of methane (CMM) and combusting it to carbon dioxide with much lower global warming potential. CMM is combusted in boilers to generate heat energy which otherwise would be produced by fossil fuel combustion, being another source of GHG emissions, which is avoided because of realization of the project. Emission reductions would not occur in the absence of the project because no reconstruction would be made to allow CMM capture and utilization. Consequently, CMM would be vented into the atmosphere and heat energy produced by natural gas combustion in boiler house of the Mine.

Reasons why GHG emission reductions would not occur in the absence of the proposed project
In the beginning of 2000-s Barakov Mine was under the same conditions and experienced the same problems as the rest of the mines in Ukraine (see section B.1. for more details). The project would not have been realized without JI incentive because as was proved by investment analysis (see section B.2.) the project activity was not profitable, therefore its realization would not be feasible under the economic conditions of the Mine at the time of decision-making. Provided that there were no other incentives for CMM utilization such as applicable legal requirements GHG emission reductions would not have occurred in the absence of the proposed JI project.

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

Table 10. Estimated amount of emission reductions before the first commitment period.

	Years
Length of the period before the first commitment period	4
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2004	71 709
Year 2005	92 725
Year 2006	82 594
Year 2007	72 675
Total estimated emission reductions before the first commitment period (tonnes of CO_2 equivalent)	319 703
Annual average of estimated emission reductions before the first commitment period (tonnes of CO_2 equivalent)	79 926

Table 11. Estimated amount of emission reductions during the part of the crediting period within the first commitment period.

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2008	70 595
Year 2009	51 085
Year 2010	68 183
Year 2011	73 068
Year 2012	73 068
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	335 999
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	67 200

Table 12. Estimated amount of emission reductions for the part of the crediting period after the end of first commitment period

	Years
Period after 2012, for which emission reductions are estimated	13
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
Year 2013	73 068
Year 2014	73 068
Year 2015	73 068
Year 2016	73 068
Year 2017	73 068
Year 2018	73 068
Year 2019	73 068
Year 2020	73 068
Year 2021	73 068
Year 2022	73 068
Year 2023	73 068
Year 2024	73 068
Year 2025	36 534
Total estimated emission reductions for the part of the crediting period after the end of the first commitment period (tonnes of CO_2 equivalent)	913 350
Annual average of estimated emission reductions for the part of the crediting period after the end of the first commitment period (tonnes of CO_2 equivalent)	70 258

A.5. Project approval by the Parties involved:

The project has been endorsed by Ukraine. The Letter of Endorsement was issued by National Environment Investment Agency of Ukraine on 27th of December 2010 with reference number 2257/23/7. Letter of Approval 2011JI45 by Ministry of Economic Affairs, Agriculture and Innovation of the Netherlands was received on 6th of December 2011. The project approval by the Host Party is expected after completion of the determination process.

SECTION B. Baseline

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

The baseline is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of greenhouse gases that would occur in the absence of the project[6]. Baseline was established in accordance with Appendix B to JI Guidelines and paragraph 23 through 29 of the Guidance on criteria for baseline setting and monitoring.

Step 1. Indication and description of the approach chosen regarding baseline setting

In line with the paragraph 9 of the latest version of the Guidelines on criteria for baseline setting and monitoring (Version 03, adopted by JISC 26 meeting in September 2011) the project participants may select to apply the JI specific approach for the baseline setting and monitoring. In this case a detailed theoretical description of the baseline in a complete and transparent manner has to be provided. All the information about baseline scenario required by paragraph 23 through 29 of the Guidance on criteria for baseline setting and monitoring is in the relevant parts of section B of this document. Additional information as well as supporting data are in the Annex 2.

Step 2. Application of the approach chosen

Key factors that affect the baseline were taken into account:
a) Sectoral reform policies and legislation. In order to improve the efficiency in coal mining and increase coal extraction the Ukrainian Coal Program was adopted by the Resolution of Cabinet of Ministers of Ukraine No. 1205 as of 19th of September 2001. It envisioned state support to coal industry, ownership structure change, improvement of safety conditions at mines and decreasing negative environmental impact caused by coal mining. Coal mine methane utilization was not covered by the Program as well as by other relevant regulation documents, namely:
- Decree of the President of Ukraine No. 26/2002 as of 16th of January 2002 "On urgent activities for improvement of work conditions and development of the state supervision at mining enterprises";
- Resolution of Cabinet of Ministers of Ukraine No. 939 as of 6th of July 2002 "On adoption of Health and Safety Program at Coal Mines".

Thus, there were no any regulations in place obliging to utilize the gases captured by methane drainage techniques, consequently, the common practice at Ukrainian mines was its venting into the atmosphere;

b) Economic situation/growth and socio-demographic factors in the relevant sector as well as resulting predicted demand. In the beginning of 2000s when the decision to implement the project was made Ukrainian coal industry was in economic, financial, technical and social crisis. Coal extraction in 1991 was 135.6 million tonnes while in 2001 it turned to 80.3 million tonnes. As stated in the World Bank report : “a core problem of the Ukrainian coal industry is that coal prices reflect neither the costs of production nor the costs of alternative energy sources that are available or potentially available to the country. The coal sector’s average current production cost is about 29 $/t, or 15% higher than the sector’s current average price of about 25 $/t”. Attracting capital to coal mining at that time was highly constrained. By 2000 over 30% of mines were closed down due to their unprofitability, at the remaining mines the funds for maintenance were channeled from their operational capitals which leaded to growth of payables and wages arrears. In the beginning of 2001 mining enterprises owed to their employees 1.9 billion UAH. Together with dangerous working conditions and high mortality rate of miners this created high social tension in the region. It is assumed that the level of coal production and demand is not

[6] FCCC/KP/CMP/2005/8/Add.2Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005, Annex, Guidelines for the implementation of Article 6 of the Kyoto Protocol, http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf

influenced by the project. Main outcome of the project is on-site heat generation by utilization of CMM. In the absence of the project activity the same amount of heat would be produced by natural gas combustion, therefore the same level of service as in the project scenario would be offered in the baseline scenario.

c) Availability of capital (including investment barriers). Attracting external capital was highly constrained for a company with such debts as Barakov Mine had at the time of decision making because positive credit history was required. Investment programs by IFI's were focused mainly on large-scale infrastructure projects having requirements for minimal investment of 5-10 million USD. Overall, investment climate of Ukraine was considered risky, capital markets underdeveloped, private capital could be attracted at prohibitively high cost due to real and perceived risks of doing business in Ukraine. This made Barakov Mine seek for solutions requiring minimal investment that could be covered by own funds of the Enterprise, which were very limited.

d) Local availability of technologies/techniques, skills and know-how and availability of the best available technologies/techniques in the future. Technologies, skills and know-how for implementation of the project activity were available. Ukraine has more than 130 year history of coalmining during which research and development base was created. The technology employed was well known, local suppliers of solutions and equipment were available.

e) Fuel prices and availability. Electricity and natural gas are widely used in Ukraine, distribution networks are well developed, and these energy sources are accessible to most of industrial users. At the time of decision making the prices for natural gas and electricity were heavily state regulated and had been relatively stable for couple of previous years. Natural gas was mainly imported from Russia, its price for Ukraine was lower than for European countries.

f) National and/or subnational expansion plans for the energy sector, as appropriate. Project realization increases energy independence of the Enterprise, which is in line with state energy policy.

g) National and/or subnational forestry or agricultural policies, as appropriate. Project realization did not have any relation to any forestry or agricultural policies.

Plausible scenarios

Before the implementation of the proposed JI project activity the Mine's demand for heating was satisfied by own heat generation at the Mine's boiler house which operated 2 natural gas-oil fired boilers with total installed capacity of 13 tonnes of steam/hour. The following alternatives were open to satisfy the Mine's heating demand:

H1: Heat generation by natural gas combustion (continuation of current practice);
H2: Heat generation by oil combustion;
H3: Heat generation by coal combustion;
H4: Heat generation by CMM combustion;
H5: Heat generation by CMM combustion with coal as reserve fuel;
H6: Heat generation by electrical boilers;
H7: Purchase thermal energy from external suppliers.

In terms of CMM treatment the Mine could:
G1: Vent CMM to the atmosphere;
G2: Flare CMM;
G3: Utilize it to produce heat in existing boiler house;
G4: Utilize it for combined heat and power generation;
G5: Utilize it as vehicle fuel.

Detailed description of the alternatives is provided below.Their feasibility analysis follows.

H1: Heat generation by natural gas combustion (continuation of current practice)
In this option the thermal energy is produced by natural gas combustion in existing boilers. As the boilers in place were natural gas-oil fueled realization of this option did not require any changes in construction of the boiler house and thus did not need capital investment. None of the barriers prevented this option from realization. From the point of view of environmental protection combusting natural gas is more preferable than other options such as heavy oil or coal combustion.

H2: Heat generation from heavy oil combustion
In this option the thermal energy is produced by heavy oil combustion in existing boilers. As the boilers in place were natural gas-oil fueled turning to heavy oil would require only minimal changes in construction of the boiler house and thus did not need high capital investment. However, heavy oil supply needed to be organized as well as special storing facilities would have to be constructed. Overall, realization of this option was not reasonable regarding availability of other fuels such as natural gas and coal.According to Ukrainian Statistic Committee heavy oil consumption for energy generation in 2000-2009 by overall coal, lignite and peat production sector was close to zero[7].
Compared to natural gas or CMM combustion emission of air pollutants, GHGs and other negative environmental impacts would have increased being still lower than for the case of coal combustion.

H3: Heat generation from coal combustion
In this option the thermal energy is produced by coal combustion in new or reconstructed boilers. Realization of this alternative required reconstruction of the two existing natural gas boilers to allow burning coal. The boilers would have to be equipped with coal feed and ash removal systems. However, combusting coking coal mined at Barakov Mine for heat generation would be not reasonable as its price was twice as big as of energy coal. The reconstructed boilers could be fueled with brown coal brought from other mines of Krasnodoncoal purchased for production costs. Overall, realization of this option clearly imposed higher costs than the other options such as using natural gas or CMM. Under economic conditions of the Mine at the moment of decision making realization of this option was not feasible. Besides, environmental impacts of this option would be the most severe out of all the others: highest emissions of GHGs and other air pollutants, generation of ash and other impacts causing negative health effects. Therefore, having other alternatives with less negative environmental impacts and requiring lower capital investment realization of this option was not reasonable.

H4: Heat generation from CMM combustion
In this option the thermal energy is produced by CMM combustion in existing reconstructed boilers. In order to implement this option the gas conditioning system would have to be installed, pipelines would have to be built and burners at the boilers would have to be replaced. As using CMM when its concentration in the gases captured by methane drainage techniques is below 25% is dangerous, it poses a risk to the Mine to remain unheated in the periods of low CMM concentrations. Therefore, this option could not have been considered reliable in terms of satisfying heating demand of the Mine, therefore was not feasible.
In terms of environmental impacts this would cause the least negative impact.

[7] Ukrainian Statistics Committee, Statistics digest “Fuel and Energy Resources in Ukraine”. Data for 2006-2009 available online at http://ukrstat.gov.ua/.

H5: Heat generation from CMM combustion with other reserve fuel
In this option the thermal energy is produced by CMM combustion in existing reconstructed boilers, and the system is backed up by boiler working on the fuel other than CMM which is used when CMM concentration does not allow its utilization. In order to implement this option in addition to the required gas conditioning system, pipelines and replacement of boiler burners, another reserve coal fired boiler had to be installed. The reserve boiler could be fueled with own coking coal or brown coal brought from other mines of Krasnodoncoal. For this purpose management and logistic systems were set allowing exchanging of coal between the mines according to their demands at given point of time. The necessary infrastructure was also in place, namely rail road connections between the mines, up- and unloading facilities etc.
Negative environmental impacts of this option are the more serious the higher is quantity of the coal used, which was intended to be minimal. The option was technically and economically feasible.

H6: Heat generation by electrical boilers
In this option the thermal energy is produced by new electrical boilers. This option required the highest of the rest of the options capital investment for installation of new electrical boilers; it also meant the need to purchase electricity.Under economic conditions of the Mine this was not economically feasible. Also having other energy resources available which required less cash for purchase (coal and CMM) turning to electricity was not reasonable. Therefore this option was clearly economically unattractive.
Its realization would cause remote indirect environmental impacts related to electricity production: GHG emissions, air pollution, radioactive waste, thermal pollution etc.

H7: Purchase thermal energy from external suppliers
In this option the thermal energy is purchased from Krasnodon central heating system which also serves Sukhodilsk. Realization of this option required construction of 5-10 km long steam pipelines using which would be inefficient in terms of high heat loses. Besides, Krasnodon central heating system with its 74 boiler houses constructed between 1958-1965 and being in a very poor condition[8]was not able to deliver as much as 13 tonnes of saturated steam per hour to satisfy heating demand of Barakov Mine. Consequently, this option was technically not feasible or reasonable to realize.
Its realization would cause remote indirect environmental impacts related to heat production: GHG emissions, air pollution, thermal pollution etc.

G1: Vent CMM to the atmosphere
In this option the CMM from degasification system of the Mine is vented directly to the atmosphere with no destruction. This would require no changes or investment and represents existing practice before the project implementation. It was allowed by Ukrainian legislation provided that pollution permits were received and pollution payments were submitted to Ukrainian Tax Administration. Thus, this option was feasible.
It is the most environmentally harmful out of all options for CMM treatment. It implies the highest emissions of CH_4 which is a GHG gas, it is also highly flammable and may form explosive mixtures with air.

[8]Regional Development Strategy for Krasnodon till 2015, http://krasnodon-rada.gov.ua/krasnodon/programma/

G2: Flare CMM
In this option CMM is burned at flare. It would require installation of flare which meant additional expenditures. As there was no any legislation in place which would oblige to do so and the activity did not generate any profit the Mine did not have any incentive to do it. Realization of this option was not plausible for the Mine, unless other benefits like the ones provided by JI mechanism existed.
This option is less environmentally harmful than the previous one, the resulting air pollution would be with methane combustion products having lower global warming potential than CH_4. However, under economic conditions of the Mine this option turned out to be not feasible.

G3: Utilize CMM to produce heat in existing boiler house
In this option CMM is combusted in the Mine's boiler house. Utilization of 100% of CMM is not reasonable due lower heat demand of the Mine in summer period. Therefore, the feasible option is partial utilization of the available CMM. In order to implement this option installation of gas conditioning system, pipelines, reserve boiler as a system back-up, and replacement of boiler burners were required.
Realization of this option is environmentally beneficial as it allows reducing GHG emissions and avoids environmental harm caused by combustion of other fossil fuels, such as for example natural gas, which would happen otherwise.

G4: Utilize CMM for combined heat and power generation
In this option CMM is combusted in the Mine's boiler house in a new CHP unit. In order to realize this option purchase and installation of combined heat and power generation unit was necessary. This option was clearly economically unfeasible due to the high costs of CHP equipment: 1 MW of installed capacity would require investment of approximately 0.5 million USD[9]. In order to cover the Mine's heating demand the required installed capacity would be approximately 10-11 MW, which was not affordable for the Mine in 2002.
In terms of environmental impacts this would be the most outstanding option as it would ensure maximum achievable efficiency of CMM utilization yielding necessary heat and electricity for the operation of the Mine.

G5: Utilize CMM as vehicle fuel
In this option CMM is used as a fuel for vehicles. To realize this option methane concentration has to be enriched to more than 90% which can be achieved by processing CMM in enriching system. Besides it also required installation of gas filling compressor plants meaning capital investment. Overall, realization of this alternative was not reasonable regarding the fact that securing heat supply to the Mine was the first priority in 2002.
Realization of this option would reduce the air pollution and GHG emissions caused by transport which would have positive impact on the environment.

All of the options listed above were consistent with existing Ukrainian legislation. The feasible options for heat generation were:
H1: Heat generation by natural gas combustion (continuation of current practice)
H5: Heat generation from CMM combustion with other reserve fuel

The feasible options for CMM utilization were:
G1: Vent CMM to the atmosphere
G3: Utilize CMM to produce heat in existing boiler house

[9] CHP units distributor's data.

When combined together the following alternatives to the project activity were open to the Mine:

Alternative 1: Producing thermal energy by natural gas combustion and venting CMM into the atmosphere (H1+G1) (continuation of the current practice);
Alternative 2: CMM utilization for heat generation at boiler house of the Mine with coal as a reserve fuel and venting rest of the CMM into the atmosphere (H5+G3) (project scenario without JI incentive).

Alternative 2 was proved to be unprofitable in the following part B.2. of this document, therefore, realization of this alternative was not economically reasonable and it cannot be considered to be baseline scenario.

Conclusion: Alternative 1 is the only feasible scenario which could happen in the absence of the project activity. Therefore, it is considered as baseline.

Baseline assumptions
A baseline was established using IPCC default emission factors. It is assumed that the CMM would be available by the end of operation period of the Mine and that the Mine's output levels in baseline scenario would be the same as in the project scenario.
ERUs are only claimed for the CMM which was actually utilized and which substituted the thermal energy that would otherwise be produced by burning natural gas. Application of such an approach to ERUs calculation guarantees that they were not earned for decreases in activity levels outside the project activity or due to force majeure.

Baseline emission calculation details are provided in the Annex 2.

Key information and data used to establish the baseline are provided below in tabular form:

Data/Parameter	$FC_{CMM,y}$
Data unit	thousand m^3
Description	is the amount of CMM combusted in boiler house in period y
Time of determination/monitoring	Measured during project lifetime
Source of data (to be) used	Project owner records based on readings of the flow meter
Value of data applied (for ex ante calculations/determinations)	**2004**: 5 175; **2005**: 6 685; **2006**: 5 955; **2007**: 5 240; **2008**: 5 134; **2009**: 3 772; **2010**: 4 916
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine emissions of GHGs due to CMM venting and heat generation. Data are collected for technological purposes of the project owner. Daily value of CMM sent to boilers is obtained by the following formula based of recordings of gas flow meter and concentration analyser at degasification station of the Mine: $FC_{CMM} = (FR_{DG}/60 \times C_{CH4} \times T_{boilers})/1000$, where FC_{CMM} is CMM send to the boilers, thousand m^3; FR_{DG} is flow rate of degasified gases, m^3/hour; C_{CH4} is CMM concentration in gases degasified, %; $T_{boilers}$ is time of CMM supply to boiler house, minutes. Daily values are summed up to get monthly and annual values.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Mine and requirements of producer

Any comment	No

Data/Parameter	$FC_{coal,y}$
Data unit	t
Description	is the quantity of coal combusted in boiler house in period y
Time of determination/monitoring	Measured during project lifetime
Source of data (to be) used	Project owner records based on measuring coal consumption by measuring bunker
Value of data applied (for ex ante calculations/determinations)	**2004**: 80; **2005**: 0; **2006**: 0; **2007**: 0; **2008**: 700; **2009**: 1 393; **2010**: 0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine emissions of GHG due to production of heat. Data are collected for technological purposes of the project owner. Monitoring of the coal consumption takes place at Coal Loader Complex. Coal is measured by the bunker above the boiler with known dimensions. The size of the bunker is 30 tonnes, it is filled with coal by transport line from Coal Loader Complex. Quantity of coal combusted is determined by the number of bunkers which were emptied. In case when some coal is left in bunker its mass is determined by the fraction of bunker volume that it fills.
QA/QC procedures (to be) applied	Data are cross-checked between the Mine's Divisions.
Any comment	No

Data/Parameter	NCV_{CH4}
Data unit	GJ/1000 m^3
Description	Net calorific value of methane
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Default value. Grigoriev, Zorin "Theoretical Basics of Thermal Engineering, Volume 2, Table 7.7, Moscow, 1988, p. 367
Value of data applied (for ex ante calculations/determinations)	35.82
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by CMM utilization at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	NCV_{coal}
Data unit	GJ/t
Description	Net calorific value of coal
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report of Ukraine, 1990-2009, Table P2.30 p. 399

Value of data applied (for ex ante calculations/determinations)	21.8
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by coal combustion at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	η
Data unit	fraction
Description	Baseline efficiency of natural gas fired boiler
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	CDM "Tool to determine the baseline efficiency of thermal or electric energy generation systems" http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf
Value of data applied (for ex ante calculations/determinations)	0.87
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy which in baseline would be produced by natural gas combustion.
QA/QC procedures (to be) applied	Default factor established according to CDM rules and procedures
Any comment	No

Data/Parameter	Eff_{HEAT}
Data unit	fraction
Description	Efficiency of methane destruction/oxidation in heat plant
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Table 1.6, p. 1.29. http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref2.pdf
Value of data applied (for ex ante calculations/determinations)	0.995
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy which in baseline would be produced by natural gas combustion.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	$OXID_{coal}$
Data unit	fraction

Description	Coal oxidation factor
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report of Ukraine 1990-2009, p. 381 (rounded value)
Value of data applied (for ex ante calculations/determinations)	0.96
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by coal combustion at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	ρ
Data unit	t/thousand m^3
Description	Density of methane
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Default data, http://www.engineeringtoolbox.com/gas-density-d_158.html
Value of data applied (for ex ante calculations/determinations)	0.668
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the mass of utilized CMM.
QA/QC procedures (to be) applied	-
Any comment	Value at conditions: t=293.15 K; p= 101.325 kPa. The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to t/thousand m^3: 0.668 kg/m^3= 0.668 t/thousand m^3

Data/Parameter	EF_{NG}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor for combusted natural gas
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4
Value of data applied (for ex ante calculations/determinations)	0.0561
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC value has to be used as a default.

QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/GJ: 56100 kg CO_2/TJ = 0.0561 tCO_2/GJ

Data/Parameter	EF_{CC}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor of coal (anthracite) combustion
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Value for anthracite. IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4
Value of data applied (for ex ante calculations/determinations)	0.0983
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC value is used as a default.
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/GJ: 98300 kg CO_2/TJ = 0.0983 tCO_2/GJ

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global warming potential of methane
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	IPCC Fourth Evaluation Report, WG1, Section 2, Table 2.14, 2007 http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14
Value of data applied (for ex ante calculations/determinations)	21
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to calculate emissions of CO_2e due to CMM venting into the atmosphere
QA/QC procedures (to be) applied	-
Any comment	No

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:

Anthropogenic emissions of GHGs are reduced by using CMM to generate thermal energy. In the absence of the project CMM would be vented into the atmosphere, while heat would be generated by natural gas combustion. Therefore, GHG emissions in the baseline scenario would likely exceed the emissions in the project scenario.

The latest version of "Tool for the demonstration and assessment of additionality" (Version 05.2) was used to demonstrate that the project could not have been realized without JI incentive.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

Alternative 1: Producing thermal energy by natural gas combustion and venting CMM into the atmosphere (continuation of the current practice);

Alternative 2: CMM utilization for heat generation at boiler house of the Mine with coal as a reserved fuel and venting rest of the CMM into the atmosphere (project scenario without JI incentive).

Sub-step 1b: Consistency with mandatory laws and regulations:

All the alternatives to the project activity were consistent with Ukrainian legislation in place at the time of decision making. Realization of none of the Alternatives would be prevented by applicable legislation. Step 2 Investment analysis is used to prove the additionality of the project.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method:

Due to the fact that the project generates financial benefits other than revenues from ERU sale, namely the economy on natural gas for heat supply of the Mine the simple cost analysis (Option I) cannot be applied. Therefore, benchmark analysis (Option III) was chosen.

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

According to the "Tool for the demonstration and assessment of additionality" (Version 05.2) in order to prove that the project was additional it is necessary to "determine whether the project activity was not economically or financially feasible, without the revenue from the sale of *emission reduction units (ERUs)*[10]". NPV was chosen as appropriate financial indicator.

Because Alternative 1 represents continuation of the current practice Alternative 2 was analyzed to determine whether it was profitable at the time of decision making.

NPV was calculated using available data and price information as of 2000 before the decision about the project was made, in accordance with Annex to "Tool for the demonstration and assessment of additionality" (Version 05.2) "Guidance on the Assessment of Investment Analysis". Cash flows were discounted using commercial lending rate adjusted by inflation (see Table 13).

[10]Tool for the demonstration and assessment of additionality (Version 05.2), p.5

Table13. Discount rate.

Datum	Value
Commercial lending rate (2000)[11], %	40.1
Consumer price index (nonfoods) (2000)[12],%	8.9
Real discount rate, %	**29**

Capital investments are detailed in Table 14. Operational costs as well as investment in degasification system were not taken into account as it was assumed that the project did not influence them. Annual operational cash flow is in Table 15.

Table 14. Capital investment (2001-2003, UAH).

	2001	2002	2003
Project Design	72 840	501 789	35 958
Equipment	1 655 289	1 628 885	137 529
Construction works	25 717	337 540	0
Total	**4 395 547**		

Table 15. Operational cash flow (UAH).

Datum	Value
Annual savings on natural gas*	1013683

*Natural gas price 1 thousand m^3= 192.5 UAH
Annual estimated natural gas demand 5266 thousand m^3

Residual value of three boilers was included as scrap metal cost because by 2025 their book value will become zero. It was included in investment analysis as a positive cash flow in the end of the project lifetime. Residual value of one boiler was estimated to be 3 634 UAH for one boiler in 2000 prices.
Thus, the following results were obtained:

Project scenario without ERU revenues
NPV: -804 785

Benchmark
NPV: 0

Negative value of NPV means that the realization of the project would not create additional value to the investor; therefore, it was not economically reasonable.

Sub-step 2d: Sensitivity analysis:
Variations up to 10% in natural gas price and investment were applied to check the sensitivity of the obtained results. The following figures were obtained:

Table 16. Sensitivity analysis results for project scenario.

Natural gas price	-10%	-5%	0	5%	10%
NPV	-1 017 908	-911 347	-804 785	-698 224	-591 662
Investment					
NPV	-511 181	-657 983	-804 785	-951 587	-1 098 389

[11] Ukrainian National Bank Bulletin No. 12/2002 (119), p.69

[12] State Statistics Committee of Ukraine, Consumer price index 1991-2007 (December to December of the previous year), http://www.ukrstat.gov.ua/

Thus, it can be concluded that Alternative 2 was not becoming economically/financially attractive in case of reasonable variation in critical parameters (natural gas price and investment).

Conclusion: the results of investment analysis prove that the proposed JI project activity was not economically and financially feasible.

Step 3: Barrier analysis

According to the "Tool for the demonstration and assessment of additionality" (Version 05.2) this step can be omitted.

Step 4: Common practice analysis

Sub-step 4a
Ukraine has the seventh largest amount of coal resources in the world, 34.1 billion tonnes in proven coal reserves, 16.2 billion tonnes of which is anthracite and bituminous coal, and 17.8 billion tonnes of which is lignite and sub-bituminous[13]. More than 90% of Ukrainian coal production takes place in Donetsk Basin in the eastern region of the country. The coal is from Carboniferous deposits with over 330 identified coal seams to a depth of 1 800 meters, 100 of which considered mineable[14]. Overall, in 1999 there were 284 operating mines in Ukraine, employing about 500 000 people.

One of the most serious problems to coal mining is methane which is contained in coal deposits. Gas content of coking coal, lean-coking coal, and lean coal is generally from 20 to 25 m^3/t while that of anthracites would be higher, typically in the range of 40 to 45 m^3/t[15]. Methane-air mixture with 2-15% of CH_4 is highly explosive, therefore to maintain proper safety conditions it has to be kept below 2%. In order to ensure this two main technologies are applied: ventilating the mine with large quantities of air and draining of methane.

Ukrainian legislation in place at the time of decision making required methane degasification from mines for safety reasons:

- Ukrainian Coal Program was adopted by the Resolution of Cabinet of Ministers of Ukraine No. 1205 as of 19th of September 2001;
- Decree of the President of Ukraine No. 26/2002 as of 16th of January 2002 "On urgent activities for improvement of work conditions and development of the state supervision at mining enterprises";
- Resolution of Cabinet of Ministers of Ukraine No. 939 as of 6th of July 2002 "On adoption of Health and Safety Program at Coal Mines".
-

None of the regulation documents obliged to utilize it. As a result, CMM utilization in Ukraine in the beginning of 2000-s was rather exception than a rule. According to the USA Environmental Protection Agency data average fraction of CMM utilized in 1997-2001 was 4%. See Table 17 for more details.

[13] Ukraine. Coal. U.S. Energy Information Administration, http://www.eia.doe.gov/emeu/cabs/Ukraine/Coal.html
[14] PEER (2000): Coal Mine Methane in Ukraine: Opportunities for Production and Investment in the Donetsk Coal Basin. Partnership for Energy and Environmental Reform, Triplett, Jerry, Alexander Filippov, and Alexander Pisarenko, September 2000. www.epa.gov/cmop/docs/ukraine_handbook.pdf

[15] PEER (2000): Coal Mine Methane in Ukraine: Opportunities for Production and Investment in the Donetsk Coal Basin. Partnership for Energy and Environmental Reform, Triplett, Jerry, Alexander Filippov, and Alexander Pisarenko, September 2000. www.epa.gov/cmop/docs/ukraine_handbook.pdf

Table 17. CH_4 Emissions from Ukrainian Coal Mines for 1997-2001, thousand tonnes[16].

Activity	1997	1998	1999	2000	2001
Liberated (underground mining)	1289.41	1316.86	1290.89	1436.68	1237.14
Recovered (utilized) (underground mining)	38.59	56.63	53.68	49.59	91.33

Sub-step 4a
A number of projects on utilization of CMM have already been registered as JI Projects in Ukraine. Emission reductions from the following projects have already been verified[17]:

Utilization of Coal Mine Methane at the Coal Mine named after A.F. Zasyadko
CMM utilisation on the Joint Stock Company named Komsomolets Donbassa Coal Mine of DTEK
Utilization of Coal Mine Methane at the Coal Mine Sukhodilska-Skhidna

All the projects are comprised of two basic parts: CMM capture and CMM utilization (heat production, CHP, vehicle filling etc.). The ways for CMM utilization differ from project to project while techniques for CMM capture are basically the same. Therefore, there are no principal differences between the proposed JI project at Barakov Mine and the ones listed above.

CMM utilization projects in Ukraine were recognized as JI Projects, therefore they cannot be considered a part of common practice, including the following:

CMM utilisation for heat generation and flaring – “Pivdennodonbaska No. 3”[18]
CMM utilisation on the Joint Stock Company named Komsomolets Donbassa Coal Mine of DTEK[19]
CMM utilisation on the Coal Mine № 22 “Kommunarskaya” of the State Holding Joint-Stock Company "GOAO Shakhtoupravlenye Donbass"[20]
CMM utilisation on the coal mine Shcheglovskaya-Glubokaya of the State Holding Joint-Stock[21]
CMM utilisation on the Joint Stock Company “Coal Company Krasnoarmeyskaya Zapadnaya No. 1 Mine[22]
Utilization of Coal Mine Methane at the Coal Mine named after A.F. Zasyadko[23].

Overall, it can be concluded that CMM utilization was not a common practice for Ukraine.

Conclusion: This JI project provides a reduction in emissions that is additional to any that would otherwise occur. Consequently, this project is additional.

[16] PEER (2002): *Coal Mine Methane Recovery in Ukraine: Inventory of Coal Mine Methane Emissions from Ukraine 1990 – 2001*, Partnership for Energy and Environmental Reform, Triplett, Jerry, Alexander Filippov, and Alexander Pisarenko , 2002. www.epa.gov/cmop/docs/inventory2002.pdf

[17] As of September 2010.

[18] http://www.neia.gov.ua/nature/doccatalog/document?id=116962

[19] http://www.neia.gov.ua/nature/doccatalog/document?id=116967

[20] http://www.neia.gov.ua/nature/doccatalog/document?id=116972

[21] http://www.neia.gov.ua/nature/doccatalog/document?id=116977

[22] http://www.neia.gov.ua/nature/doccatalog/document?id=116982

[23] http://www.neia.gov.ua/nature/doccatalog/document?id=116921

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

According to paragraph 14 of the JI Guidelines Version 03: "*In the case of a JI project aimed at reducing emissions, the project boundary shall:*
(a) Encompass all anthropogenic emissions by sources of GHGs which are:
(i) Under the control of the project participants;
(ii) Reasonably attributable to the project; and
(iii) Significant, i.e., as a rule of thumb, would by each source account on average per year over the crediting period for more than 1 percent of the annual average anthropogenic emissions by sources of GHGs, or exceed an amount of 2,000 tonnes of CO_2 equivalent, whichever is lower; and
(b) Be defined on the basis of a case-by-case assessment with regard to the criteria referred to in subparagraph (a) above."

There are the following sources of GHG emissions related to the proposed baseline and project scenarios:
- All sources of emissions that are not influenced by the projects have been excluded;
- All sources of emissions that are influenced by the projects have been included.

Table 18. Sources of emissions included in consideration or excluded of it.

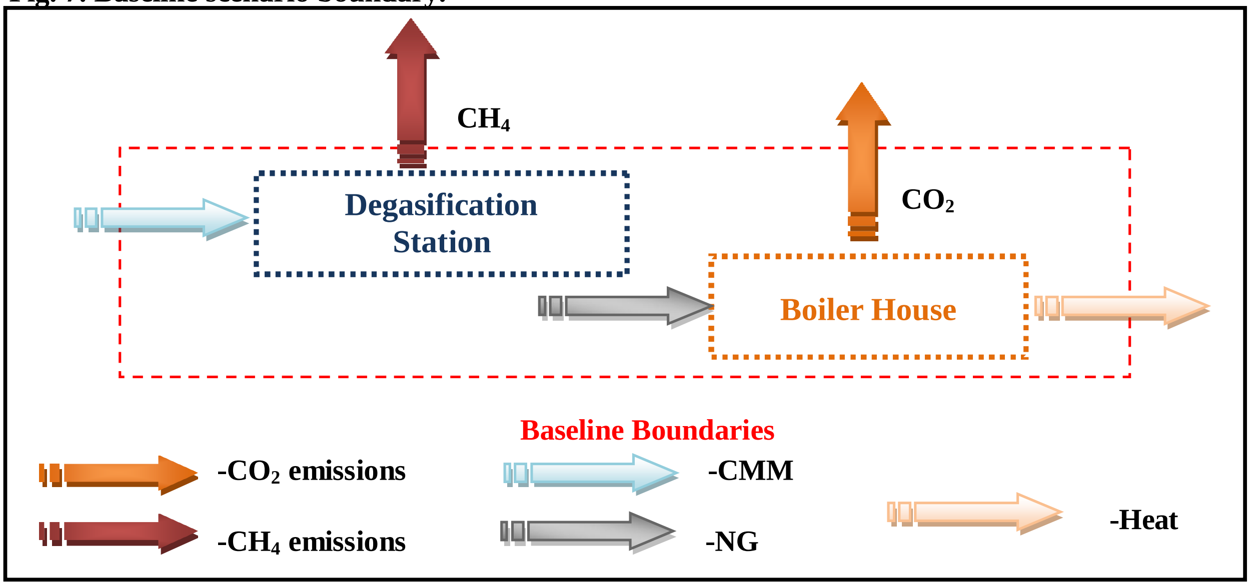
	Source	**Gas**	**Incl./ Excl.**	**Justification/Explanation**
Baseline	Emissions from release of methane into the atmosphere	CH_4	**Incl.**	**Main source of emissions.** Only the change in CMM utilization will be taken into account by monitoring methane consumption by the project activity.
	Emissions from the production of heat replaced by the project activity	**CO_2**	**Incl.**	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
Project	Emissions from NMHC destruction	CO_2	Excl.	Considered negligible. Analysis of chemical compound of the gases extracted by the Mine's degasification system showed that concentration of NMHC (non-methane hydro carbons) in the sample was 0,26% which is not significant and therefore was neglected.
	Emissions of uncombusted methane through vent in the Boiler House	CH_4	Excl.	Release CMM during short period of time (up to 5 minutes) taken to firing the boiler when CMM reaches the boiler house before burner is turned on and in emergency situations. Considered negligible.
	Emissions from methane destraction	**CO_2**	**Incl.**	**Main source of emissions**
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.
	Emissions of uncombusted methane	**CH_4**	**Incl.**	**Main source of emissions**
	Emissions from coal combustion	**CO_2**	**Incl.**	**Main source of emissions**
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.

Baseline scenario
The baseline scenario is the continuation of current practice of venting CMM into the atmosphere with no destruction and heat generation by burning natural gas in the boiler house of the Mine. Consequently, baseline scenario boundary (illustrated by Figure 7) includes Barakov Mine boiler house and degasification station.

Project scenario
Project scenario is CMM utilization at Barakov Mine boiler house to produce thermal energy for covering heating demand of the Mine with coal used as reserve fuel. Therefore, project scenario boundary (illustrated by Figure 8) includes Barakov Mine boiler house, degasification station and coal loader complex.

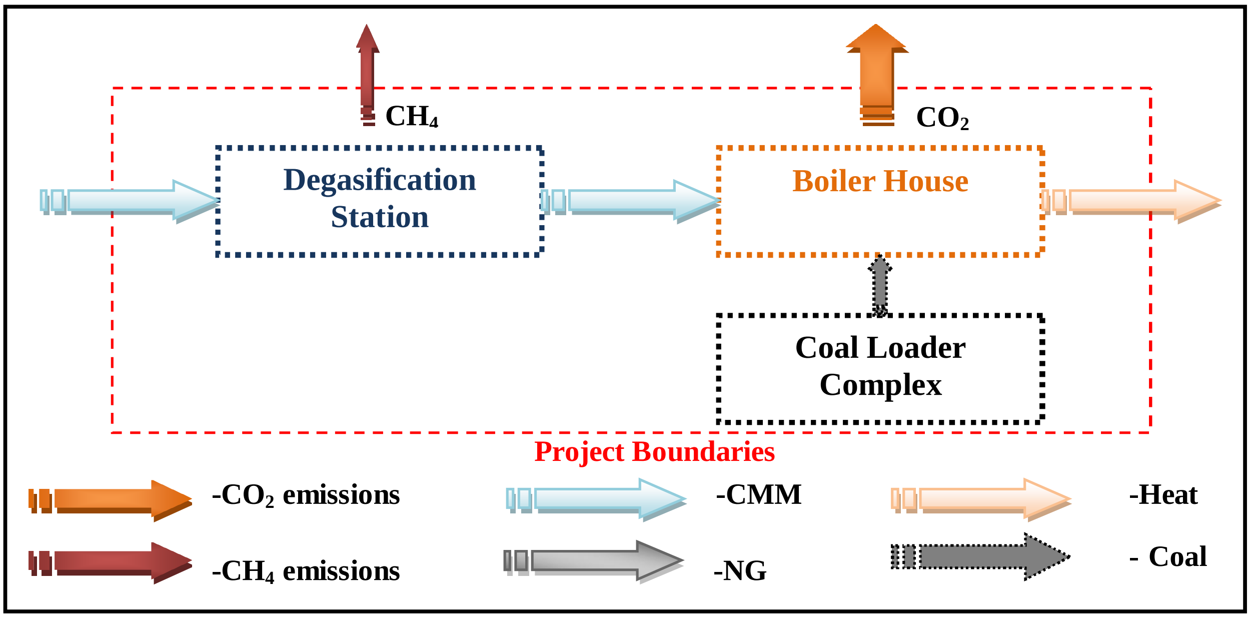
Leakage
Potential leakages associated with consumption of coal (fugitive methane emissions during coal mining) are estimated[24] to be 25,67 m^3 CH_4/t of coal, which results in emissions of maximum of 502 t CO_2e a year (as in 2009 with maximum coal consumption). As it is less than 1% of difference between baseline and project emissions, or 2000 t of CO_2e. They were considered negligible in accordance with paragraph 18 of Guidance on Criteria for Baseline Setting and Monitoring, Version 03.

Fig. 7. Baseline scenario boundary.



[24] Default value. National Inventory Report of Ukraine, 1990-2009, p. 90

Fig.8. Project scenario boundary.



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 baseline setting: 15/10/2010.

Name of person/entity setting the baseline:

Anna Vilde
Phone: +38 050 410 25 98
E-mail: vilde@global-carbon.com

Global Carbon BV Contact information is in the Annex 1.

Anna Vilde is not a project participant. Global Carbon BV is a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project: 06/06/2001. Date of approval of the project documentation by the Makeevka SSI of Health and Safety in Mining.

C.2. Expected operational lifetime of the project:

The project will last as long as the Mine is operated, thus at least until 2025[25]. Therefore, operational lifetime of the project is 22 years or 264 month.

C.3. Length of the crediting period:

Start of crediting period: 01/01/2008
End of the crediting period: 31/12/2025

Length of the period before the first commitment period of the Kyoto Protocol: 4 years or 48 months (01/01/2004-31/12/2007).

Length of the part of crediting period within the first commitment period of the Kyoto Protocol: 5 years or 60 months (01/01/2008-31/12/2012).

Length of the part of crediting period after the first commitment period of the Kyoto Protocol: 13 years or 156 months (01/01/2012-31/12/2025).

The status of emission reductions or enhancements of net removals generated by JI projects before the beginning or after the end of the first commitment period of the Kyoto Protocol may be determined by any relevant agreement under the UNFCCC.

[25] Precise date of operation shut down is not available and will become apparent on monitoring stage. It is assumed that operations will last till the end of 2025.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

JI specific approach is used for monitoring in accordance with paragraph 9 (a) of the Guidance on criteria for baseline setting and monitoring.

Step-wise approach is used to describe the monitoring plan:

Step 1. Indication and description of the approach chosen regarding monitoring
Option *a* provided by the Guidelines for the Users of the Joint Implementation Project Design Document Form, Version 04 is applied: JI specific approach is used for the monitoring plan.

In accordance with the approach chosen baseline emissions will be calculated based on project level of CMM utilization and relevant emission factor.
The best practice for JI project monitoring should not influence (or minimally influence) common monitoring practice used in the Mine. Therefore, existing statistical documents (log books, etc.) will be used as a source of data. All metering devices used for metering the data, necessary for ER calculations, will be regularly checked and calibrated, if necessary, to provide sufficient level of certainty.
All data needed for ER calculation will be collected by the Mine and after that recalculated into the value of emission reduction by method described below.
If the main metering device fails, and there are no reserve metering devices available, the monitoring report will use indirect data and evidence, but only if their applicability (data and evidence) is justifiably proved. Likely, a conservative approach will be used.
The data monitored and required for calculation of the ERUs will be archived and kept for 2 years after the last transfer of ERUs.

Step 2. Application of the approach chosen

It is assumed that in the absence of the project the Mine would continue generating heat by natural gas combustion. CMM would be vented into the atmosphere.

Baseline emissions
The baseline scenario is continuation of CMM venting into the atmosphere and production of thermal energy by natural gas combustion. Emission sources in the baseline are:

- Emissions of methane as a result of venting;
- Emissions from combustion of natural gas for heat generation.

Project emissions

In the project scenario CMM is utilized in the boiler house to generate thermal energy, rest of CMM is vented. Emission sources in the project scenario:

- Emissions from destruction of methane in the project;
- Emissions of uncombusted methane in the project;
- Emissions from coal combustion (as a reserve fuel).

Data and parameters that are not monitored, but remain fixed once determined during PDD development, are provided in the table below:

Table 19. List of constants used in the calculations of baseline and project emissions.

Data / Parameter	*Data unit*	*Description*	*Data Source*	*Value*
EF_{CH4}	tCO_2/tCH_4	CO_2 emission factor for CMM combustion	M_{CO2}/M_{CH4} = 44/16 = 2.75 tCO_2/tCH_4	2.7500
EF_{NG}	tCO_2/GJ	CO_2 emission factor of natural gas combustion	Default value. IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4 The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/ GJ: 56100 kg CO_2/TJ = 0.0561 tCO_2/GJ	0.0561
EF_{CC}	tCO_2/GJ	CO_2 emission factor of coal (anthracite) combustion	Default value for anthracite. IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4 The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/ GJ: 98300 kg CO_2/TJ = 0.0983 tCO_2/GJ	0.0983
GWP_{CH4}	tCO_2e/tCH_4	Global Warming Potential (GWP) of methane	Default value. IPCC Fourth Evaluation Report, RG1, Section 2, Table 2.14, 2007 (hereinafter - IPCC 2007) http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14	21.0000
η	fraction	Average net energy efficiency of heat generation boiler	Default value according to "Tool to determine the baseline efficiency of thermal or electric energy generation systems"	0.8700
Eff_{HEAT}	fraction	Efficiency of methane destruction/oxidation in heat plant	Default value. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Table 1.6, p. 1.29. http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref2.pdf	0.9950

NCV_{CH4}	GJ/thousand m^3	Net calorific value of methane	Default value, Grigoriev, Zorin "Theoretical Basics of Thermal Engineering", Volume 2, Table 7.7, p. 367, Moscow, 1988	35.8200
NCV_{coal}	GJ/t	Net calorific value of coal	Default value. National Inventory Report of Ukraine, 1990-2009, p. 399	21.8000
ρ_{CH4}	t/thousand m^3	Density of methane (t=293.15 K; p=101.325 kPa)	Default value, Gases – Densities http://www.engineeringtoolbox.com/gas-density-d_158.html The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to t/thousand m^3: 0.668 kg/m^3= 0.668 t/thousand m^3	0.6680
$OXID_{coal}$	fraction	Coal Oxidation Factor	Default value. National Inventory Report of Ukraine 1990-2009, p. 381 (rounded value)	0.9600

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

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1 $FC_{CMM,y}$	CMM sent to the boilers	Flow meters	thousand m^3	(m) and (c)	daily	100%	Electronic and paper	See Annex 3
P-2 $FC_{coal,y}$	Coal consumption by boiler	Measuring bunker	t	(m) and (c)	Upon request for coal from Mine's boiler house	100%	Electronic and paper	See Annex 3

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

Results of the emissions calculations will be presented in metric tons of carbon dioxide equivalent (tCO_2e), 1 metric ton of carbon dioxide equivalent is equal to 1 metric ton of carbon dioxide (tCO_2), i.e. 1 tCO_2e = 1 tCO_2.
Project emissions are calculated using the following formulae:

(D.1.1) $$PE_y = PE_{MD,y} + PE_{UM,y} + PE_{CC,y},$$

where

PE_y is the GHG emissions due to the project in period y, tCO_2e.
$PE_{MD,y}$ is the GHG emissions due to methane destruction in period y, tCO_2e.
$PE_{UM,y}$ is the GHG emissions of uncombusted methane in period y, tCO_2e.
$PE_{CC,y}$ is the GHG emissions due to coal combustion in period y, tCO_2e.

(D.1.2) $$PE_{MD,y} = (FC_{CMM,y} - FC_{CMM,y} \times (1 - Eff_{HEAT})) \times \rho_{CH4} \times EF_{CH4},$$

where

$PE_{MD,y}$ is the GHG emissions due to methane destruction in period y, tCO_2e.
$FC_{CMM,y}$ is methane sent to boilers in period y, thousand m^3 [Parameter P-1 in Table D.1.1.1.];
ρ_{CH4} is density of methane, t/thousand m^3 (See Table 19);
EF_{CH4} is the CO_2 emission factor for methane combustion, tCO_2 /tCH_4 (See Table 19);
Eff_{HEAT} is efficiency of methane destruction/oxidation in heat plant, fraction (See Table 19).

(D.1.3) $$PE_{UM,y} = FC_{CMM,y} \times (1 - Eff_{HEAT}) \times \rho_{CH4} \times GWP_{CH4},$$

where

$PE_{UM,y}$ is the GHG emissions of uncombusted methane in period y, tCO_2e.
$FC_{CMM,y}$ is methane sent to boilers in period y, thousand m^3 [Parameter P-1 in Table D.1.1.1.];
Eff_{HEAT} is efficiency of methane destruction/oxidation in heat plant, fraction (See Table 19);

ρ_{CH4} is density of methane, t/thousand m^3 (See Table 19);

GWP_{CH4} is the global warming potential of methane, tCO_2e/tCH_4 (See Table 19).

(D.1.4) $$PE_{CC,y} = FC_{coal,y} \times NCV_{coal} \times EF_{CC},$$

where

$PE_{CC,y}$ is the GHG emissions due to coal combustion in period y, tCO_2e.

$FC_{coal,y}$ is coal combustion by the boiler in period y, t [Parameter P-2 in Table D.1.1.1.];

NCV_{coal} is net calorific value of coal, GJ/t (See Table 19);

EF_{CC} is the CO_2 emission factor of coal (anthracite) combustion, tCO_2/GJ (See Table 19) .

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:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B-1 $FC_{CMM,y}$	CMM sent to the boilers	Flow meters	thousand m^3	(m) and (c)	daily	100%	Electronic and paper	See Annex 3
B-2 $FC_{coal,y}$	Coal consumption by boiler	Measuring bunker	t	(m) and (c)	Upon request for coal from Mine's boiler house	100%	Electronic and paper	See Annex 3

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

The project baseline is production of heat by combustion of natural gas. No steps for CMM utilization are undertaken. The methane is freely released into the atmosphere.

Respectively, the main source of GHG emission under the baseline scenario is production of heat through combustion of natural gas and coalmine methane release.
Results of the emissions calculations will be presented in metric tons of carbon dioxide equivalent (tCO_2e), 1 metric ton of carbon dioxide equivalent is equal to 1 metric ton of carbon dioxide (tCO_2), i.e. 1 tCO_2e = 1 tCO_2.
The baseline GHG emissions are calculated using the following equation:

(D.2.1) $$\boldsymbol{BEy = BE_{CMM,y} + BE_{HG,y},}$$

where

BE_y is the baseline GHG emissionsin the period *y*, tCO_2e;

$BE_{CMM,y}$ is the GHG emissions due to release of coalmine methane into the atmosphere in baseline scenarioin the period *y*, tCO_2e;

$BE_{HG,y}$ is the GHG emissions due to natural gas combustion for heat generation in baseline scenarioin the period *y*, tCO_2e.

(D.2.2) $$\boldsymbol{BE_{CMM,y} = FC_{CMM,y} \times \rho_{CH4} \times GWP_{CH4},}$$

where

$BE_{CMM,y}$ is the GHG emissions due to methane release into the atmosphere which would happen in the absence of the project during the period *y*, tCO_2e;

$FC_{CMM,y}$ is CMM send to the boilers in period *y*, thousand m^3 [Parameter B-1 in Table D.1.1.3.];

ρ_{CH4} is density of methane, t/thousand m^3(See Table 19);

GWP_{CH4} is the global warming potential of methane t CO_2e/tCH_4 (See Table 19).

(D.2.3) $$\boldsymbol{BE_{HG,y} = (HG_{CMM,y} + HG_{coal,y}) \times EF_{NG}},$$

where

$BE_{HG,y}$	is the GHG emissions due to natural gas combustion for heat generation in baseline scenarioin period *y*, tCO_2e.
$HG_{CMM,y}$	is the amount of heat produced from coalmine methane combustion in the project scenario that would otherwise have been produced by natural gas combustion in period *y*, GJ;
$HG_{coal,y}$	is the amount of heat produced by coal combustion that would otherwise have been produced by natural gas combustion in the baseline scenario, GJ;
EF_{NG}	is the CO_2 emission factor for natural gas combustion, t CO_2/GJ (See Table 19).

The heat produced from coalmine methane combustion, which in the absence of the project activity would have been generated by burning of natural gas, is calculated using the following formula:

(D.2.4) $$\boldsymbol{HG_{CMM,y} = (FC_{CMM,y} - FC_{CMM,y} \times (1 - Eff_{HEAT})) \times NCV_{CH4} \times \eta},$$

where

$HG_{CMM,y}$	is the amount of heat produced from coalmine methane combustion in the project scenario that would otherwise have been produced by natural gas combustion in period *y*, GJ;
$FC_{CMM,y}$	is CMM send to the boilers in period *y*, thousand m^3 CH_4 [Parameter B-1 in Table D.1.1.3.];
NCV_{CH4}	is the net calorific value of methane, GJ/ thousand m^3(See Table 19);
η	is the boiler efficiency factor, fraction (See Table 19).
Eff_{HEAT}	is efficiency of methane destruction/oxidation in heat plant, fraction (See Table 19).

(D.2.5) $HG_{coal,y} = FC_{coal,y} \times NCV_{coal} \times OXID_{coal} \times \eta$,

where

$HG_{coal,y}$	is the amount of heat produced from coal combustion that would otherwise have been produced by natural gas combustion in the baseline scenario, GJ;
$FC_{coal,y}$	is the amount of coal combusted in the period y, t;
NCV_{coal}	is the net calorific value of coal, GJ/ t (See Table 19);
η	is the boiler efficiency factor, fraction (See Table 19);.
$OXID_{coal}$	is coal oxidation factor, fraction (See Table 19).

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

Not applicable.

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

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

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

Not applicable.

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

Potential leakages associated with consumption of coal (fugitive methane emissions during coal mining) are estimated[26] to be 25,67 m^3/t , which results in emissions of maximum of 502 t CO_2e a year (as in 2009 with maximum coal consumption). As it is less than 1% of difference between baseline and project emissions, or 2000 t of CO_2e. They were considered negligible in accordance with paragraph 18 of Guidance on Criteria for Baseline Setting and Monitoring, Version 03.

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

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

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

Not applicable.

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

The general equation for calculating the project emissions reduction is the following:

$$\boldsymbol{ERy = BEy - PEy,}$$

where

ERy is the total emission reduction for the project in period *y*, tCO_2e;

[26] Default value. National Inventory Report of Ukraine, 1990-2009, p. 90

BEy is the total baseline GHG emissions in period y, tCO_2e;

PEy is the total project GHG emissions in period y, tCO_2e;

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:

Collection and archiving of the information on the environmental impacts of the project will be done in accordance with the Host Party legislation based on the approved EIA and received allowances for pollution. The following pollutants are continuously monitored at the Mine, the data is used for calculation of annual payment for pollution: ash, manganese, sodium hydrate, nitrogen dioxide, hydrogen sulphide, methane, anhydrite etc. It is archived according to the rules for accounting information storage: data is available for the latest three years minimum.

Quality control and quality assurance of measurements is ensured by complying with national legislation on calibration standards and quality norms of the measuring equipment used for the monitoring of GHG emission reductions due to the project. Under requirements of quality control system, regular maintenance and testing regime to ensure accuracy of flow meters, gas-analyzers, and heat measuring instruments will be provided. All the measuring instruments will be duly calibrated with calibration protocols provided to the independent accredited entity.

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

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
$FC_{CMM,y}$ *Table D.1.1.1. P-1* *Table D.1.1.3. B-1*	*medium*	The total quantity of CMM sent to the boilers will be calculated based on measured data of gas flow meter, concentration analyser and time of supply to boiler house at degasification station. See Annex 3 for more details. Each device used in monitoring is calibrated annually by external certified organization. Testing results and maintenance activities made are recorded in annual Technical reports.
$FC_{coal,y}$ *Table D.1.1.1. P-2* *Table D.1.1.3. B-2*	*medium*	The total quantity of coal sent to the boilers will be measured upon request for coal combustion by measuring bunker at boiler house. See Annex 3 for more details. Data are cross-checked between the Mine's divisions.

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

A clear management structure has been established to ensure accurate execution of the monitoring plan (see figure 9).

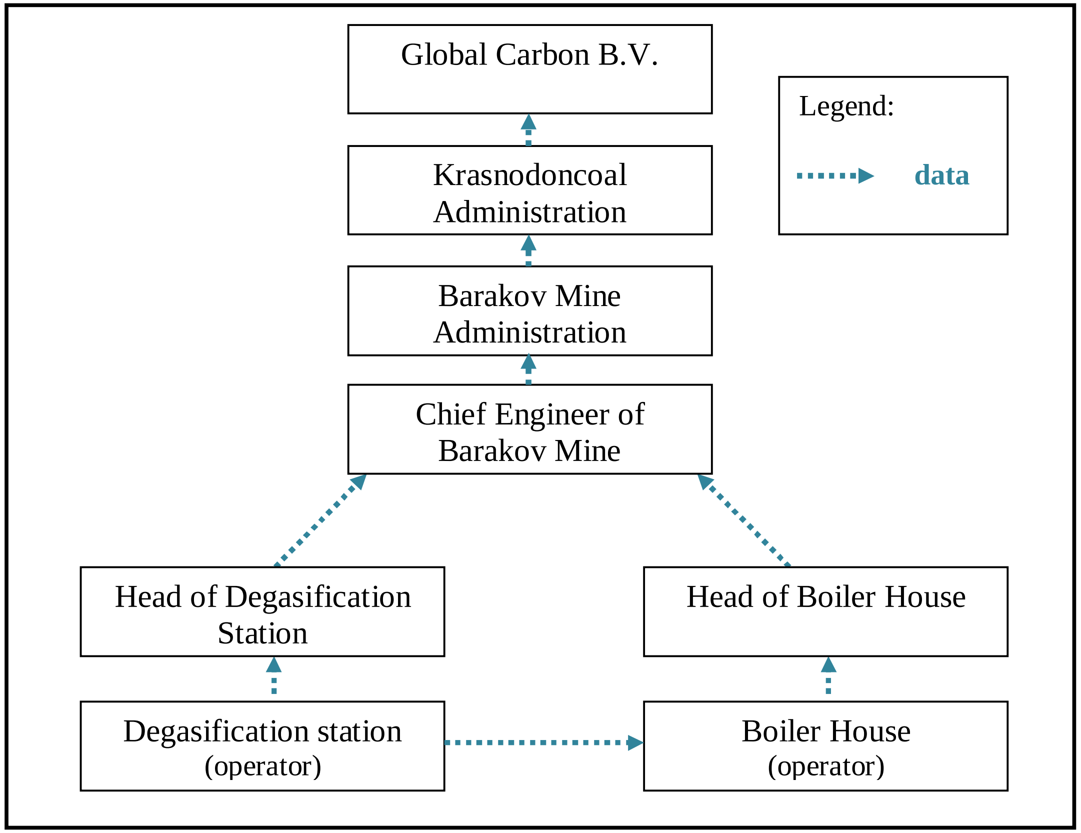


Fig.9 Monitoring and quality control system at Barakov Mine.

Data storage and responsibilities
All operators of the boilers are responsible for data administration. The relevant data will be recorded each two hours by filling in the special logs. Data are summed up into monthly and annual figures. Information is collected by Chief Engineer of the Coal Mine through supervising and coordinating activities of his subordinates, such as Head of degasification station, Head of boiler house.
The general supervision of the monitoring system will be executed by Krasnodoncoal Administration under the existing control and reporting system. All data will be stored for entire period till at least two years after the last transfer of ERU's. Calculations of GHG emission reductions will be performed by Global Carbon B.V.

Emergency operations
In case of breakdown of CMM supply system (either of whole system or separate feeding pipe) methane-air mixture will be urgently released into atmosphere through the emergency gas vent stack. The shut-off valves will automatically close CMM supply pipes to boiler house. In case of emergency in the boiler house the CMM supply there will be immediately termonated. Consequently, CMM consumption will not be measured due to the absence of CMM flow to the boiler house, therefore emission reductions will be earned for only the share of CMM which was actually utilized and flared.
The procedures to be followed if expected data are unavailable are as follows: in case of absence of the flow meters due to their calibration or repair the average readings for the previous three days are to be recorded. The maximum acceptable period for the flow meter absence is 3 days.

Employees' qualification
The employees responsible for the boilers work and for the monitoring control were dully trained for working with CMM fuelled boilers.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:
Date of establishing the monitoring plan: 30/09/2011
Name of person/entity establishing the monitoring plan:

Anna Vilde
Phone: +38 050 410 25 98
E-mail: vilde@global-carbon.com

Global Carbon BV
Contact information is in the Annex 1.

Anna Vilde is not a project participant. Global Carbon BV is a project participant.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Table 20 Estimated project emissions during the part of the crediting period within the first commitment period

Parameter	Unit	2008	2009	2010	2011	2012	Total
Project emissions of CO_2 from methane destroyed	tCO_2e	9 385	6 895	8 986	9 630	9 630	**44 526**
Project emissions of CH_4 from uncombusted methane	tCO_2e	360	265	345	370	370	**1 710**
Project emissions of CO_2 from coal combustion	tCO_2e	1 440	2 866	0	0	0	**4 306**
Total Project emissions during the part of the crediting period within the first commitment period	tCO_2e	11 185	10 026	9 331	10 000	10 000	**50 542**

Table 21 Estimated project emissions for the part of the crediting period after the end of the first commitment period

Parameter	Unit	2013-2024	2025	Total
Project emissions of CO_2 from methane destroyed	tCO_2e	9 630	4 815	**120375**
Project emissions of CH_4 from uncombusted methane	tCO_2e	370	185	**4625**
Project emissions of CO_2 from coal combustion	tCO_2e	0	0	**0**
Total Project emissions for the part of the crediting period after the end of the first commitment period	tCO_2e	10 000	5 000	**125000**

Table 22 Estimated project emissions before the first commitment period

Parameter	Unit	2004	2005	2006	2007	Total
Project emissions of CO_2 from methane destroyed	tCO_2e	9 460	12 220	10 885	9 578	**42 143**
Project emissions of CH_4 from uncombusted methane	tCO_2e	363	469	418	368	**1 618**
Project emissions of CO_2 from coal combustion	tCO_2e	165	0	0	0	**165**
Total Project emissions before the first commitment period	tCO_2e	**9 988**	**12 689**	**11 303**	**9 946**	**43 926**

E.2. Estimated leakage:

No leakage is expected outside the project boundary.

Table 23 Estimated leakage during the part of the crediting period within the first commitment period

Parameter	Unit	2008	2009	2010	2011	2012	Total
Leakage during the part of the crediting period within the first commitment period	tCO_2e	0	0	0	0	0	**0**

Table 24 Estimated leakage for the part of the crediting period after the end of the first commitment period

Parameter	Unit	2013-2024	2025	Total
Leakage for the part of the crediting period after the end of the first commitment period	tCO_2e	0	0	**0**

Table 25 Estimated leakage before the first commitment period

Parameter	Unit	2004	2005	2006	2007	Total
Leakage before the first commitment period	tCO_2e	0	0	0	0	**0**

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

Table 26 Estimated total project emissions during the part of the crediting period within the first commitment period

Parameter	Unit	2008	2009	2010	2011	2012	Total
Total Project emissions during the part of the crediting period within the first commitment period	tCO_2e	**11 185**	**10 026**	**9 331**	**10 000**	**10 000**	**50 542**

Table 27 Estimated total project emissions for the part of the crediting period after the end of the first commitment period

Parameter	Unit	2013-2024	2025	Total
Total Project emissions for the part of the crediting period after the end of the first commitment period	tCO_2e	**10 000**	**5 000**	**125 000**

Table 28 Estimated total project emissions before the first commitment period

Parameter	Unit	2004	2005	2006	2007	Total
Total Project emissions before the first commitment period	tCO_2e	**9 988**	**12 689**	**11 303**	**9 946**	**43 926**

E.4. Estimated baseline emissions:

Table 29 Estimated baseline emissions during the part of the crediting period within the first commitment period

Parameter	Unit	2008	2009	2010	2011	2012	Total
Baseline emissions of CH_4 from release of methane into the atmosphere	tCO_2e	72 027	52 914	68 962	73 904	73 904	**341 711**
Baseline emissions of CO_2 from the production of heat replaced by the project activity	tCO_2e	9 753	8 197	8 552	9 164	9 164	**44 830**
Baseline emissions during the part of the crediting period within the first commitment period	tCO_2e	**81 780**	**61 111**	**77 514**	**83 068**	**83 068**	**386 541**

Table 30 Estimated baseline emissions for the part of the crediting period after the end of the first commitment period

Parameter	Unit	2013-2024	2025	Total
Baseline emissions of CH_4 from release of methane into the atmosphere	tCO_2e	73 904	36 952	**923 800**
Baseline emissions of CO_2 from the production of heat replaced by the project activity	tCO_2e	9 164	4 582	**114 550**
Baseline emissions for the part of the crediting period after the end of the first commitment period	tCO_2e	83 068	41 534	**1 038 350**

Table 31 Estimated baseline emissions before the first commitment period

Parameter	Unit	2004	2005	2006	2007	Total
Baseline emissions of CH_4 from release of methane into the atmosphere	tCO_2e	72 600	93 784	83 538	73 506	**323 428**
Baseline emissions of CO_2 from the production of heat replaced by the project activity	tCO_2e	9 097	11 630	10 359	9 115	**40 201**
Baseline emissions before the first commitment period	tCO_2e	**81 697**	**105 414**	**93 897**	**82 621**	**363 629**

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

Table 32 Estimated emission reductions during the part of the crediting period within the first commitment period

Parameter	Unit	2008	2009	2010	2011	2012	Total
Emission reductions during the part of the crediting period within the first commitment period	tCO_2e	**70 595**	**51 085**	**68 183**	**73 068**	**73 068**	**335 999**

Table 33 Estimated emission reductions for the part of the crediting period after the end of the first commitment period

Parameter	Unit	2013-2024	2025	Total
Emission reductions for the part of the crediting period after the end of the first commitment period	tCO_2e	**73 068**	**36 534**	**913 350**

Table 34 Estimated emission reductions before the first commitment period

Parameter	Unit	2004	2005	2006	2007	Total
Emission reductions before the first commitment period	tCO_2e	**71 709**	**92 725**	**82 594**	**72 675**	**319 703**

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

The result of the application of the formulae above shall be indicated using the following tabular format.

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2004	9 988	0	81 697	71 709
Year 2005	12 689	0	105 414	92 725
Year 2006	11 303	0	93 897	82 594
Year 2007	9 946	0	82 621	72 675
Total (tonnes of CO_2 equivalent)	**43 926**	**0**	**363 629**	**319 703**

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2008	11 185	0	81 780	70 595
Year 2009	10 026	0	61 111	51 085
Year 2010	9 331	0	77 514	68 183
Year 2011	10 000	0	83 068	73 068
Year 2012	10 000	0	83 068	73 068
Total (tonnes of CO_2 equivalent)	**50 542**	**0**	**386 541**	**335 999**

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2013	10 000	0	83 068	73 068
Year 2014	10 000	0	83 068	73 068
Year 2015	10 000	0	83 068	73 068
Year 2016	10 000	0	83 068	73 068
Year 2017	10 000	0	83 068	73 068
Year 2018	10 000	0	83 068	73 068
Year 2019	10 000	0	83 068	73 068
Year 2020	10 000	0	83 068	73 068
Year 2021	10 000	0	83 068	73 068
Year 2022	10 000	0	83 068	73 068
Year 2023	10 000	0	83 068	73 068
Year 2024	10 000	0	83 068	73 068
Year 2025	5 000	0	41 534	36 534
Total (tonnes of CO_2 equivalent)	**125 000**	**0**	**1 038 350**	**913 350**

SECTION F. Environmental impacts

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

Environmental impact assessment of the project was undertaken as a part of "Revision of the Project for K_d^5Coal Bad Baring and Exploitation in Lying Wing of Duvannyy Thrust Fault" which explored the developments necessary for the operation of the Mine. All the necessary permissions were obtained before the beginning of the project in compliance with the existing Ukrainian legislation, namely: the Laws of Ukraine "On Protection of Environment", "On Ecological Expertise", "On Protection of Atmospheric Air", "On Ensuring Sanitary and Epidemic Welfare of the Population", and "On Local Councils and Local Government", as well as the applicable Water Code, Land Code, and Forest Code. The project has received a positive conclusion of State Integrated Expertise, which includes expertise of fire safety, health and safety, sanitary and hygiene impacts, energy efficiency and environmental impact.

Compared to the baseline scenario the level of negative environmental impact is much lower. According to EIA section of "Revision of the Project for K_d^5 Coal Bad Baring and Exploitation in Lying Wing of Duvannyy Thrust Fault" the execution of the project reduces emissions of methane by up to 100%, emissions of carbon oxide and suspended solid particles by 75%. This is also important in terms of transboundary effects of the project because Barakov Mine is located just 16 km away from Ukrainian border with Russia. Thus, reduction of air pollution achieved by the project also has positive transboundary impact. Main environmental impacts of the project are caused by exhaust gases emitted by boilers (CO_2, CO, NO_x etc). These gases are annually monitored and reported through official annual statistical form 2-tp (air) *Data on protection of atmospheric air*. Emissions of these gases are within the permitted levels.

Project location is not within natural reserve territory; there were no any fauna and flora species mentioned on Red Lists were detected on the area of the project location. The project is physically limited by the territory of Barakov Mine and does not require any additional land.

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

Overall, the project is environmentally beneficial as it causes less pollution than in case of realisation of the baseline scenario.

SECTION G. Stakeholders' comments

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

According to the Host Party's legislation, in particular the applicable Resolution of Cabinet of Ministers of Ukraine No. 1308 from 17th of August 1998, amended in 2000 and 2002, "Procedures for approval of investment programs, construction projects and for their integrated assessment"[27] no stakeholder consultations were required for development and approval of the CMM utilization project.
Stakeholder comments of the proposed JI project are to be collected during the determination process of the proposed JI project.

[27] Resolution of Cabinet of Ministers of Ukraine No. 1308 from 17th of August 1998 "Procedures for approval of investment programs, construction projects and for their integrated assessment" http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1308-98-%EF (available in Ukrainian)

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	PJSC "Krasnodon Coal Company"
Street/P.O.Box:	Komsomolska str.
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City:	Krasnodon
State/Region:	Luhansk oblast
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Fax:	+38 (06435) 65146
E-mail:	
URL:	http://www.krasnodoncoal.com/ua/
EDRPOU code:	32363486
KVED types of economic activities:	10.10.1 Coal mining and coal washing 51.51.0 Fuel wholesale 51.39.0 Multiple product food, drinks and smokables wholesale 51.90.0 Other types of wholesale trading 92.40.0 Activity of informational agencies 45.21.5 Construction of facilities for energy, mining and manufacturing industries.
Represented by:	
Title:	Acting General Director
Salutation:	Mr.
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Middle name:	Anatoliyovych
First name:	Olexandr
Department:	
Phone (direct):	+38 (06435) 65415
Fax (direct):	+38 (06435) 65146
Mobile:	
Personal e-mail:	Aleksandr.Angelovskii@krasnodoncoal.com

Organisation:	Global Carbon B.V. (registration date 30/08/2004)
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Phone:	+31 30 2982310
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Represented by:	
Title:	Managing Director
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Annex 2

BASELINE INFORMATION

In order to calculate baseline emissions of the project a JI specific approach was used in accordance with the JI Guidance on Criteria for Baseline Setting and Monitoring, Version 03. No approved CDM methodology was applied.

As shown in Section B.1. above, the most plausible baseline scenario is natural gas combustion for heat generation and venting CMM into the atmosphere.
Results of the emissions calculations are presented in metric tons of carbon dioxide equivalent (tCO_2e), 1 metric ton of carbon dioxide equivalent is equal to 1 metric ton of carbon dioxide (tCO_2), i.e. 1 tCO_2e =1 tCO_2. Baseline emissions are calculated using the following formulae:

1. $BE_y = BE_{CMM,y} + BE_{HG,y}$,

where

BE_y is the baseline GHG emissions in year y, tCO_2e;

$BE_{CMM,y}$ is the GHG emissions due to release of coalmine methane into the atmosphere in baseline scenario in year y, tCO_2e;

$BE_{HG,y}$ is the GHG emissions due to natural gas combustion for heat generation in baseline scenario in year y, tCO_2e.

In its turn, the baseline emissions due to release of coalmine methane into the atmosphere is calculated using the following equation:

2. $BE_{CMM,y} = FC_{CMM,y} \times \rho_{CH4} \times GWP_{CH4}$,

where

$BE_{CMM,y}$ is the GHG emissions due to release of coalmine methane into the atmosphere in baseline scenario in the year y, tCO_2e;

$FC_{CMM,y}$ is the amount of coalmine methane sent to the boilers in the year y, thousand m^3;

ρ_{CH4} is density of methane, t/thousand m^3.

GWP_{CH4} is a global warming potential of methane, tCO_2e/tCH_4.

3. $BE_{HG,y} = (HG_{CMM,y} + HG_{coal,y}) \times EF_{NG}$,

where

$BE_{HG,y}$ is the GHG emissions due to natural gas combustion for heat generation in baseline scenario in year y, tCO_2e.

$HG_{CMM,y}$ is the amount of heat produced from coalmine methane combustion that would otherwise have been produced by natural gas combustion in the baseline scenario in the year y, GJ;

$HG_{coal,y}$ is the amount of heat produced from coal combustion that would otherwise have been produced by natural gas combustion in the baseline scenario in the year y, GJ;

EF_{NG} is the CO_2 emission factor for natural gas combustion, tCO_2/GJ.

4. $HG_{CMM,y} = (FC_{CMM,y} - FC_{CMM,y} \times (1 - Eff_{HEAT})) \times NCV_{CH4} \times \eta$,

where

$HG_{CMM,y}$	is the amount of heat produced from CMM combustion that would otherwise have been produced by natural gas combustion in the baseline scenario in the year y, GJ;
$FC_{CMM,y}$	is the amount of CMM sent to the boilers in the year y, thousand m^3;
NCV_{CH4}	is the net calorific value of methane, GJ/ thousand m^3;
η	is the boiler efficiency factor, fraction.
Eff_{HEAT}	is efficiency of methane destruction/oxidation in heat plant, fraction.

5. $HG_{coal,y} = FC_{coal,y} \times NCV_{coal} \times OXID_{coal} \times \eta$,

where

$HG_{coal,y}$	is the amount of heat produced from coal combustion that would otherwise have been produced by natural gas combustion in the baseline scenario in the year y, GJ;
$FC_{coal,y}$	is the amount of coal combusted in the year y, t;
NCV_{coal}	is the net calorific value of coal, GJ/t;
η	is the boiler efficiency factor, fraction.
$OXID_{coal}$	is coal oxidation factor, fraction.

The actual data of post-project coalmine methane utilization in 2003-2009 have been used for calculations. The arithmetic average for 2003-2008 was used for 2010-2012 projection. The data for 2009 were not representative because of high consumption of reserve coal which was due to low volumes of CMM available because of the beginning of new coal bed exploration.

Uncertainties and safeguarding conservativeness

The main baseline emission source is release of methane into the atmosphere (90% of emissions of CO_2e) with the rest of emissions resulted from baseline production of heat energy. The key parameter for calculation of emission reductions is quantity of methane which was to be vented, but instead was utilized in the boiler house for heat generation under the project scenario.

Because there is no adjustment to standard temperature and pressure during CMM measurement by the flow meter, quantity of CMM at working conditions was used for emission reduction calculations. Conservativeness of such approach was checked by calculating the volume of CMM at standard conditions by applying ideal gas law and using data obtained at working conditions measured by the Mine. The result was the following:

Table 35.Comparison of CMM volume combusted in boilers at WTP and STP.

	Quantity of CMM combusted in boilers (WTP; (t=305.15 K; p= 110.932 kPa)), 1000 m^3 (measured)	Quantity of CMM combusted in boilers (STP; (t=293.15 K; p= 101.325 kPa)), 1000 m^3 (calculated)
2004	5175	5443
2005	6685	7032
2006	5955	6263
2007	5240	5511
2008	5134	5400
2009	3772	3967
2010	4916	5170

It is clear, that volume of CMM combusted in boilers is higher at STP. However, it was decided to base calculations at measured values to maintain conservativeness and accuracy of the results.

It is also conservative to use efficiency of methane destruction/oxidation in heat plant for calculation. 2006 IPCC Guidelines assume 100% oxidation; however, it was decided to apply 1996 IPCC approach regarding the long period of time that the Mine's boilers have been in operation.

Uncertainty evaluation
Uncertainty was evaluated by calculating relative error of measurement of quantity of methane utilized in boiler house, which is a key parameter for baseline emissions calculation.

Daily quantity of methane utilized in boiler house is calculated by the following formula:

$$FC_{CMM} = (FR_{DG}/60 \times C_{CH4} \times T_{boilers})/1000,$$

where
FC_{CMM} is CMM send to the boilers, thousand m^3;
FR_{DG} is flow rate of degasified gases, m^3/hour;
C_{CH4} is CMM concentration in gases degasified, %;
$T_{boilers}$ is time of CMM supply to boiler house, minutes.

Relative error is a ratio between absolute error and average value of series of measurements.
Absolute error was calculated by the law of propagation of uncertainties:

$$U_{FC} = \sqrt{{U_{FR}}^2 + {U_C}^2 + {U_T}^2},$$

where
U_{FC} is absolute error of FC_{CMM};
U_{FR} is absolute error of FR_{DG};
U_C is absolute error of C_{CH4};
U_T is absolute error of $T_{boilers}$.

Absolute error of each component is determined as

$$U = \sqrt{{U_S}^2 + {U_R}^2},$$

where
U is absolute error of a parameter;
U_S is standard error;
U_R is random error.

Standard error is reflected in accuracy class of the monitoring equipment and was taken from their specifications. It was assumed to be half of clock's division value for time measurement. Random error was calculated based on standard deviation of a randomly selected series of measurements multiplied by Student's ratio for confidence interval 95%.

As a result, the following values were obtained:

Relative error of measuring gas flow FR_{DG}	8%
Relative error of measuring methane concentration C_{CH4}	5%
Relative error of measuring time of CMM supply to boiler house $T_{boilers}$	1%
Combined relative error of FC_{CMM}	**10%**

Uncertainties have been taken into account by applying IPCC default emission factors which are calculated on conservative basis taking into account uncertainties and fall within 95% confidence interval.

Key information and data used to establish the baseline are provided below in tabular form:

Data/Parameter	$\boldsymbol{FC_{CMM,y}}$
Data unit	thousand m^3
Description	is the amount of CMM combusted in boiler house in period y
Time of determination/monitoring	Measured during project lifetime
Source of data (to be) used	Project owner records based on readings of the flow meter
Value of data applied (for ex ante calculations/determinations)	**2004**: 5 175; **2005**: 6 685; **2006**: 5 955; **2007**: 5 240; **2008**: 5 134; **2009**: 3 772; **2010**: 4 916
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine emissions of GHGs due to CMM venting and heat generation. Data are collected for technological purposes of the project owner. Daily value of CMM sent to boilers is obtained by the following formula based of recordings of gas flow meter and concentration analyser at degasification station of the Mine: $FC_{CMM} = (FR_{DG}/60 \times C_{CH4} \times T_{boilers})/1000$, where FC_{CMM} is CMM send to the boilers, thousand m^3; FR_{DG} is flow rate of degasified gases, m^3/hour; C_{CH4} is CMM concentration in gases degasified, %; $T_{boilers}$ is time of CMM supply to boiler house, minutes. Daily values are summed up to get monthly and annual values.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Mine and requirements of producer
Any comment	No

Data/Parameter	$\boldsymbol{FC_{coal,y}}$
Data unit	t
Description	is the quantity of coal combusted in boiler house in period y
Time of determination/monitoring	Measured during project lifetime
Source of data (to be) used	Project owner records based on measuring coal consumption by measuring bunker
Value of data applied (for ex ante calculations/determinations)	**2004**: 80; **2005**: 0; **2006**: 0; **2007**: 0; **2008**: 700; **2009**: 1 393; **2010**: 0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine emissions of GHG due to production of heat. Data are collected for technological purposes of the project owner. Monitoring of the coal consumption takes place at Coal Loader Complex. Coal is measured by the bunker above the boiler with known dimensions. The size of the bunker is 30 tonnes, it is filled with coal by transport line from Coal Loader Complex. Quantity of coal combusted is determined by the number of bunkers which were emptied. In case when some coal is left in bunker its mass is determined by the fraction of bunker volume that it fills.
QA/QC procedures (to be) applied	Data are cross-checked between the Mine's Divisions.

Any comment	No

Data/Parameter	NCV_{CH4}
Data unit	GJ/1000 m^3
Description	Net calorific value of methane
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Default value. Grigoriev, Zorin "Theoretical Basics of Thermal Engineering, Volume 2, Table 7.7, Moscow, 1988, p. 367
Value of data applied (for ex ante calculations/determinations)	35.82
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by CMM utilization at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	NCV_{coal}
Data unit	GJ/t
Description	Net calorific value of coal
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report of Ukraine, 1990-2009, Table P2.30 p. 399
Value of data applied (for ex ante calculations/determinations)	21.8
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by coal combustion at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	η
Data unit	fraction
Description	Baseline efficiency of natural gas fired boiler
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	CDM "Tool to determine the baseline efficiency of thermal or electric energy generation systems" http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf
Value of data applied (for ex ante calculations/determinations)	0.87

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy which in baseline would be produced by natural gas combustion.
QA/QC procedures (to be) applied	Default factor established according to CDM rules and procedures
Any comment	No

Data/Parameter	Eff_{HEAT}
Data unit	fraction
Description	Efficiency of methane destruction/oxidation in heat plant
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Table 1.6, p. 1.29. http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref2.pdf
Value of data applied (for ex ante calculations/determinations)	0.995
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy which in baseline would be produced by natural gas combustion.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	$OXID_{coal}$
Data unit	fraction
Description	Coal oxidation factor
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report of Ukraine 1990-2009, p. 381 (rounded value)
Value of data applied (for ex ante calculations/determinations)	0.96
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the amount of thermal energy generated by coal combustion at the Mine's boiler house.
QA/QC procedures (to be) applied	-
Any comment	No

Data/Parameter	ρ
Data unit	t/thousand m^3
Description	Density of methane
Time of determination/monitoring	Fixed ex ante

Source of data (to be) used	Default data, http://www.engineeringtoolbox.com/gas-density-d_158.html
Value of data applied (for ex ante calculations/determinations)	0.668
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to determine the mass of utilized CMM.
QA/QC procedures (to be) applied	-
Any comment	Value at conditions: t=293.15 K; p= 101.325 kPa. The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to t/thousand m^3: 0.668 kg/m^3= 0.668 t/thousand m^3

Data/Parameter	EF_{NG}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor for combusted natural gas
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4
Value of data applied (for ex ante calculations/determinations)	0.0561
Justification of the choice of data or description of measurement methods and procedures (to be) applied	IPCC value has to be used as a default.
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/GJ: 56100 kg CO_2/TJ = 0.0561 tCO_2/GJ

Data/Parameter	EF_{CC}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor of coal (anthracite) combustion
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Value for anthracite. IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2: Energy, Chapter 1, p. 1.23, Table 1.4
Value of data applied (for ex ante calculations/determinations)	0.0983
Justification of the choice of data or description of measurement	IPCC value is used as a default.

methods and procedures (to be) applied	
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2/GJ: 98300 kg CO_2/TJ = 0.0983 tCO_2/GJ

Data/Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global warming potential of methane
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	IPCC Fourth Evaluation Report, WG1, Section 2, Table 2.14, 2007 http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14
Value of data applied (for ex ante calculations/determinations)	21
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Reference data. This is the key parameter to calculate emissions of CO_2e due to CMM venting into the atmosphere
QA/QC procedures (to be) applied	-
Any comment	No

Annex 3

MONITORING PLAN

JI specific approach is used for monitoring in accordance with paragraph 9 (a) of the Guidance on criteria for baseline setting and monitoring.
Key elements for the monitoring plan are the following:

Data/Parameter	**CMM sent to the boilers** $FC_{CMM,y}$
Data unit	thousand m^3
Source of data (to be) used	Registration log book
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Daily value of CMM sent to boilers is obtained by the following formula based of recordings of gas flow meter and concentration analyser at degasification station of the Mine: $FC_{CMM} = (FR_{DG}/60 \times C_{CH4} \times T_{boilers})/1000$, where FC_{CMM} is CMM send to the boilers, thousand m^3; FR_{DG} is flow rate of degasified gases, m^3/hour; C_{CH4} is CMM concentration in gases degasified, %; $T_{boilers}$ is time of CMM supply to boiler house, minutes. Daily values are summed up to get monthly and annual values. Monthly technical reports are to be prepared by the Mine and provided to Global Carbon B.V. for emission reductions calculation.
OA/QC procedures (to be) applied	The relevant metering devices will be calibrated according to the host Party's legislation and requirements of the supplier.

Data/Parameter	**Coal combustion by the boiler** $FC_{coal,y}$
Data unit	t
Source of data (to be) used	Registration log book
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Monitoring of the coal consumption takes place at Coal Loader Complex. Coal is measured by the bunker above the boiler with known dimensions. The size of the bunker is 30 tonnes, it is filled with coal by transport line from Coal Loader Complex. Quantity of coal combusted is determined by the number of bunkers which were emptied. In case when some coal is left in bunker its mass is determined by the fraction of bunker volume that it fills.
OA/QC procedures (to be) applied	Coal consumption is registered in log books at Boiler House and Coal Loader Complex which are cross checked.