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 A.F. Zasyadko".

PDD version 4.0, dated 2 February 2007

A.2. Description of the project:

Gassy underground coal mines are designed and operated in such way that methane liberated during the extraction of coal is removed from the mine through powerful ventilation fans which are part of a system that ensure safe working conditions in the mine. For particularly gassy mines, operators may employ additional methane drainage systems to supplement their ventilation systems in order to maintain a safe working environment. Gas may be recovered and pumped to the surface in the process of removing gas via an underground drainage system; but utilization of recovered methane is not currently an important operational practice at underground coal mines. As usual Coal Mine Methane (CMM) produced from drainage systems also has very limited commercial application, and as a result is released to the atmosphere.

The purpose of this project is the avoidance of methane emissions into the atmosphere at Leasing Company "the Coal Mine named after A.F. Zasyadko", further referred to the Zasyadko mine or simply the mine. Coal Mine Methane, drained and recovered in the operating mine works and from mine ventilation works, as well as methane produced by surface wells at Zasyadko Mine, will be **used to (i) produce electricity** for mine works and the surplus will be fed into the public grid thus reducing and avoiding methane emissions in the atmosphere; **(ii) replace heat** currently produced by coal- and gas-fired boilers, including municipal boilers; and **(iii) produce gas** for use as vehicle fuel[1].

CMM fired combined heat and power modules or CHPs will supply electricity to the mine and provide the surplus to the public grid. Heat recovery systems will provide heat to the Mine and municipal boilers. The existing on-site heat-only boilers will be closed down whereas the municipal boiler houses will operate at a lower level. A description of the names of involved municipal boiler houses is specified in Annex 2.

Furthermore five automotive double-block gas filling stations will provide fuel to the Mine's truck fleet.

[1] The fourth element comprises the supply of CMM to the natural gas grid for off-site usage for electricity and/or heat generation. This project will be developed in a later stage and will be presented in a separate PDD.

A.3. Project participants:

Please list project participants and Parties involved and provide contact information in annex 1. Information shall be indicated using the following tabular format.		
Party involved	Legal entity project participant (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	Lease company "the Mine named after A.F. Zasyadko"	No
Japan	MARUBENI CORPORATION	No
Switzerland	VEMA S.A.	No
Netherlands	Global Carbon B.V.	No

Table 1: Project participants

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is located in Donetsk, the capital of Donetsk oblast (region). Donetsk is situated in the eastern part of Ukraine. Geographical location of the project is shown on the maps below.

A.4.1.1. Host Party(ies):

Ukraine.

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

Donetsk region.

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

Donetsk city.

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

The project is located at the Coal Mine named after A.F. Zasyadko. The mine consists of four sites being the Vostochnaya, Yakovlevskaya, Grigoryevskaya, and Centralnaya production sites of the coal mine. The project's measures will influence energy flows and emissions at all four sites plus the nearby municipal boilers. The coal mine is located in Kiev district of the city of Donetsk, the capital of Donetsk oblast. The locations of the Donetsk region as well as location of the Zasyadko coal mine are shown on the maps below.

Figure 1: Location of Donetsk

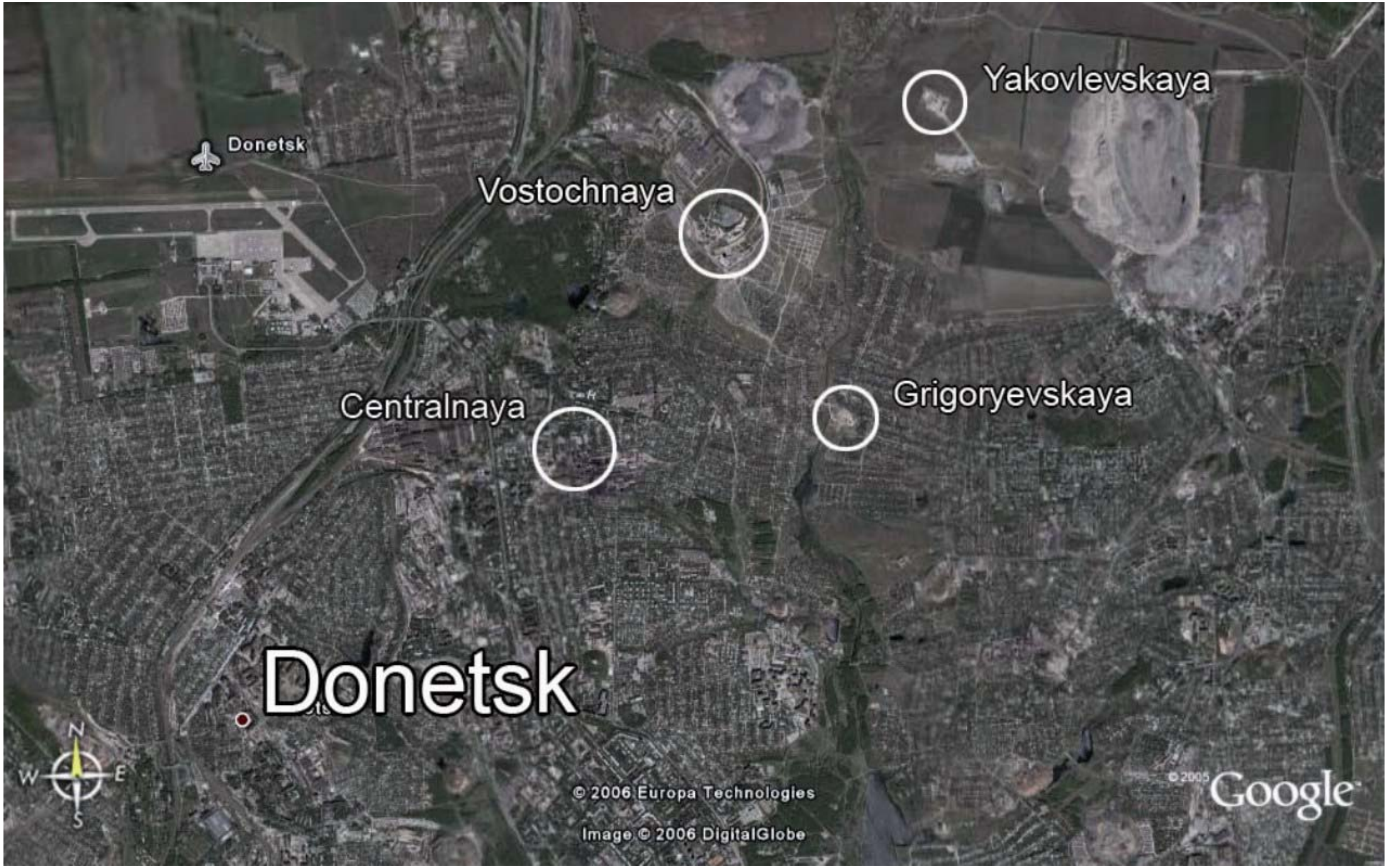

Figure 2: Location of the project (source Google Earth)

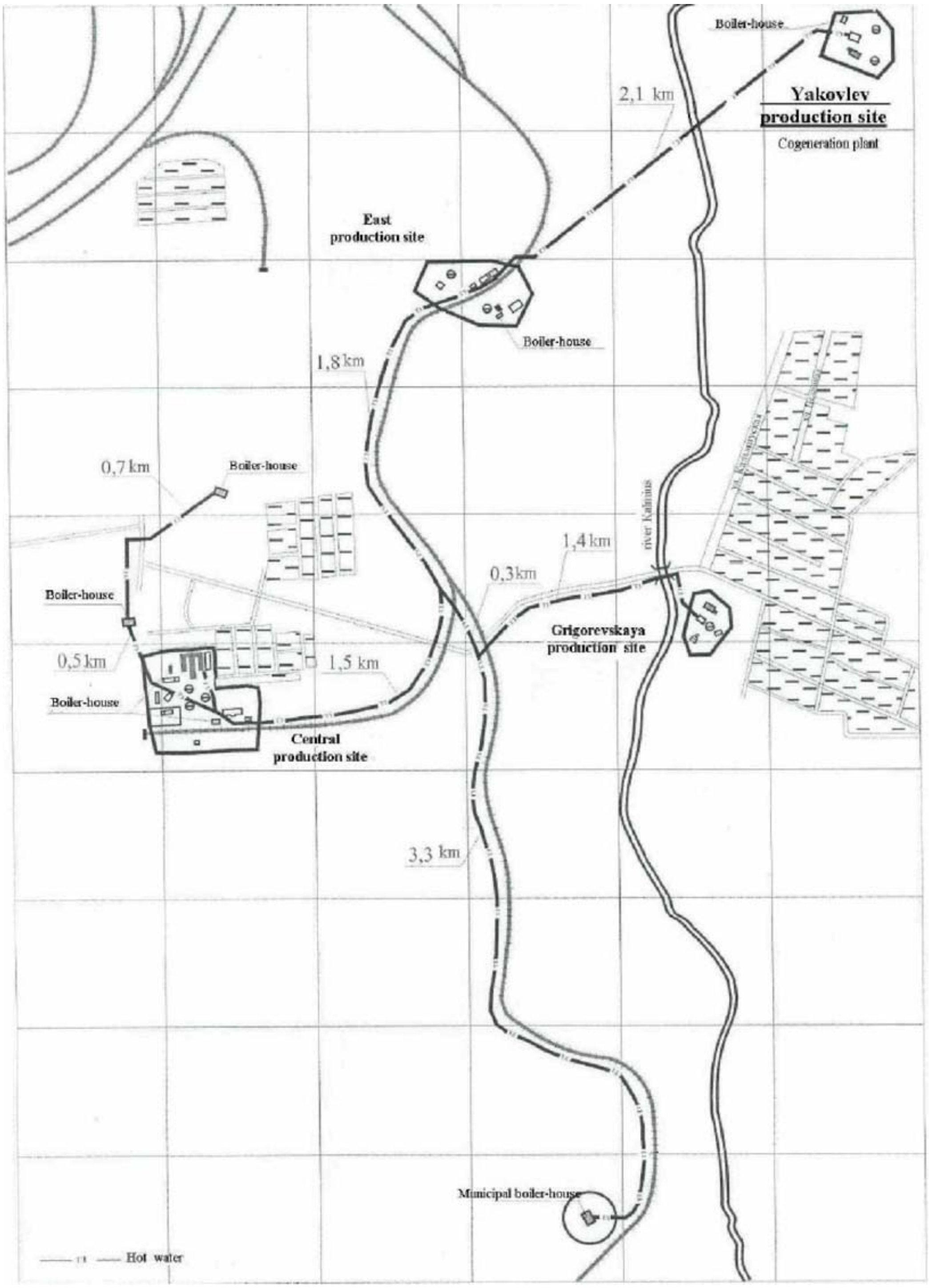

Figure 3: Zasyadko Coal Mine layout [2]

[2] Note that in the figure East production site means Vostochnaya production site

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

The Donetsk basin (Donbass) is the largest industrial region of Ukraine with coal, metallurgic and chemical industries. Donbass is one of the most hazardous regions of Ukraine in terms of environmental pollution. The main contributor of methane emissions to the atmosphere is the coal industry. Methane reserves in carboniferous deposits are estimated from 12 to 25 trillion m^3.

Every year, many millions of cubic meters of methane gas (CH_4) are released from the coal mines in Donbass. The methane, present in large quantities in the porous structure of coal, is released by degasification activities and ventilating air circulating in the mine and then discharged into atmosphere leading thus to global warming as methane is # 2 greenhouse gas regulated by the Kyoto Protocol.

The Zasyadko coal mine has been under development since 1958. Its mining allotment includes neighbouring territory of the cities Donetsk and Makeevka and Yasinovatskiy district of Donetsk oblast. Among nineteen coal seams bearing 125 mln tonnes of coking coals the mine is developing only four, i.e. m_3, l_4 l1 and k_8. The mine methane deposits contain about 18.9 bln. m^3 of gas. Annual coal production makes about 4 mln. tonnes.

A high methane content is among the key factors determining the complexity of coal recovery and its high production cost at the Zasyadko Coal Mine. The methane presence and the threat of methane-air mix explosion hamper the progress of the mining works and demand to increase safety working conditions of miners. Statistical survey of fatal accidences occurred in mines witnesses that the great majority of those relate directly to ignition and explosion of methane. The President of Ukraine and the Government preoccupied with concerns on providing safety for coal miners have issued several decrees to support and to regulate activities to be implemented:

- The Decree of the President of Ukraine as of 16th of January 2002 # 26/2002 "On urgent activities for improvement of work conditions and development of the state supervision at mining enterprises";
- The Governmental Decree as of 6th of July 2002 # 939 has approved the Complex Programme of coal-beds degasification at coal mines.

Both decrees focus on improving the safety of the mines, but do not require any utilization of the CMM. According to both decrees there is no necessity to neither flare nor utilize captured CMM.

Degasification activities

To comply with provisions of the Complex Programme, the Zasyadko Coal Mine is implementing its own degasification project that envisages drilling underground boreholes, introduction of vacuum pumping stations (VPS) at two production sites, namely Vostochnaya and Yakovlevskaya. As of 1st January 2007, the progress of the degasification project is as follows:

- 11 drilling machines are in operation;
- 42 km of Φ 630 mm and 530 mm degasification pipelines has been laid out;
- 7 km of underground degasification boreholes is being drilled monthly;
- 3 vacuum pumping stations are in operation: two at the Vostochnaya production site comprised of 6 each vacuum pumps (12 in total) and one at the Yakovlevskaya production site comprised of 9 vacuum pumps;
- daily methane captured flow rate is 150 m3/min.

Further development of degasification activity envisages the increase of methane drainage flow rate up to 500 m3/min by:

- increasing underground drilling up to 10-12 km per month (about 120 km per annum);
- laying down more 20 km of pipelines;
- commissioning of one vacuum pumping station at Grigoryevskaya production site consisting of 9 vacuum pumps with output capacity of 150 m3/min each;

- having 4 VPS in permanent operation;

It is also necessary to purchase two machines for drilling surface goaf wells. Each machine can drill wells of 3 km in depth and 200 mm in diameter per month.

The degasification activities at the mine are implemented *independently* from the JI project and do not interfere in methane extraction volumes to the surface.

Utilization of methane captured (the project)
The implementation of the degasification programme at the Zasyadko Coal Mine contributes to environmental pollution and leading to climate change due to increasing the drainage of coal mine methane (CMM) into the atmosphere. To prevent methane emissions and use opportunities provided by the Joint Implementation mechanism, the Mine started CMM utilization projects by introducing best available technologies based of utilizing the methane energy content. The use of CMM will be provided through construction of 24 combined heat and power (CHP) generation modules and five gas filling stations.

Cogeneration plants
The core activity of this project is the installation of two CHP plants that will consist of 12 CHP generation modules each. The location of the CHP plants is the Vostochnaya and Yakovlevskaya production site. Each cogeneration modules, supplied by GE Jenbacher, has an installed capacity of 3.035 MW_{el} totalling to a power capacity of 72.84 MW. The thermal capacity amounts to 2.63 Gcal/h per CHP module.

Indicator	**Unit**	Value
Electrical capacity	kW	3.035
Heat capacity	Gcal/h	2.630
Consumption of CMM	m^3/h	708
Consumption of ignition dose	m^3/h	35
Gas mixture methane content	%	30
Methane concentration of ignition dose[3]	%	94.8

Table 2: The key technical indicators of a JMS 620 module as follows

Electricity utilization
Currently electricity for the Zasyadko Coal Mine production sites and facilities is purchased from the grid. Power consumers at the four production sites are supplied by the grid through a VPS-110 electric power substation at a voltage of 110/6 kV**.** In the envisaged project the electricity generated by both CHP plants will be supplied for own consumption of the mine. The surplus will be supplied to the regional grid. Electricity exchange of both Vostochnaya site and Grigoryevskaya site will take place at an existing substation at the Vostochnaya site. Electricity exchange between Vostochnaya site and Yakovlevskaya site will occur via the public electricity grid.

[3] The source of methane for ignition as well as methane for the gas filling stations is CMM from goaf wells with concentration of 93-96%.

Heat utilization
Currently the heat supply of Zasyadko Coal Mine, namely Vostochnaya, Centralnaya and Grigoryevskaya sites, is provided by one coal boiler and two natural gas boilers. In the course of putting into operation of the CHP modules located on the mine sites, the consumers of heat at all sites will receive the heat generated by the CHP modules and the boilers at these sites will be decommissioned. Surplus heat will be delivered to the nearby district heating system of Donetsk.

In 2008 a on-site heat transport system will connect both CHP systems with all heat consumers at all four production sites and with the four municipal boiler houses.

AGFCP (Automobile Gas Filling Compressor Plant) filling plants[3]
CMM with a methane content of more than 90 % can be utilised as fuel for automotive transport. For this purpose, in total of five gas filling compressor plants manufactured by Sumygazmash, Ukraine will be installed until 2007. In 2004 the first gas filling compressor plant was installed. The CMM will replace the usage of diesel and gasoline of the vehicles.

In order to secure a constant supply of CMM to the gas filling stations, gas collecting tanks with a capacity of 18,000 m^3 at Vostochnaya site and 5,000 - 6,000 m^3 at Grigoryevskaya site will be built.

Training programme
The staff of the mine will receive an extensive training programme for operating this project:
- Five specialist of the Mine have received an in-depth technical training programme of the Jenbacher equipment for the duration of 10 working in Austria;
- To train the staff in the control programme “ControlLogix 5550 and RSView 32, the controllers received a training in Moscow on the 29th of May 2006;
- During the commissioning works of the first 12 CHP modules at Vostochnaya, the staff received on the spot training. A similar training will be given during the commissioning works at Yakovlevskaya.

Maintenance programme
The maintenance and operation of the project equipment will be provided by the mine itself. For this purpose the Ukrainian company Sinapse has been awarded a two year contract (with option for prolongation) for the maintenance of the 24 CHP modules.

Risks of the project

The following risk could be identified:

Risk	**Mitigation**
Lower CMM utilization than expected	The amount of extracted CMM is higher than the amount of utilized CMM. Lower extracted CMM than expected will not lead to lower utilization of CMM.
Malfunctioning of CHP modules	Proper training of staff and regular maintenance of equipment
Lower concentration of methane in extracted gas	The CHP facility automatically regulates the amount of gas that is combusted in the CHP modules.
Lower demand for heat	The amount of heat at the production sites is fairly constant. Only the delivered heat to the DH-system could be lower. In the estimation already conservative figures have been taken.

Table 3: Risk and mitigation to the project

Figure 4: Automobile Gas Filling Compressor Plant

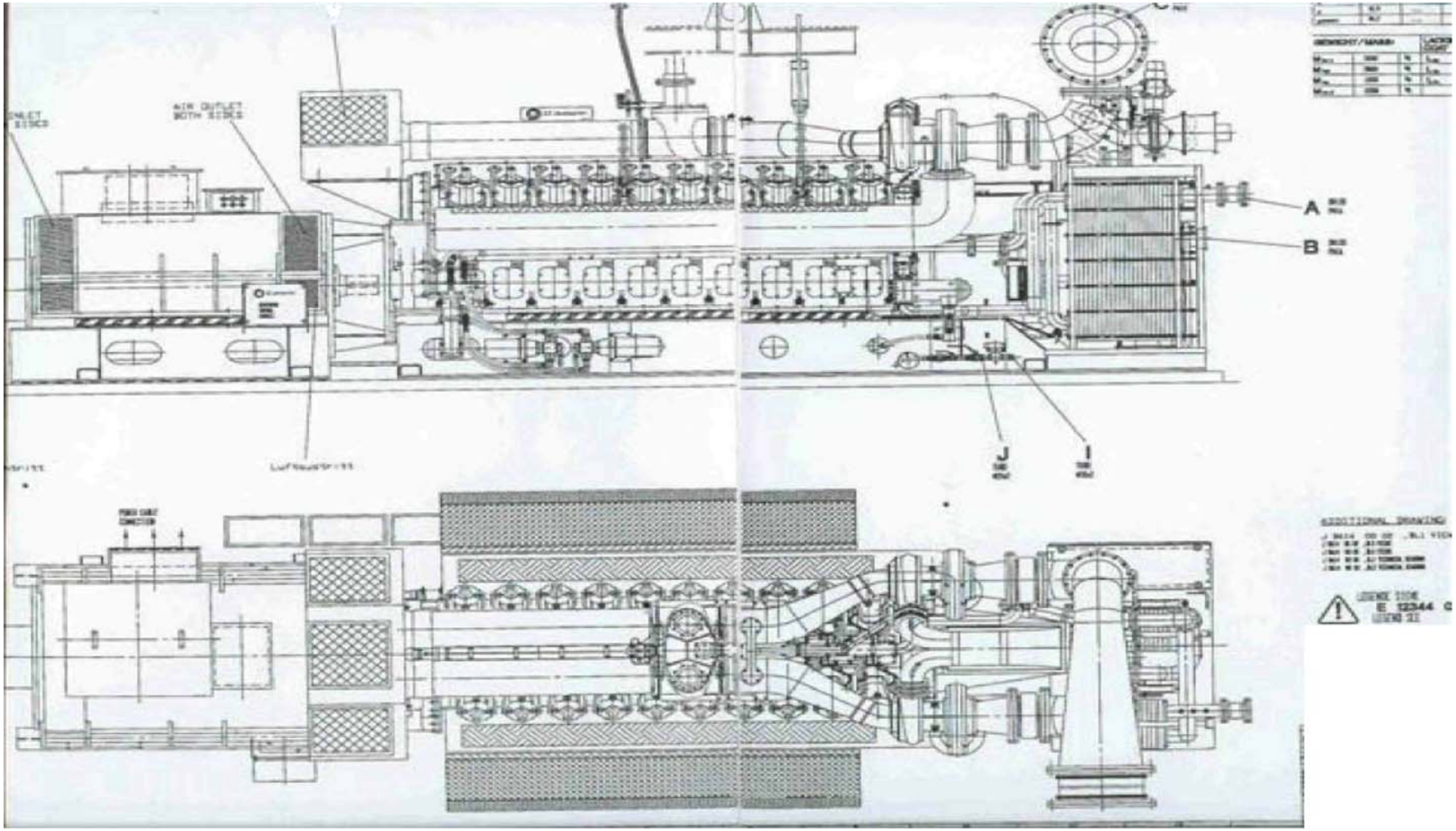

Figure 5: GE Jenbacher 620 module

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

The generation of electricity and heat at the CHP modules will lead to a destruction of CMM that otherwise would be vented into the atmosphere.

The generated electricity will be consumed on-site and the surplus electricity will be delivered to the regional grid. Both effects lead to a reduced emission of greenhouse gases on the Ukrainian electricity grid.

The use of CHPs fully covers the demand of the mine for thermal power. Due to the utilization of heat from the CHP plants, the boilers on the Centralnaya, Vostochnaya, and the Yakovlevskaya production site will be decommissioned. The shut-off of the boiler rooms results in avoided combustion of coal at the Centralnaya boilers and of natural gas at the Vostochnaya and Yakovlevskaya boilers leading to reduction of emissions. As heat will also be delivered to the DH-system, less natural gas will be fired in the municipal DH-system.

The supply of CMM to vehicle will lead to an additional destruction of CMM. As the vehicles currently are fuelled by diesel and gasoline, the project will avoid combustion of fossil vehicle fuels at vehicles that will be switched to CMM.

According to Ukrainian law "On the ecological examination" all projects that can result in violation of ecological norms and/or negative influence on the state of natural environment are subject to ecological examination. In order to comply with regulation Zasyadko Coal Mine submitted the project, which envisages CMM utilization activities at both production sites, to the Ukrainian Ministry of ecology and natural resources for preliminary state ecological expertise. The expertise was positive and particularly emphasized reduction of coal mine methane and other pollutants emissions.

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

Of the different measures the emission reductions are achieved in the following ways:

No	Activity	Project	Baseline	Reduction
1	Combustion of methane in CHP	1,417,587	10,477,549	9,059,961
2	Replacement of electricity	0	2,411,080	2,411,080
3	Replacement of heat	0	460,510	460,510
4	Replacement of car fuel	58,626	476,930	418,304
	Total reductions	**1,476,214**	**13,826,069**	**12,349,855**

Table 4: Emission reductions per measure

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

	Years
Length of the crediting period until 31 December 2007	4
Year	Estimate of annual emission reductions in tonnes of CO_2 equ.
Year 2004	35,832
Year 2005	33,936
Year 2006	428,318
Year 2007	1,111,751
Total estimated emission reductions over the period until 31 December 2007 (tonnes of CO2 equ.)	1,609,837

Table 5: Estimated emission reduction until 31 February 2007

	Years
Length of the crediting period within 2008-2012	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equ.
Year 2008	2,139,833
Year 2009	2,150,046
Year 2010	2,150,046
Year 2011	2,150,046
Year 2012	2,150,046
Total estimated emission reductions over the crediting period (tonnes of CO2 equ.) within 2008 - 2012	10,740,018
Annual average over estimated emission reductions over the crediting period within 2008-2012 (tonnes of CO2 equ.)	2,148,004

Table 6: Estimated amount of emission reductions over the period 2008-2012

A.5. Project approval by the Parties involved:

The project has been approved by Ukraine. The approval was issued by the Minister of Environmental Protection in a letter dated 14th of March 2006 with reference number № 2568/01-10.

Approval from the Investor Parties is currently being applied for.

SECTION B. Baseline

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

The approved consolidated methodology ACM0008 / Version 02*"Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring")* has been used to identify the baseline scenario of the proposed JI project.

Applicability of ACM0008
The project involves the extraction of pre mining CMM through surface goaf wells, underground boreholes, gas drainage galleries to capture CMM. This extraction activity is listed as one of the applicable project activity.

The methane is captured and destroyed through utilisation to produce electricity and thermal energy, and methane is provided for vehicle use.

Ex-ante projections have been made for methane extraction and utilization. The CMM is captured through existing mining activities. The following does apply to the Zasyadko mine:

- The mine is not an open cast mine;
- The mine is not an abandoned/decommissioned coal mine;
- There is no capture of virgin coal-bed methane;
- There is no usage of CO_2 or any other fluid/gas to enhance CDM drainage.

In step 1 below the method of extraction is described in more detail.

Hence ACM0008 is fully applicable to this JI project.

Step 1. Identification of options for capturing/use of CMM

Step 1a. Options for extraction

According to the ACM0008 methodology, all technically feasible options to extract CMM have to be listed.

In the Donbass the coal seams if a very low permeability. Therefore it is not possible to extract CBM before strata is de-stressed due to mining of the coal unless applying special measure to enhance CBM drainage. This is confirmed by the following statement. *"It is necessary to note that in pas decades, due to low permeability of loaded coal seams (2-3 degrees less than permeability of manifolds of traditional gas fields), and presence of methane in seams with close sorption connection with coal media, mainly in form of the solid coal and gas solution, basic studies for issue of preliminary extraction of methane from coal carrying strata were directed to substantiation and development of prospective methods of artificial increase of gas recovery of coal seams based on application of proper energy intensive technical influences to massif or coal seam [1,2]"*[4]

In the case of Zasyadko mine there are only two options that are technically feasible to extract CMM for utilization purposes, being:

1. CMM extraction through underground boreholes;
2. CMM extraction through surface goaf wells.

Approximately 85 to 90% of the total extracted CMM is generated through the underground boreholes and the remaining 10 to 15% through surface goaf wells. The concentration of methane in the extracted

[4] Source: "Analysis of geomechnical processes in coal carrying strata by prior extraction of coal mine methane", National Academy of Science of Ukraine, Methane of Ukraine, edition 17, 2000.

gas ranges from 27 – 31% from the underground boreholes and the concentration of the methane from the goaf wells is in the range of 90 – 99%.

Due to the low permeability of the coal seams, extraction of CMM can only take place just before and during the mining of the coal. For the purpose of using the correct classifications of ACM0008, this CMM will be referred to as pre mining CMM.

Methane is also released in the atmosphere in the form of ventilation air methane (post mining CMM). Due to the low concentration of methane in the ventilation air, this methane cannot be utilized. Throughout the PDD ventilation air methane will not be considered.

The CMM from the goaf wells is automatically released due to the existing high pressure. Vacuum pumps are used to extract the CMM through underground boreholes. In the figure below the scheme of extraction through underground boreholes is shown.

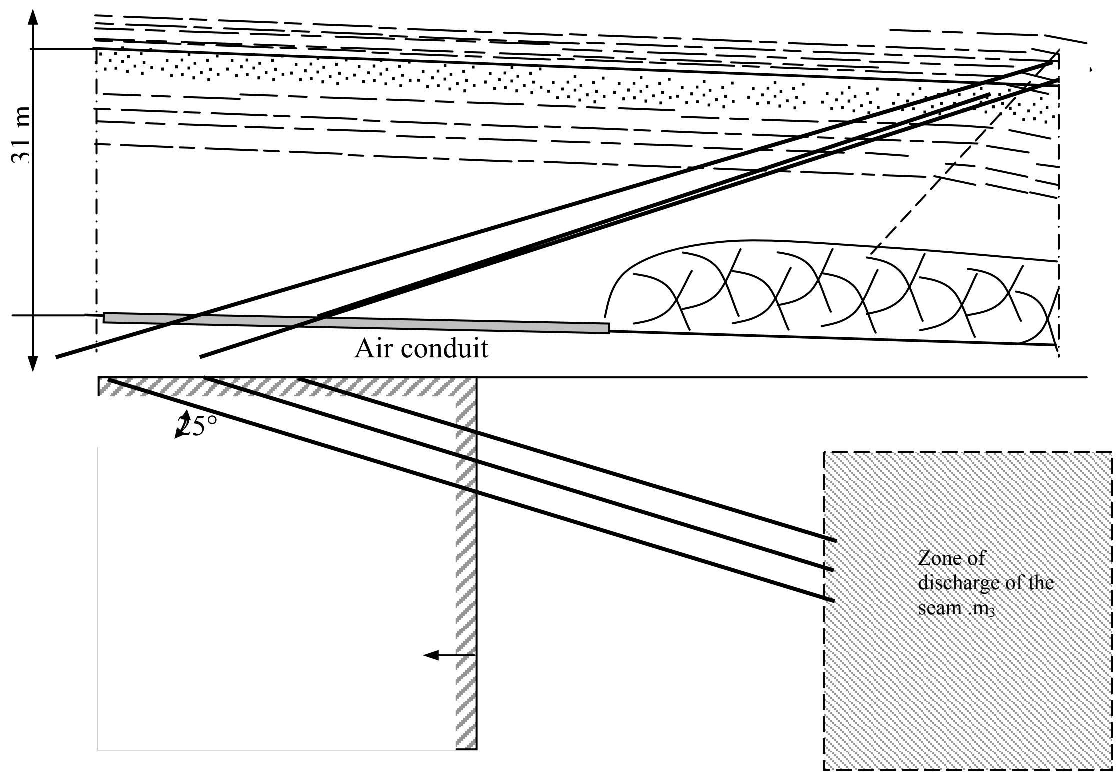

Figure 6 : Scheme of location of degassing holes in the roof of the seam m3

Step 1b and step 1c. Options for CMM treatment and energy production

Several approaches can be taken to treat the captured CMM at Zasyadko mine:

i. Venting into the atmosphere (current situation);
ii. Using destroying ventilation air methane rather than venting it;
iii. Flaring of CMM;
iv. Using methane for additional grid power generation;
v. Using methane for additional captive power generation;
vi. Using methane for additional heat generation;
vii. Feed into gas pipeline to be used as fuel for vehicles or heat/power generation;
viii. Possible combination of options i to vii.

Some of these options were considered as possible alternatives for the baseline scenario. In step 3 of this section some of these options will be further developed into baseline scenario alternatives. The generation of own energy is one of the requirements for developing this project. The destruction of ventilation air methane (option ii) was not considered as the concentration of methane in the ventilation air is too low to make destruction technical feasible. The mine has no own power (electricity) generation facilities so option v was not considered.

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

According to the national safety regulations, the coal mine methane has to be extracted. There is no regulation in place that would require any specific utilization of the extracted methane. On the other hand, there is no national regulation in place that would prohibit the use of CMM for heat and/or electricity generation. Therefore, all the alternatives listed in step 1b are in compliance with the existing regulations.

Step 3. Formulation of the baseline scenario alternatives

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

Alternative 1. Venting of CMM
Since there are no legal requirements for treatment and utilization of the captured CMM, it is common practice at Ukrainian coal mines to vent the CMM into the atmosphere. This alternative entails a continuation of the practise before project implementation and that is to vent all CMM into the atmosphere. The majority of the CMM is extracted by the vacuum pumps of the underground boreholes and vented into the atmosphere. Some CMM is vented automatically through goaf wells.

The energy needs of the mine will, under this scenario, continue to be supplied in the following way:

- Electricity needs will be supplied by the regional grid;
- On-site heat demands will be supplied by on-site boilers which are natural gas fired (at Vostochnaya and Yakovlevskaya site) and coal fired (Centralnaya site);
- Vehicle fuel will be regular fuel, being diesel (50%) and gasoline (50%).

Alternative 2. Flaring of CMM
CMM captured at the Zasyadko mine can be flared in torches supplied by the vacuum pumps and possibly the goaf wells. The infrastructure for methane flaring does not exist at Zasyadko Mine. Therefore this alternative would require additional investment. At the same time, flaring of the captured methane is not required by existing national regulations.

The energy needs of the mine will be supplied in the same way as described in alternative 1.

Alternative 3. Using methane for on-site heat generation
CMM captured at the Zasyadko mine can be utilized for on-site heat generation. Under this alternative the existing heat-only boilers would have to be reconstructed or replaced in order to be able to combust CMM. This would mean that either the burner will be replaced or a complete new boiler system will have to be installed. In addition a gas enrichment facility and control system will be needed to clean the CMM and to assure that CMM in the right concentration is supplied to the boilers. These existing boilers are located at the productions sites of Vostochnaya, Yakovlevskaya burning natural gas, and Centralnaya burning coal.

The heat needs of the mine can be fully covered under this alternative. However, the amount of CMM utilized will only be a fraction of the amount of CMM under the project scenario.

The electricity needs of the mine will be supplied in the same way as described in alternative 1 and vehicle fuel will be regular fuel.

Alternative 4: Using methane for on-site electricity generation
CMM captured at the Zasyadko mine can be utilized for on-site electricity generation. Under this alternative small power modules will have to be installed to generate electricity. Heat that is generated will not be utilized. In addition to the power modules a gas treatment facility and control system will be needed to clean the CMM and to assure that CMM in the right concentration is supplied to the power modules.

The electricity needs of the mine can be fully covered under this alternative and surplus electricity will be delivered to the regional grid. The heat needs of the mine will be supplied in the same way as described in alternative 1 and vehicle fuel will be regular fuel.

Alternative 5. Using methane for on-site electricity and heat generation
The concentration of CMM captured at Zasyadko mine has a relatively high concentration of methane and can be used for the combined production of electricity and heat. Under this alternative 24 small cogeneration modules will be installed to produce electricity and heat. In addition a gas treatment facility and control system will be needed to clean the CMM and to assure that CMM is supplied in the right concentration.

Electricity produced by the installation will be used for own consumption needs and the surplus will be supplied to the national electricity grid ands. The generated heat will be used for on-site needs to replace existing boilers and the remaining heat will be supplied to the nearby district heating system.

Alternative 6. Using methane for on-site vehicle consumption
The extracted CMM can be supplied to on-site vehicle gas filling stations to supply CMM to vehicles. The gas filling stations require CMM with a high concentration (90% or higher) which can be supplied directly from the goaf wells. As the CMM from those goaf wells is released under high pressure, no pumping stations are required. Additional investment shall be made by the project owners to create the infrastructure for this alternative being automotive gas filling compressor stations (AGFCP). The vehicles should make their vehicles suitable for CMM consumption. However, the amount of CMM that can be consumed by this project is small.

The energy needs of the mine will be supplied in the same way as described in alternative 1.

Alternative 7: Feeding CMM into the natural gas pipeline for off-site vehicle use and/or electricity and heat generation
The extracted CMM can be supplied to the regional gas grid replacing part of the natural gas that is consumed in the city of Donetsk. The gas can be used for heat generation, electricity generation and/or vehicle use. This alternative would require a significant investment in a CMM purification plant to clean the CMM and to increase the concentration methane of the gas mixture. Furthermore a piping infrastructure to transport the CMM to the local natural gas grid will be needed.

The energy needs of the mine will be supplied in the same way as described in alternative 1.

Alternative 8: Using methane for on-site electricity and heat generation and using methane for on-site vehicle consumption (= project scenario)
This alternative is a combination of alternative 5 and alternative 6 and constitutes the proposed JI project without the incentive of the project as a Joint Implementation project

Step 4. Elimination of the baseline scenario alternatives that face prohibitive barriers

In this section the possible alternatives formulated above will be checked against the existing economic and other barriers for their implementation. Non-realistic alternatives will be eliminated.

Alternative 1. Venting of CMM
The existing national regulations require that captured CMM has to be vented for safety reasons. There are no legal requirements that prohibit venting or require mines to utilize CMM. This alternative represents the situation in the absence of the proposed JI activity. There are no barriers or external factors that prevent this alternative to be continued. Therefore, this scenario can be considered to be a realistic alternative.

Alternative 2. Flaring of CMM
Flaring of the CMM is not required by the existing national regulation. Additional investment has to be made by the project owners to install torches that will be used for flaring. Taking into account that no additional revenue from JI mechanism is taken into account at this point, this scenario shall not be considered as realistic for the fact that is not required and it is facing a prohibitive barrier for the fact that this investment will not generate any revenues. Furthermore this alternative would not generate energy, which is a requirement of the mine for the development of any utilizations project.

Alternative 3. Using methane for on-site heat generation
CMM can be used for heat generation that can be consumed on-site. This alternative would require the purchase of a gas enrichment installation plus other controlling equipment to ensure a proper concentration of CMM (>35%) in the gas to avoid explosions[5]. This alternative would only mean that a fraction of the CMM will be utilized.

According to publicly available information[6] 41,981 million cubic meters of CMM were generated by Ukraine coal mines in 1999 with approximately 13 percent being extracted through degasification systems while the rest released into atmosphere through ventilation systems. Only four percent of CMM in Ukraine was utilized. Also refer to section B.2., sub-step 3a, for a more detailed description of the barriers.

This alternative faces barrier due to the absence of prevailing practises to utilize CMM.

Alternative 4: Using methane for on-site electricity generation
CMM can be used for on-site electricity generation that is consumed on-site and the surplus is delivered to the grid. Under this alternative heat is not utilized.

The amount of investment under this alternative would be similar as under the project scenario as the same cogeneration modules will be used to generate the electricity. As is shown in section B.2 the project scenario is financially not attractive. Alternative 4 would even be less attractive as heat is not utilized so less revenue is generated. Therefore this alternative faces a prohibitive barrier and is economically not attractive.

Alternative 5. Using methane for on-site electricity and heat generation
CMM can be used for on-site electricity and heat generation. This alternative is similar to the project scenario excluding utilization of methane for on-site vehicle consumption. The alternative does however

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[5] The mine has tried to utilize CMM in the existing boilers in a pilot project. The project was stopped due to the fluctuating concentration of methane in the gas and the resulting danger of explosions.

[6] Handbook "Coal mine methane in Ukraine: opportunities for production and investment in the Donetsk coal basin", U.S. Environment Protection Agency, 2001, pp. 1-3.

faces barrier due to the absence of prevailing practises to utilize CMM as described under alternative 3 and under sub-step 3a of section B.2. The amount of investment under this alternative would be similar as under the project scenario the majority of the investment cost constitutes the cogeneration modules. As is shown in section B.2 the project scenario is financially not attractive.

Therefore this alternative faces two prohibitive barriers.

Alternative 6. Using methane for on-site vehicle consumption
Similar to alternative 3, consumers of CMM for on-site vehicle use are available. This alternative is a realistic alternative. The alternative does however faces barrier due to the absence of prevailing practises to utilize CMM as described under alternative 3.

Alternative 7: Feeding CMM into the natural gas pipeline for off-site vehicle use and/or electricity and heat generation
CMM can be supplied to the grid for off-site utilization. The mine is considering this alternative to be implemented. The alternative does however faces barrier due to the absence of prevailing practises to utilize CMM. Furthermore the required investment for the purification plant is high. There is significant uncertainty in Ukraine on the domestic price of natural gas, and as a consequence, on the economic feasibility of such a project. Project finance in Ukraine is absent as is shown in section B.2 and therefore the investment would have to be paid from the cash flow of the mine.

Without a JI incentive this project faces a prohibitive barrier.

Alternative 8: Using methane for on-site electricity and heat generation and for using for on-site vehicle consumption (= project)
This alternative is the project scenario without a JI incentive. This alternative is a realistic alternative but faces both barriers and is economically not attractive. This is proven in section B.2 of this PDD

Conclusion
There is only one realistic option for the baseline scenario which is a continuation of the existing situation which is to vent CMM into the atmosphere, generate heat with the existing boilers, purchase of electricity from the grid and continue fuel the vehicle with diesel (=Alternative 1).

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:

In accordance with the chosen methodology, additionality has to be proven by applying the "Tool for demonstration and assessment of additionality (version 02)[7]". The result is given below.

Step 0. Preliminary screening

a) The project has started after 1 January 2000. The table below shows the implementation of different stages of the project.

Activity	Date
Commissioning of two gas filling compressor stations	March 2004
Commissioning of one new gas filling compressor station	March 2005
Commissioning of the 1st CHP modules at Vostochnaya site	January 2006

[7] Source: cdm.unfccc.int

Commissioning of the 12th CHP modules at Vostochnaya site	April 2006
Shut-down of boilers at Vostochnaya site	September 2006
Commissioning of one new gas filling compressor station	November 2007
Commissioning of 1st CHP modules at Yakovlevskaya site	December 2007
Commissioning of one new gas filling compressor station	January 2008
Commissioning of 12th CHP modules at Yakovlevskaya site	March 2008
Shut-down of boilers at Yakovlevskaya site	March 2008
Shut-down of boilers at Centralnaya site	May 2008
Supply of heat to DH-system	September 2008

Table 7: Implementation stages

b) Additional income from the JI mechanism was considered by the mine.

In 2000 the company "BCCK Engineering inc." started a feasibility study of a project to treat and enrich CMM. In this feasibility study several alternatives for the utilization of the CMM were presented being
- to feed CMM into the local gas grid;
- use it as a fuel for vehicles;
- use it for cogeneration using gas turbines.

The final version of the feasibility study was presented on the 15th of August 2003.

In the period 2001 – 2003, the mine management visited several hardware suppliers in Germany to discuss options for CMM utilizations. As a result of these visits it was decided not to purchase cogeneration modules based on gas turbines but to purchase reciprocating cogeneration modules. On the 13th of November 2003 a contract was signed with GE Jenbacher for the supply of cogeneration modules.

In 2006 it was decided to postpone the implementation of the project to supply treated and enriched CMM to the natural gas grid of Donetsk due to the high investment costs and the absence of investment means.

Additional income from the JI mechanism was considered by the project sponsor before the final decision regarding the proposed projects was made:
- The feasibility study prepared by BCCK Engineering as mentioned above described the possibility to use JI revenue. In appendix H the emissions of the project were calculated;
- The Zasyadko mine contracted "Advanced Technology Partners Inc" from the United States on the 24th of September 2002 to study the enrichment of CMM. Part of this study was to analyse the impact on the emissions and the emission reduction potential. Two scenarios were developed and the emission reduction potential was calculated[8];
- In the article "Coal mine methane utilization and issues brought by implementation of Kyoto protocol decision at the Coal Mine named after A.F. Zasyadko" the utilization of CMM was described in connection with the Kyoto Protocol. This article was published in issue number 5 of the year 2003.

The mine participated in a tender of the Austrian and Netherlands' government to sell emission reductions. A Project Idea Note was submitted as follows:
- to the Austrian Kommunalkredit, covering the Vostochnaya site, submitted 25 August 2004;

[8] USA, June 2003. "Advanced Technology Partners Inc", annex 2-1 and annex 2-2

- to the Dutch ERUPT 5 programme, covering the Yakovlevskaya site, submitted October 2004.

In the course of both tenders for each tender a PDD and Determination Protocol was submitted[9].

Step 1. Alternatives
In accordance with the methodology ACM0008, this step is ignored.

Step 2. Investment analysis

Sub-step 2a. Determination of the analysis method

The proposed JI project will generate additional profit from electricity, heat and vehicle fuel sales. Therefore, simple cost analysis (Option I) is not applicable.

Obtaining financial indicators for similar projects in Ukraine is problematic as this project is unique in its kind; therefore the investment comparison analysis (Option II) cannot be performed for the identified alternatives. Therefore the benchmark analysis (Option III) will be used to test the additionality of the proposed JI activity.

Sub-step 2b. Application of the benchmark analysis

The core business of the Zasyadko mine is to mine coal for the Ukrainian and international market. The project would secure energy supply at the site independent from third party power suppliers. Nevertheless such an investment would deviate investment capital away from the mine core business, being the mining of coal and ensure the safety of the miners. On the other hand the project would enable the mine to improve the reliability of energy supply at more favourable tariff. Therefore the minimum requirement for the mine was that the project should at least be profitable. Therefore the most relevant benchmark for the mine is the Net Present Value which should at least be positive.

Sub-step 2c. Calculation and comparison of the indicators

The economic indicators for the proposed project (alternative 8) without JI revenue has been calculated under the following assumptions:

- Prices of electricity, heat, and gas were taken as of 2003 when the decision to implement the project was taken;
- Degasification activities and vacuum pumps were excluded from the capital costs as they are not part of the project (the degasification activities would have to be implemented anyway irrespective of the JI project).

The project has the following economic indicators:

NPV	-53.0 mln UAH
IRR	5%

Table 8: Economic indicators of project

As clearly can been seen the project is not feasible without JI revenues.

Sub-step 2d. Sensitivity analysis

A sensitivity analysis of the proposed project was made based on the market forecasts available at the moment of making the financial analysis of the proposed project. The electricity price in 2003 was

[9] The current PDD is a combination of both PDDs including an update of the project.

changed 20% downwards and 20% upwards as the electricity component is the biggest source of revenue.

	Base case	Electricity up 20%	Electricity down 20%
NPV	-53.0 mln UAH	-11.2 mln UAH	-94.9 mln UAH
IRR (%)	5%	14%	-5%

Thus, even in the case of a significant change in the electricity price, the NPV of the proposed project does not become positive.

Step 3. Barrier analysis

Sub-step 3a. Barrier identification

The proposed JI activity faces the following barriers:

Barriers to prevailing practices
According to publicly available information[10] 41,981 million cubic meters of CMM were generated by Ukraine coal mines in 1999 with approximately 13 percent being extracted through degasification systems while the rest released into atmosphere through ventilation systems. Only four percent of CMM (79 mln. cubic meters) was utilized as the fuel primary.

The situation at the Zasyadko Coal Mine is totally in line with national one. Some CMM was utilized in the boiler houses at Vostochnaya production site in a pilot project. However, this pilot project was not successful due to the fluctuating concentration of methane in the extracted gas. To operate CMM in boilers the concentration should be at least 35% of avoid the danger of explosions.

Existing legislation[11] is primary orientated on increasing safety of coal mine operations thus facilitating and enforcing development of degasification and ventilation systems at coal mines.

Therefore current practices prevent the project from being implemented and clearly prevent the development of CMM utilization activities.

Technology barrier
According to publicly available information[12] as well as studies of the Institute of Geotechnical Mechanics of the National Academy of Science of Ukraine named after N.S. Polyakov the project represents the first application CHP technology for CMM utilization not only at Zasyadko Coal Mine but also in Ukraine. Therefore there is clear technology barrier for the realization of the proposed project.

Besides the Zasyadko Coal Mine does not have skilled and properly trained labour force to operate CHP modules. In order to overcome this barrier supplier of the equipment (GE Jenbacher) will provide training courses for people that will be operating CHP modules. Such provision is included in the contract between Zasyadko coal mine and GE Jenbacher.

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[10] Handbook "Coal mine methane in Ukraine: opportunities for production and investment in the Donetsk coal basin", U.S. Environment Protection Agency, 2001, pp. 1-3.

[11] Decree of the President of Ukraine as of 16th of January 2002 # 26/2002 "On urgent activities for improvement of work conditions and development of the state supervision at mining enterprises"; The Governmental Decree as of 6th of July 2002 # 939 "On Complex Programme of coal-beds degasification at coal mines".

[12] Handbook "Coal mine methane in Ukraine: opportunities for production and investment in the Donetsk coal basin", U.S. Environment Protection Agency, 2001, pp. 1-3.

Financial barrier

Domestic financial market opportunities for project financing in Ukraine are virtually absent. A common practice for the commercial bank financing can be a loan for up to maximum 3 years at 18-24% interest rate in the national currency. This is confirmed by the following article about project financing: "*The Ukraine continues to pose some investment risks due to political, economic and legislative instability. To date, these risks have made strictly private, long term financing prohibitively expensive or impossible to obtain, leaving quasi-public multilateral financial institutions (such as the European Bank for Reconstruction and Development, the International Finance Corporation, etc.) as the principal sources for Ukrainian project financing.*"[13]

In absence of project financing, the project would have to be financed from the cash flow of the mine. This would channel money away from important investments like increasing the safety of the mine workers which is first priority of the mine.

Sub-step 3b. Influence of the barriers identified on the alternative baseline scenario

The only viable alternative to the proposed JI activity is continuation of the existing situation. Since this scenario does not require any additional investment or changes in the technology, it is not affected by the barriers described above.

Step 4. Common practice analysis

Venting the captured CMM into the atmosphere is the common practice in the coal sector of Ukraine[14]. There are no other major examples of using the CMM for power generation that have been implemented without the additional JI incentive.

The proposed activity is not common practice.

Step 5. Impact of JI revenues

Acceptance of the proposed project as a JI activity will allow to alleviate the financial barrier.

	NPV	IRR
Without revenue from emission reductions	-53.0 mln UAH	5%
With revenue from emission reductions	+168.5 mln UAH	45%

Table 9: Impact of JI revenues

Acceptance of the proposed project as a JI project and alleviation of the financial barrier allows the project owners to purchase the equipment from an international manufacturer who can assist with technology transfer and educating the staff responsible for operation and maintenance.

Conclusion

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

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[13] "Project Financing", Alexey V. DIDKOVSKIY, the Ukrainian Journal of Business Law, May 2003. http://www.shevdid.com/publication/ovd_031.pdf

[14] Handbook "Coal mine methane in Ukraine: opportunities for production and investment in the Donetsk coal basin", U.S. Environment Protection Agency, 2001, pp. 1-3.

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

Baseline emissions

Source	Gas		Justification / Explanation
Emissions of methane as a result of venting	CH_4	Included	The main emission source. The amount of methane to be released depends on the amount used of the CHPs and the amount of CMM delivered by the gas filling stations.
Emissions from destruction of methane in the baseline	CO_2	Excluded	There is neither flaring nor use for heat and power in the baseline scenario.
	CH_4	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.
	N_2O	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.
Grid electricity generation (electricity provided to the grid)	CO_2	Included	Only CO_2 emissions associated to the same quantity of electricity than electricity generated as a result of the use of methane included as baseline emission will be counted. The standardized electricity baseline for the Ukrainian grid has been used. Please refer to annex 2.
	CH_4	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.
	N_2O	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.
Captive power and/or heat, and vehicle fuel use	CO_2	Included	In the baseline scenario heat would be generated by on-site heat boilers and off-site heat-boiler of the DH-heating system. Furthermore vehicle would continue to use fossil-fuel vehicle fuels.
	CH_4	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.
	N_2O	Excluded	Excluded for simplification. This is conservative and in accordance with ACM0008.

Table 10: Sources of emission in the baseline scenario

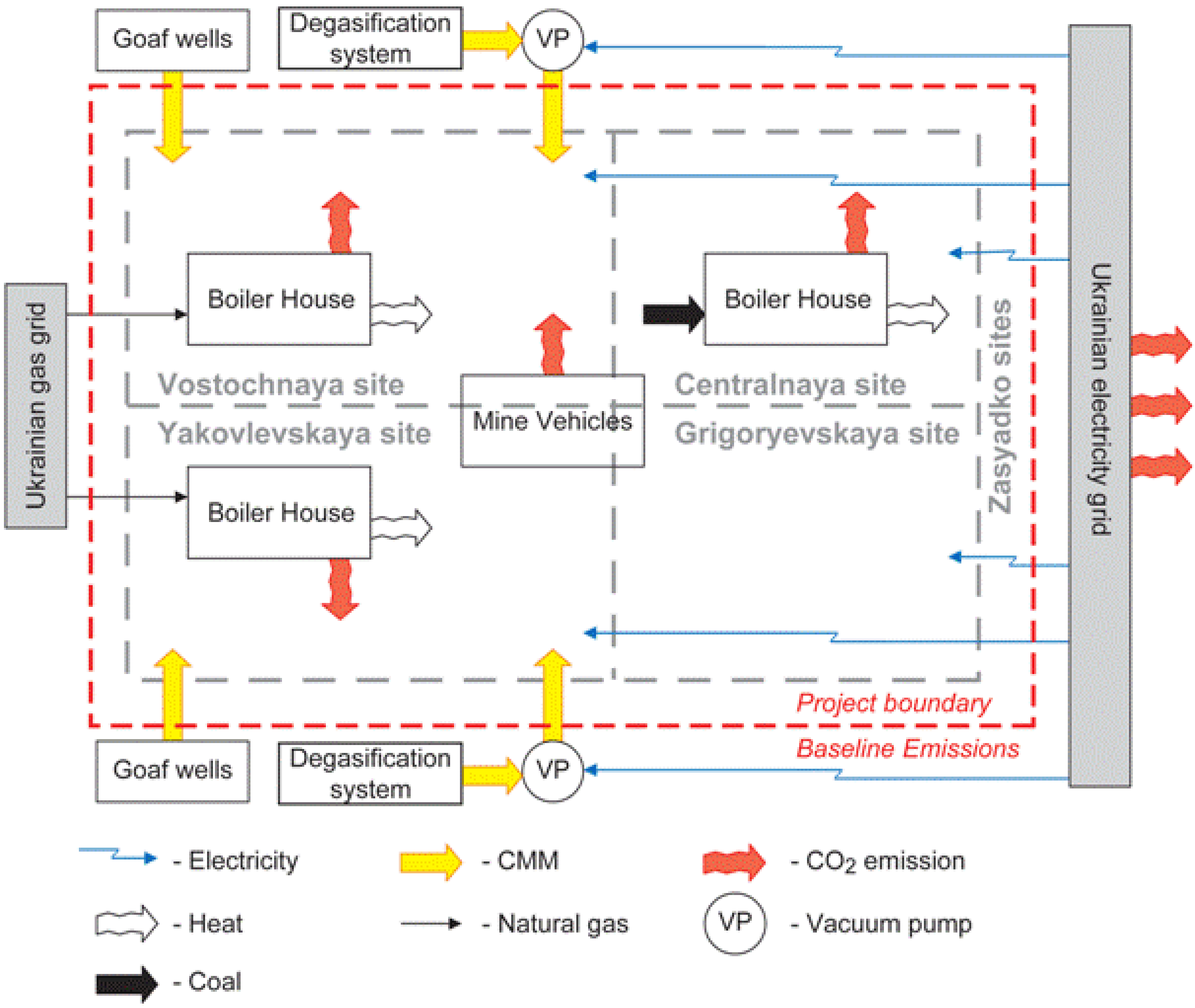

Figure 7: Baseline emissions.

Project activity

Source	**Gas**		**Justification / Explanation**
Emissions of methane as a result of continued venting	CH_4	Excluded	Only the change in CMM/CBM emissions release will be taken into account, by monitoring the methane used or destroyed by the project activity.
On-site fuel consumption due to the project activity, including transport of the gas	CO_2	Excluded Included Included Excluded	The electricity consumption of the vacuum pumps is not included in the project boundary as they are necessary for the extraction itself and is performed both in the baseline and project scenario. The own electricity consumption of the gas treatment facility has been included and subtracted for the amount of electricity produced by the CHP. The own electricity consumption of the CHP plants has been included and subtracted for the amount of electricity produced by the CHP. The own electricity consumption of the five AGFCP stations is not significant[15] and has been excluded.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0008. This emission source is assumed to be very small.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0008. This emission source is assumed to be very small.
Emissions from methane destruction	CO_2	Included	From the combustion of methane in the CHP stations and for the vehicle use.
Emissions from NMHC destruction	CO_2	Included	NMHC accounts less than 1% by volume of extracted coal mine gas so has been excluded for estimating the emission reductions. However the NMHC percentage will be monitored on a regular basis and will be included if above 1%.
Fugitive emissions of unburned methane	CH_4	Included	The CHP stations will effectively burn 100% of all methane supplied. However in accordance with ACM0008 small amounts of uncombusted methane (0.5%) will be accounted for to remain conservative.
Fugitive methane emissions from on-site equipment	CH_4	Excluded	Excluded for simplification in accordance with ACM0008. This emission source is assumed to be very small.
Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles	CH_4	Excluded	Excluded for simplification in accordance with ACM0008. However taken into account among other potential leakage effects (see leakage section).
Accidental methane release	CH_4	Excluded	Excluded for simplification in accordance with ACM0008. This emission source is assumed to be very small.

Table 11: Sources of emissions in the project scenario

[15] The average per year over the crediting period is less than 1% of the annual average and does not exceed the amount of 2,000 tCO2e. Reference JISC "Guidance on Criteria for Baseline Setting and Monitoring".

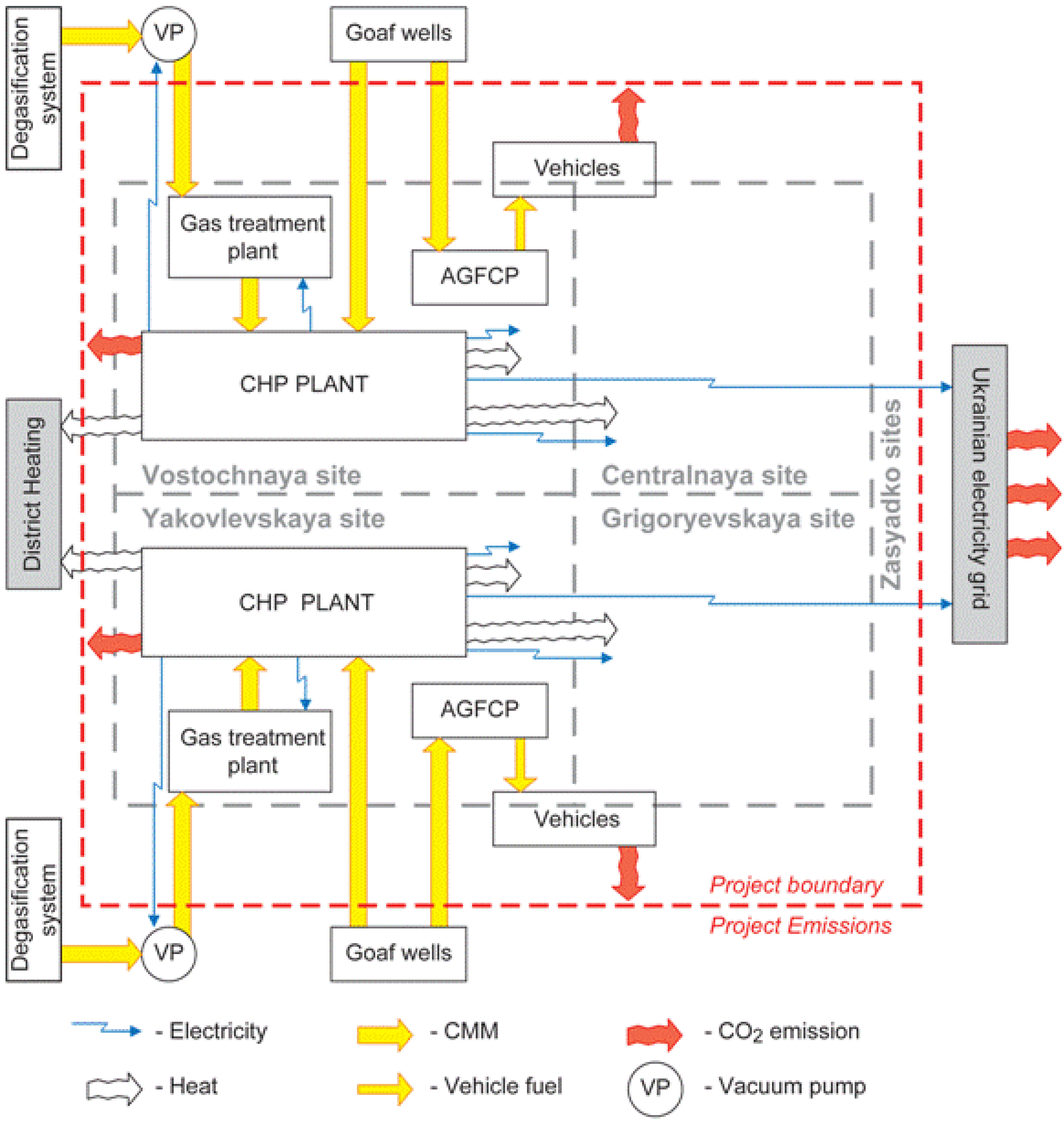

Figure 8: Project emissions

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

Date of completion of the baseline study: 2 February 2007

Name of person/entity setting the baseline:
- Global Carbon B.V.

See Annex 1 for detailed contact information.

This PDD has been based on two earlier prepared PDDs and has been updated to reflect the most actual situations and to meet the requirements of the Joint Implementation Supervisory Committee (JISC)[16].

The previous PDDs are:

- "Recovery and utilization of coal methane through power generation" at the Vostochnaya and Central site, dated August 2005;
- "Coal Mine Methane utilization at Yakovlevskaya production site, Zasyadko coal mine, Donetzk, Ukraine", dated March 2005.

[16] "Guidelines on criteria for baseline setting and monitoring", JISC04, ji.unfccc.int

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

1 March 2004

C.2. Expected operational lifetime of the project:

No less than 10 years

C.3. Length of the crediting period:

Start of crediting period: 1 March 2004

Length of crediting period: From 1 March 2004 till 31 December 2012:

- For the period up to 31 December 2007 Early Credits will be claimed to be transferred through Article 18 of the Kyoto Protocol (IET);
- For the period 1 January 2008 till 31 December 2012 credits will be transferred through Article 6 of the Kyoto Protocol (JI).

Please note that the baseline setting and monitoring of Early Credits is identical with the baseline setting and monitoring of emission reduction that will be generated through the JI mechanism.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

ACM0008 (version 2) "Consolidated monitoring methodology for virgin coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring" has been used to set up the monitoring plan.

Applicability requirements for the monitoring plan of the ACM008 methodology are identical to respective requirements of the baseline setting. For a detailed overview of the ACM008 applicability please refer to section B.1 of this PDD.

The specific applicability requirements of the monitoring protocol related to flaring is not relevant as no methane is to be flared in the proposed JI project.

General remarks to the Monitoring Plan:

- In consultation with the verifier, the monitoring plan will be updated during the first verification;
- Social indicators such as number of people employed, safety record, training records, etc, will be available to the verifier;
- Environmental indicators such as dust emissions, NO_x, or SO_x will be available to the verifier. These indicators are being reported to the Department of Ecology of the Donetsk regional authorities on a monthly and annual basis;
- The CH_4 and N_2O emission reductions will not be claimed as mentioned in section B.3 and will therefore not be monitored. This is conservative and in accordance with ACM0008;
- IPCC default factors have been taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
- In accordance with ACM0008 only methane that is being destroyed by the project should be measured. Nevertheless in the Monitoring Report all extracted methane will be reported indicating the amount of non-utilized methane (vented CMM).

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
P1 PE_y	Project emission in year y	Monitoring of GHG emissions in year y	tCO_2e	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
P2 PE_{MD}	Project emissions	Monitoring of	tCO_2e	c	yearly	100%	Electronic and	Calculated using

	from methane destroyed	GHG emissions in year y					paper	the formulae in Section D.1.1.2
P3 PE_{UM}	Project emissions from un-combusted methane	Monitoring of GHG emissions in year y	tCO_2e	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
P4 MD_{CHP}	Methane destroyed in the CHPs	Flow meters	tCH_4	c	monthly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
P5 MD_{GAS}	Methane destroyed by the vehicles supplied by the new gas filling stations	Flow meters	tCH_4	c	monthly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
P6 CEF_{CH4}	Carbon emission factor for combusted methane	IPCC	tCO2e/tCH4	c	fixed ex-ante	100%	Electronic and paper	Set at 2.75 tCO2e /tCH4
P7 CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons	Periodical analysis	$tCO_eeq/tNMHC$	m	quarterly	100%	Electronic and paper	
P8 r	Relative proportion of NMHC compared to methane	Periodical analysis		c	quarterly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
P9 PC_{CH4}	Concentration (in mass) of methane in extracted gas	Periodical analysis	%	m	quarterly	100%	Electronic and paper	
P10 PC_{NMHC}	NMHC concentration (in mass) of extracted gas	Periodical analysis	%	m	quarterly	100%	Electronic and paper	
P11 MM_{CHP}	Methane measured sent to the CHPs	Flow meters	tCH_4	m	continuously	100%	Electronic and paper	
P12 Eff_{CHP}	Efficiency of methane destruction/oxidation in CHP	IPCC	%	e	fixed ex-ante	100%	Electronic and paper	Set at 99,5%
P13 MM_{GAS}	Methane measured supplied to vehicle by the new gas filling stations	Flow meters	tCH_4	m	continuously	100%	Electronic and paper	

P14 Eff_{GAS}	Overall efficiency of methane destruction/oxidation at the vehicles	IPCC	%	e	fixed	100%	Electronic and paper	Set at 98.5%
P15 GWP_{CH4}	Global warming potential of methane	IPCC	tCO2e/tCH4	e	fixed	100%		Set at 21

Table 12: Data to be collected in the project scenario

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

Project emissions
The project emissions of the project are given by the following equation. The emissions for the use to capture and use methane PE_{ME} have not been taken as the energy use for the vacuum pumps are outside the project boundary (see section B.3) and the annual electricity consumption of the gas filling station results in emission below 2,000 tCO2e.

$$PE_y = PE_{MD} + PE_{UM} \quad (1)$$

Where:
PE_y Project emission in year y (tCO2e)
PE_{MD} Project emissions from methane destroyed (tCO2e)
PE_{UM} Project emissions from un-combusted methane (tCO2e)

The project emissions from methane destroyed
The project emissions from methane destroyed are given by the equation below. Methane will be destroyed in CHPs (and in vehicles) and as the CHP produces both electricity and heat at one source, MD_{ELEC} and MD_{HEAT} are combined into MD_{CHP}. No flaring takes place so $MD_{FL} = 0$.

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) x (CEF_{CH4} + r x CEF_{NMHC}) \quad (2)$$

with:

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

where:

PE_{MD} Project emissions from CMM destroyed (tCO2e)
MD_{CHP} Methane destroyed in the CHPs (tCH4)
MD_{GAS} Methane destroyed by the vehicles supplied by the new gas filling stations (tCH4)
CEF_{CH4} Carbon emission factor for combusted methane (2.75 tCO2e/tCH4)
CEF_{NMHC} Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) ($tCO_e eq/tNMHC$)
r Relative proportion of NMHC compared to methane
PC_{CH4} Concentration (in mass) of methane in extracted gas (%)
PC_{NMHC} NMHC concentration (in mass) of extracted gas (%)

The relative proportion of NMHC is less than 1% and therefore has been excluded in the calculations. However, the NMHC content will be periodical analysed, and if significant, will be included in the project emissions. So:

$$PE_{MD} = (MD_{CHP} + MD_{GAS}) x CEF_{CH4} \quad (3)$$

Emissions of CHPs

The emissions of the CHPs are given by the following equation:

$$MD_{CHP} = MM_{CHP} x Eff_{CHP} \quad (4)$$

where:
MD_{CHP} Methane destroyed in the CHPs (tCH4)
MM_{CHP} Methane measured sent to the CHPs (tCH4)
Eff_{CHP} Efficiency of methane destruction/oxidation in CHP (taken as 99.5% from IPCC)

Emissions of gas utilization

Some methane will be supplied to the gas filling station that will supply the vehicles. The emissions as a result are given by the following equations.

$$MD_{GAS} = MM_{GAS} x Eff_{GAS} \quad (5)$$

where:
MD_{GAS} Methane destroyed by the vehicles supplied by the new gas filling stations (tCH4)
MM_{GAS} Methane measured supplied to vehicle by the new gas filling stations (tCH4)
Eff_{GAS} Overall efficiency of methane destruction/oxidation through gas grid to various combustion end uses, combining fugitive emissions from

the gas grid and combustion efficiency at end user (taken as 98.5% from IPCC)

Emissions from un-combusted methane

$$PE_{UM} = GWP_{CH4} x (MM_{CHP} x (1 - Eff_{CHP}) + MM_{GAS} x (1 - Eff_{GAS})) \quad (6)$$

where:
PE_{UM} Project emissions from un-combusted methane (tCO2e)
GWP_{CH4} Global warming potential of methane (21 tCO2e/tCH4)
MM_{CHP} Methane measured sent to use at CHP (tCH4)
Eff_{CHP} Efficiency of methane destruction in CHP (taken as 99.5% from IPCC)
MM_{GAS} Methane measured sent to use for gas filling station (tCH4)
Eff_{GAS} Efficiency of methane destruction in vehicle usage (taken as 98.5% from IPCC)

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
B1 BE_y	Baseline emissions in year	Monitoring of GHG emissions in year y	tCO_2e	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B2 $BE_{MR,y}$	Baseline emissions from release of methane into the atmosphere that is avoided by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2e	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4

B3 $BE_{Use,y}$	Baseline emissions from the production of electricity, heat, and vehicles replaced by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2e	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B4 $CMM_{PJ,CHP,y}$	Pre-mining CMM captured, sent to and destroyed in the CHP in the project activity in year y	Flow meters	tCH_4	m	continuously	100%	Electronic and paper	This value is identical to MM_{CHP} in the project scenario
B5 $CMM_{PJ,GAS,y}$	Pre-mining CMM captured, supplied to the net gas filling stations and destroyed by the vehicles in the project activity in year y	Flow meters	tCH_4	m	continuously	100%	Electronic and paper	This value is identical to MM_{GAS} in the project scenario
B6 ED_{CPMM}	Emissions from displacement of end uses by use of coal mine methane and pre-mining methane.	Monitoring of GHG emissions in year y	tCO_2e	c	continuously	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B7 $PB_{Use,y}$	Potential total baseline emissions from the production of power, heat, and vehicle fuels replaced by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4

B8 $BE_{Use,el,y}$	Total baseline emissions from the production of electricity replaced by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B9 BE $_{Use,heat,y}$	Total baseline emissions from the production of heat replaced by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B10 BE $_{Use,gas,y}$	Total baseline emissions of vehicle fuels replaced by the project activity in year y	Monitoring of GHG emissions in year y	tCO_2	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
B11 $GEN_{CHP,y}$	Net electricity generated by the project activity of the CHP plants in year	Meters at the CHP equipment	MWh	m	continuously	100%	Electronic and paper	The net electricity generated takes own electricity consumption of the gas treatment facility and the CHP system into account
B12 EL $_{cons,y}$	Net electricity consumed by the mine on-site in year	Meters on-site	MWh	m	continuously	100%	Electronic and paper	The net electricity consumption is the consumption of all four production sites only

B13 $EF_{grid,produced,y}$	Emissions factor of electricity of replaced grid electricity production by the project activity in year	See annex 2	tCO_2/MWh	e	fixed ex-ante	100%	Electronic and paper	See annex 2
B14 $EF_{grid,reduced,y}$	Emissions factor of electricity of replaced on-site electricity consumption by the project activity	See annex 2	tCO_2/MWh	e	fixed ex-ante	100%	Electronic and paper	See annex 2
B15 $HEAT_{deliv,DH,y}$	Heat generation by project activity in a year y and delivered to district heating	Heat Meters	GJ	m	continuously	100%	Electronic and paper	
B16 $EF_{heat,DH,y}$	Emissions factor for heat production at the District Heating system in the baseline scenario in the year y	Report of DonetskTeploEnergo	tCO_2/GJ	c	annually	100%	Electronic and paper	See annex 2
B17 $EF_{CO2,DH,y}$	Emission factor for fuel used in DH-boilers	IPCC default	tC/TJ	m	annually	100%	Electronic and paper	See annex 2
B18 $Eff_{heat,DH,y}$	Efficiency of DH-boilers affected by the project	Report of DonetskTeploEnergo	%	m	annually	100%	Electronic and paper	See annex 2
B19 $HEAT_{deliv,vost,y}$	Heat delivered to Vostochnaya site in a year y	Heat Meters	GJ	m	continuously	100%	Electronic and paper	

B20 $EF_{heat,vost}$	Emissions factor for heat at Vostochnaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	c	fixed ex-ante	100%	Electronic and paper	See annex 2
B21 $HEAT_{deliv,yak,y}$	Heat delivered to Yakovlevskaya site in a year y	Heat Meters	GJ	m	continuously	100%	Electronic and paper	
B22 $EF_{heat,yak}$	Emissions factor for heat at Yakovlevskaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	c	fixed ex ante	100%	Electronic and paper	See annex 2
B23 $HEAT_{deliv,centr,y}$	Heat delivered to Centralnaya site in a year y	Heat Meters	GJ	m	continuously	100%	Electronic and paper	
B24 $EF_{heat,centr}$	Emissions factor for heat at Centralnaya site in the baseline scenario	Boiler efficiency	tCO_2/GJ	c	fixed ex-ante	100%	Electronic and paper	See annex 2
B25 $VFUEL_y$	Vehicle fuel provided by the project activity	Fuel Meters	GJ	c	continuously	100%	Electronic and paper	This value will be calculated based MM_{GAS} of the project scenario multiplied with LHV of methane
B26 EF_v	Emissions factor for vehicle operation replaced by the project activity	IPCC default	tCO_2/GJ	c	yearly fixed	100%	Electronic and paper	See annex 2

Table 13: Data to be collected in the baseline scenario.

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

Baseline emissions

The baseline emissions are given by the following equation. There is no destruction of methane in the baseline scenario at the mine so $BE_{MD,y} = 0$.

$$BE_y = BE_{MR,y} + BE_{Use,y} \qquad (7)$$

Where:

BE_y Baseline emissions in year y (tCO2e)

$BE_{MR,y}$ Baseline emissions from release of methane into the atmosphere that is avoided by the project activity in year y (tCO2e)

$BE_{Use,y}$ Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO2e)

Baseline emissions of methane avoided by project activity

As there is neither CBM nor CMM at the mine, the emissions equal the amount of post-mining CMM captured in the project activity that is sent to the CHP and the gas filling stations.

$$BE_{MR.y} = GWP_{CH4} x (CMM_{PJ,CHP,y} + CMM_{PJ,GAS,y}) \qquad (8)$$

Where:

$CMM_{PJ,CHP,y}$ Pre-mining CMM captured, sent to and destroyed in the CHP in the project activity in year y (tCH_4)

$CMM_{PJ,GAS,y}$ Pre-mining CMM captured, supplied to the net gas filling stations and destroyed by the vehicles in the project activity in year y (tCH_4)

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

Baseline emissions of replacement of electricity, heat and vehicle fuel by the project activity

As there is only post-mining CMM involved the baseline emissions are given in the following equation.

$$BE_{Use,y} = BE_{Use,el,y} + BE_{Use,heat,y} + BE_{Use,gas,y} \qquad (9)$$

Where:

$BE_{Use,y}$ Potential total baseline emissions from the production of power, heat, and vehicle fuels replaced by the project activity in year y (tCO_2)

$BE_{Use,el,y}$ Total baseline emissions from the production of electricity replaced by the project activity in year y (tCO_2)
$BE_{Use,heat,y}$ Total baseline emissions from the production of heat replaced by the project activity in year y (tCO_2)
$BE_{Use,gas,y}$ Total baseline emissions of vehicle fuels replaced by the project activity in year y (tCO_2e)

Baseline emissions of replacement of electricity (power)
The baseline emissions of the replacement of electricity by the project activity are given by two equations. When the amount of electricity generated in a year by the project activity is less than the total amount of electricity consumed by the mine, the baseline emissions are as follows:

$$BE_{Use.el.y} = GEN_{CHP,y} xEF_{grid,reduced} \quad (10)$$

When the amount of electricity generated in a year by the project activity is more than the total amount of electricity consumed by the mine (i.e. electricity will be supplied to the grid), the baseline emissions are as follows:

$$BE_{Use,el,y} = (GEN_{CHP,y} - EL_{cons,y})xEF_{grid,produced,y} + EL_{cons,y} xEF_{grid,reduced,y} \quad (11)$$

where:
$BE_{Use,el,y}$ Total baseline emissions from the production of electricity replaced by the project activity in year y (tCO2)
$GEN_{CHP,y}$ Net electricity generated by the project activity of the CHP plants in year y (MWh)
$EF_{grid,produced,y}$ Emissions factor of electricity of replaced grid electricity production by the project activity in year y (tCO_2/ MWh)
$EL_{cons,y}$ Net electricity consumed by the mine on-site in year y (MWh)[17]
$EF_{grid,reduced,y}$ Emissions factor of electricity of replaced on-site electricity consumption by the project activity (tCO_2/ MWh)

Baseline emissions of replacement of heat
Heat is being replaced on site at three different sites[18], being at the on-site boilers at Vostochnaya, Yakovlevskaya, and Centralnaya[19]. Furthermore, heat is being replaced at the city district heating system. The baseline emissions are given in the following equation.

$$BE_{Use,Heat,y} = HEAT_{deliv,DH,y} xEF_{heat,DH,y} + HEAT_{deliv,vost,y} xEF_{heat,vost} + HEAT_{deliv,yak,y} xEF_{heat,yak} + HEAT_{deliv,centr,y} xEF_{heat,centr} \quad (12)$$

---

[17] Net electricity consumed by the mine includes all electricity consumed by the Vostochnaya, Yakovlevskaya, Centralnaya, and Grigoryevskaya production sites but excluding electricity consumption of the project being the gas treatment facility and the CHP system. Electricity consumed by the administrative building of the Zasyadko mine is also not included in the net electricity consumed in order to be conservative.

[18] Some heat will also be delivered to the Grigoryevskaya site replacing existing electricity heating. Due to the small heat consumption, the heat consumption will not be taken into account. As a result emission reductions will not be claimed, which is conservative.

[19] The boilers at the Centralnaya site include the boilers at the greenhouse and the garage.

where:

$HEAT_{deliv,DH,y}$	Heat generation delivered to district heating by the project activity in the year y (GJ)
$EF_{heat,DH,y}$	Emissions factor for heat production at the District Heating system in the baseline scenario in the year y (tCO_2/GJ)
$HEAT_{deliv,vost,y}$	Heat delivered to Vostochnaya site delivered by the project activity in the year y (GJ)
$EF_{heat,vost}$	Emissions factor for heat at Vostochnaya site in the baseline scenario (tCO_2/GJ)
$HEAT_{deliv,yak,y}$	Heat delivered to Yakovlevskaya site delivered by the project activity in a year y (GJ)
$EF_{heat,yak}$	Emissions factor for heat at Yakovlevskaya site in the baseline scenario (tCO_2/GJ)
$HEAT_{deliv,centr,y}$	Heat delivered to Centralnaya site delivered by the project activity in a year y (GJ)
$EF_{heat,centr}$	Emissions factor for heat at Centralnaya site in the baseline scenario (tCO_2/GJ)

Baseline emissions of replacement of vehicle fuels

The baseline emissions of the replacement of vehicle fuels by the project activity are given by the following equation.

$$BE_{Use.Gas} = VFUEL_y x EF_v \qquad (13)$$

$VFUEL_y$	Vehicle fuel provided by the project activity (GJ)
EF_V	Emissions factor for vehicle operation replaced by the project activity (tCO_2/GJ)

District heating boilers emission factor

The heat supplied to the district heating system will cause four boilers to operate at a lower level. These three boilers are:

- Ionina boiler house;
- block 287 boiler house;
- block 518 boiler house.

As the boilers will not be decommissioned it is possible to monitor the fuel used and the efficiency of the boilers on an annual basis. The specific value of the emission factor of the boilers is calculated as follows:

$$EF_{heat,DH,y} = \frac{EF_{CO2,DH,y}}{Eff_{heat,DH,y}} x \frac{44}{12} x \frac{1TJ}{1000GJ} \qquad (14)$$

where:

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

In parallel to this CMM project an energy efficiency JI project has been developed at the district heating system of Donetsk (project reference nr 0007). This project entails increasing the efficiency of heat generation and could improve the boiler efficiency at one of the three boilers. As the monitoring plan entails the monitoring of the actual boiler efficiency double counting of emission reductions is avoided.

On-site heat generation emission factors

The three heat generation emission factors of Vostochnaya, Centralnaya, and Yakovlevskaya are fixed ex-ante by the following equation. As these boilers will be decommissioned no monitoring of emission factors will be possible. The specific value of each emission factor is given in Annex 2.

$$EF_{heat,i,y} = \frac{EF_{CO2,i}}{Eff_{heat,i}} x \frac{44}{12} x \frac{1TJ}{1000GJ} \qquad (15)$$

where:

$EF_{heat,i,y}$	Emissions factor for heat generation (tCO_2/ GJ)
$EF_{CO2,i}$	CO_2 emission factor of fuel used in heat generation (tC/TJ)
$Eff_{heat,i}$	Boiler efficiency of the heat generation (%)
i	i stands for Vostochnaya, Centralnaya, or Yakovlevskaya
44/12	Carbon to Carbon Dioxide conversion factor
1/1000	TJ to GJ conversion factor

The fuel used at Vostochnaya and Yakovlevskaya site is natural gas. The emission factor of fuel used for natural gas is taken 15.3 tC/TJ (= IPCC default). The emission factor of the coal used at the Centralnaya boilers (grade G) is determined by the following equation.

$$EF_{CO2,centr} = \frac{C_r}{LHV_{coal}} x \frac{1000}{100} \qquad (16)$$

where:

$EF_{CO2,centr}$	CO_2 emission factor of coal used in heat generation at Centralnaya site (tC/TJ)
C_r	Mass content of coal (%)
LHV_{coal}	Lower heating value of coal (GJ/ton coal)

Vehicle fuel emission factor

The emission factor as a result of vehicle fuel use is given by the following equation. The specific value of this emission factor is given in Annex 2.

$$EF_V = \frac{EF_{CO2,i}}{Eff_V} x \frac{44}{12} x \frac{1TJ}{1000GJ} \qquad (17)$$

where:

EF_V	Emissions factor for vehicle operation replaced by the project activity (tCO_2/GJ)
EF_{CO2i}	CO_2 emission factor of fuel used for vehicle operation (tC/TJ)
Eff_V	Vehicle engine efficiency (%)
44/12	Carbon to Carbon Dioxide conversion factor
1/1000	TJ to GJ conversion factor

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

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

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:

In accordance with ACM0008 the following leakages should be considered:

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

There is no leakage in the project as:

1. There is no CMM being used for thermal demand under the baseline scenario. Hence there is no leakage for displacement of baseline thermal energy uses;
2. There is no CBM involved hence no leakage occurs from CDM drainage from outside the de-stressed zone;
3. There is no impact of the JI project on coal production as degasification activities are independent from the JI project;
4. The impact of the JI project on coal prices is difficult to assess. The JI project as such does not influence coal production so it is unlikely that the JI project will impact coal prices

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

There is no leakage in the project

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

There is no leakage in the project

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 greenhouse gas emission reduction achieved by the project over a period is the difference between the total baseline emissions over the period , the total project emissions over the period and the leakage. In case of the proposed project leakage is zero. This is given by the equation:

$$ER_y = BE_y - PE_y \quad (18)$$

where:

ER_y Emissions reductions of the project activity during the year *y* (tCO_2e)
BE_y Baseline emissions during the year *y* (tCO_2e)
PE_y Project emissions during the year *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:

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

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.
P7 CEF_{NMHC}	10%	The total quantity of NMHC content is quarterly measured in a external laboratory with special gas analyser equipment. The accuracy of the equipment is set fixed according to manufacturer data and calibration of the equipment will be done in accordance with the internal procedures of the laboratory.
P9 PC_{CH4}	2%	See CEF_{NMHC}
P10 PC_{NMHC}	10%	See CEF_{NMHC}
P11 MM_{CHP}	2%	The total quantity of methane sent to CHP is measured directly at each individual CHP module. Each CHP module has a separate meter to meter the amount of fuel gas and the amount of ignition gas consumed. For cross-checking of the amount of fuel gas pumped at the vacuum pumps and the gas treatment facility will be used. For cross-checking of the ignition gas the amount of CMM extracted from the goaf wells will be measured. For QA/QC procedures please refer of section D.3.
P13 MM_{GAS}	2%	The total quantity of methane sent to AGFCP will be measured at the AGFCP station. for cross-checking the amount of CMM extracted from the goaf wells will be measured. For QA/QC procedures please refer of section D.3
B4 $CMM_{PJ,CHP,y}$	2%	See MM_{CHP}
B5 $CMM_{PJ,GAS,y}$	2%	See MM_{GAS}
B11 $GEN_{CHP,y}$	0.5%	The net electricity generated by the project is measured directly at the cogeneration plant. For cross-checking the amount of electricity supplied/consumed by the high voltage grid will be used subtracting electricity consumed by the mine. For QA/QC procedures please refer of section D.3

B12 $EL_{cons,y}$	0.5%	The amount of electricity consumed during each year will measured directly at the four different sites. For cross-checking the amount of electricity supplied from the 110 kV grid, using commercial meters will be used.
B15 $HEAT_{deliv.DH,y}$	2%	The amount of heat delivered to the district heating will be measured through individual heat meters at the on-site heat network that will be commissioned in 2008.
B17 $EF_{CO2,DH,y}$	-	Type of fuel used at DH-boilers
B18 $Eff_{heat,DH,y}$	n/a	The efficiency of the DH-boilers will be obtained from DonetskTeploComunenergo
B19 $HEAT_{deliv,vost,y}$	2%	The amount of heat delivered to the site will be measured by meters at the heat dispatch system.
B21 $HEAT_{deliv,yak,y}$	2%	See $Heat_{deliv,vost,y}$
B23 $HEAT_{deliv,centr.y}$	2%	See $Heat_{deliv,vost,y}$.

Table 14: Quality control and quality assurance.

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

The operational and management structure of the project is the same for Vostochnaya and Yakovlevskaya CHP plants. The structure for site given in the figure below:

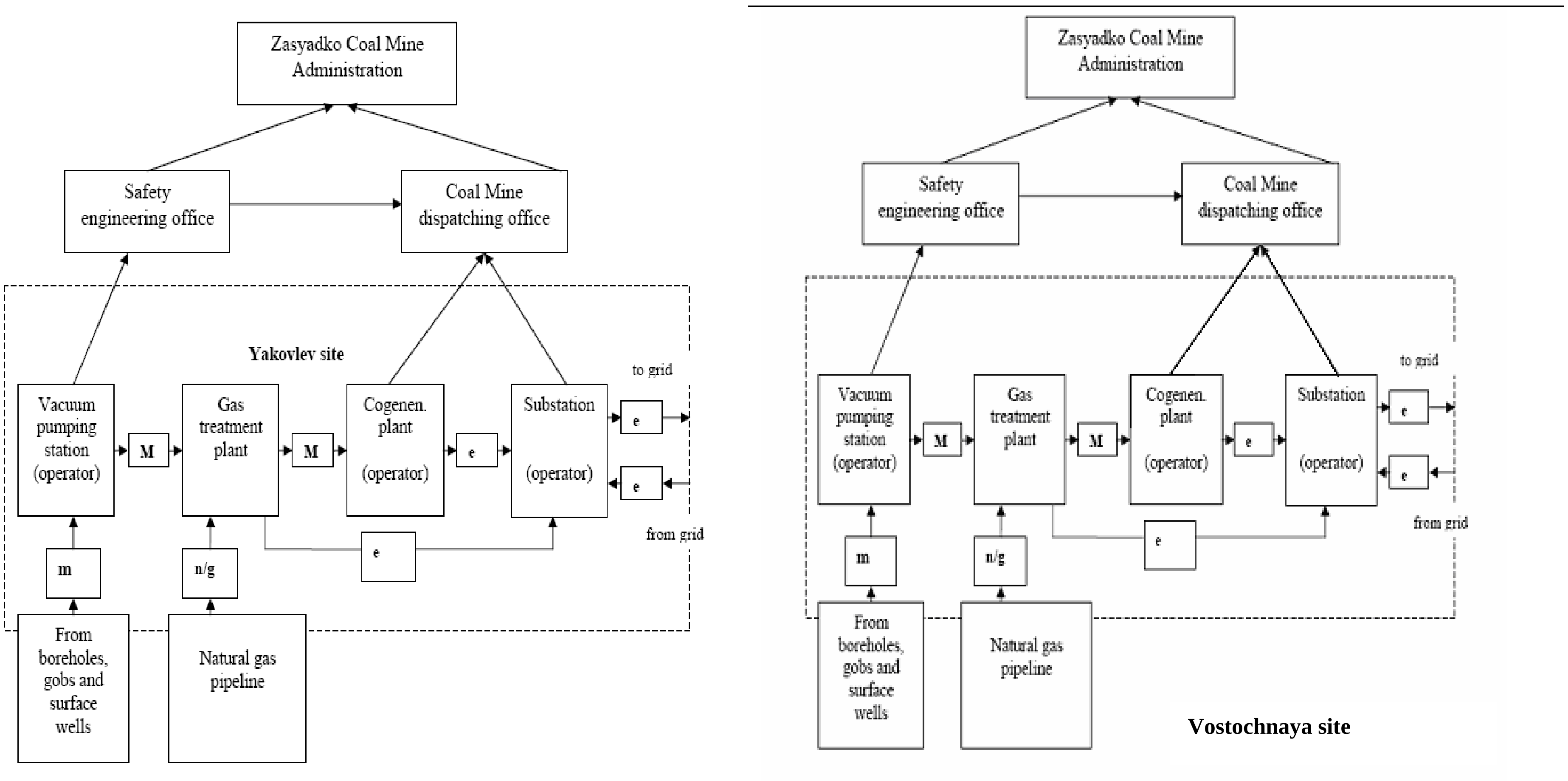

Figure 9 : Monitoring and quality control system for Vostochnaya and Yakovlevskaya sites

The control and monitoring system can be divided into an electrical part, a heat part, and a gas part.

Electrical measurements

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

- Net electricity generation of both CHP systems ($GEN_{CHP,y}$);
- Net electricity consumption of the mine at all four production sites ($EL_{cons,y}$).

The mine is connected at different points with the regional grid and the mine has its internal 6 kV grid to transport electricity to consumers and from the CHP units. In the figure below the different meters are indicated with different colours. To meter the net electricity generated by both CHP systems the yellow meters will be used as primary meters. For metering the electricity consumption of the mine the green meters will be used. For cross-checking of these figures the red meters (commercial meters connected to the grid) and blue meters (meters of the switch board of the mine) will be used.

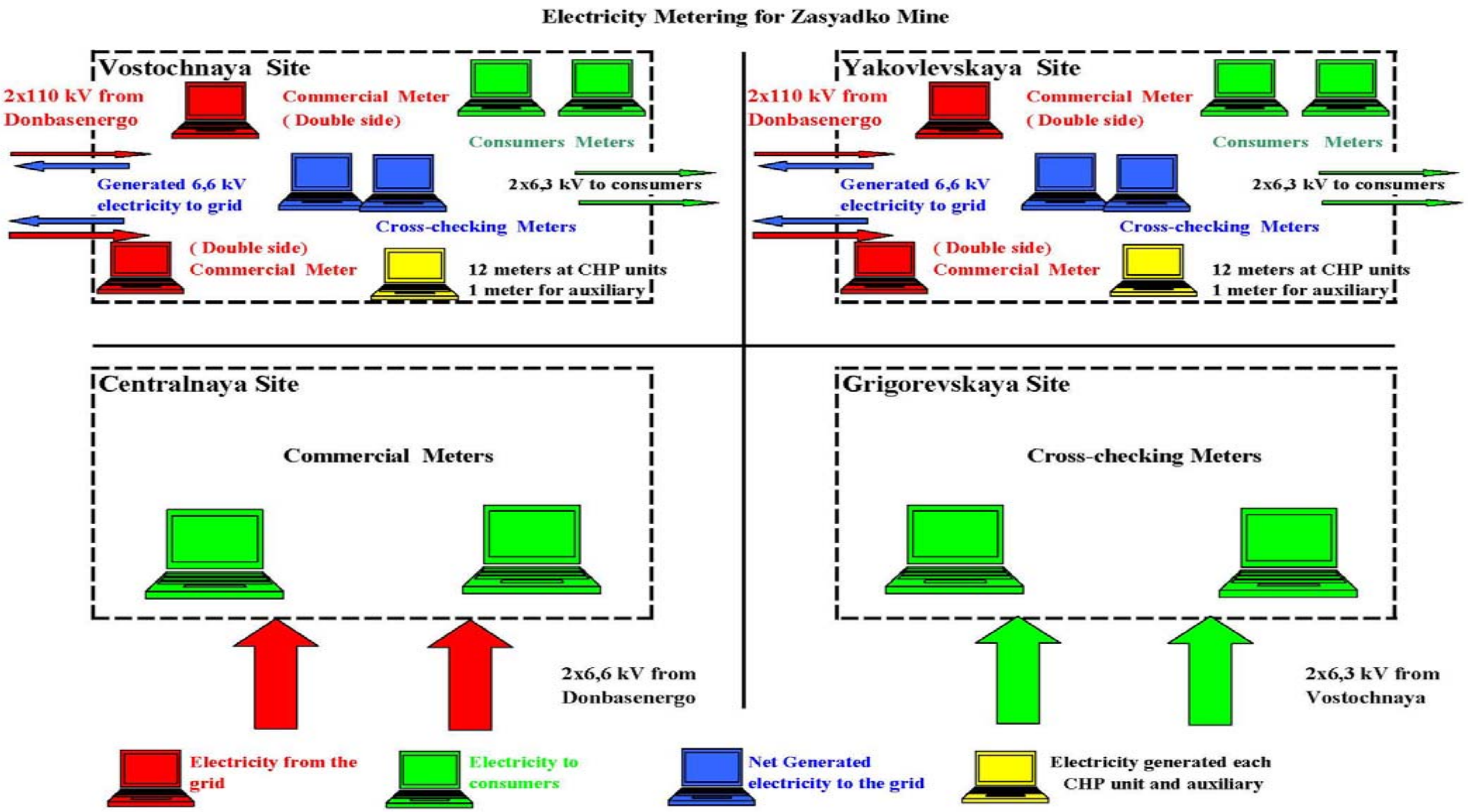

Figure 10: Electricity metering

Measuring instrument	Work parameter	Uncertainty level of data	QA/QC procedures	Body responsible for calibration and certification
Electricity meter at CHP system (6 kV)	Net electricity generated by CHP system	0.5%	Calibration interval of such meters is 3 years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for MCC ALFA SMART	Ukrainian Centre for Standardization and Metrology
Electricity meters at individual CHP modules (6 kV)	Gross electricity generated by CHP system	0.5%	Calibration interval of such meters is 3 years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for MCC ALFA SMART	Ukrainian Centre for Standardization and Metrology
Electricity meters for CHP own consumption and gas treatment plant (6 kV)	Electricity consumption of CHP plant and gas treatment plant	0.5%	Calibration interval of such meters is3 years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for MCC ALFA SMART	Ukrainian Centre for Standardization and Metrology
Commercial electricity meter at 110 kV	Power consumption or supply from the Ukrainian grid	0.2%	Calibration interval of such meters is 3 years. Calibration procedures for meters are implemented in compliance with calibration methodology developed for MCC ALFA SMART	Ukrainian Centre for Standardization and Metrology

Table 15: Electricity metering equipment

Heat measurements

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

- Heat delivered to Vostochnaya site, Yakovlevskaya site, Centralnaya site, and the District Heating system;
- The heat delivered to the Grigoryevskaya site will be measured, but will not be used to calculate emissions reductions due to the very low amount of heat. This is conservative. See also footnote in section D.1.1.4.

Three heat substations will be in operation from which the heat will be dispatched to the different consumers. As the substations are to be built on the same location as were the boilers were located, the heat delivered will be measured at this location. These meters are indicated below in yellow. The green meters will meter the actual consumption at the sites and the DH-system. The red meters will measure the heat generation of each individual CHP modules and the blue meter will meter the heat generated by each CHP facility. These figures will be used for cross-checking.

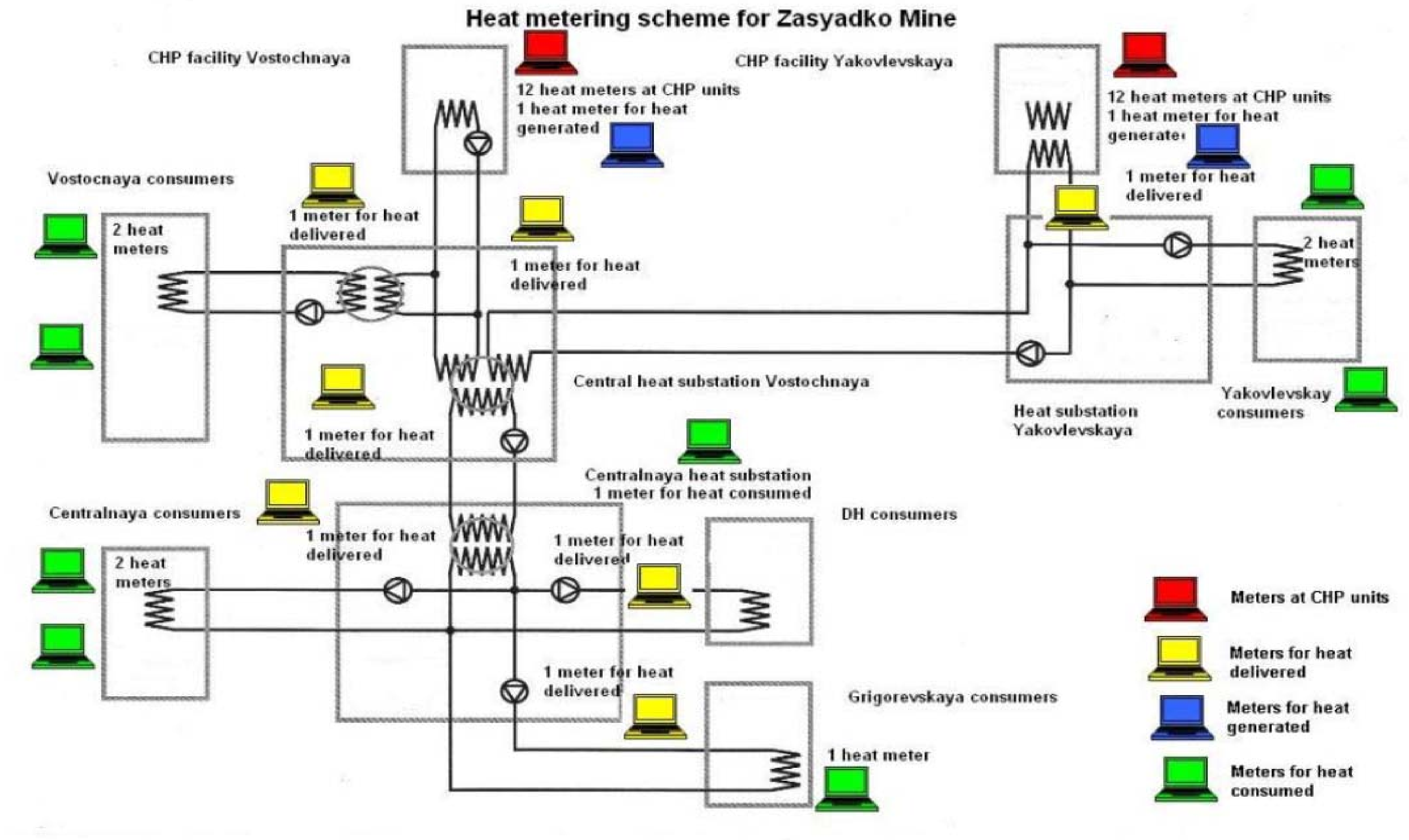

Figure 11: Heat Metering for Zasyadko Mine.

Measuring instrument	Work parameter	Uncertainty level of data	QA/QC procedures	Body responsible for calibration and certification
Heat meter SA-94/2 M	Amount of heat generated by each CHP module	2%	Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Heat meter SA-94/2 M	Amount of heat generated by CHP facility	2%	Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Heat meter SA-94/2 M	Amount of heat delivered to each production site	2%	Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Heat meter SA-94/2 M	Amount of heat delivered to DH system	2%	Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Heat meter SA-94/2 M	Amount of heat consumed by each production site	2%	Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology

Table 16: Heat metering equipment

Measurement of CMM consumption

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

- CMM consumed at the CHP modules (MM_{CHP});
- CMM delivered to the gas filling stations (MM_{GAS}).

The total record of CMM consumption is made directly at each CHP module. Two separate flow meters will measure the amount of CMM supplied to each CHP module as fuel methane and as ignition methane. These meters are indicated below in yellow for fuel methane and green for ignition methane. For cross-checking of the amount of supplied fuel gas the meters at the vacuum pump stations (pink meters) will be used and the meters at the surface wells (red meters).

The CMM consumption of the gas filling stations will be metered directly at each block indicated with green meters. For cross-checking the amount CMM at the surface wells (red meters) will be used.

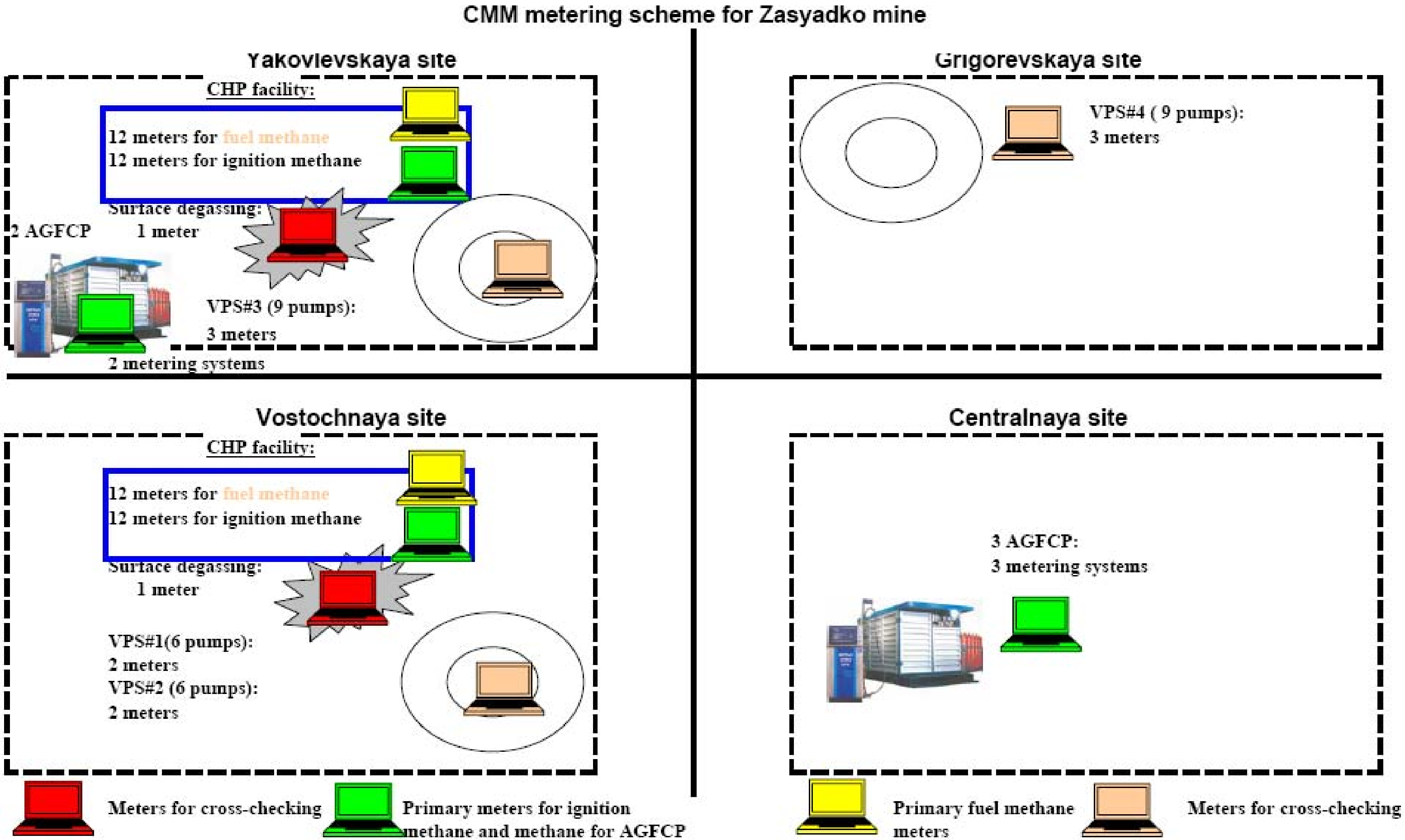

Figure 12: CMM metering for Zasyadko Mine

Measuring instrument Flow meters	Work parameter	Uncertainty level of data	QA/QC procedures	Body responsible for calibration and certification
Volume of pure methane consumed as fuel gas at CHP module	Volume of pure methane supplied to CHP modules	2%	DRG.M Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Volume of pure methane consumed as ignition gas at CHP module	Volume of pure methane supplied to CHP modules	2%	DRG.M Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Volume of pure methane supplied by the vacuum pumps to the gas treatment plant	Volume of pure methane supplied to CHP modules	2%	Gas Analyzer AG0012 Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology
Volume of pure methane supplied by the gas treatment plant to the CHP modules.	Volume of pure methane supplied to CHP modules	2%	W.Keuter.Im Lipperfeld 36 D 46047 Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology

Table 17: Methane metering equipment

The follows parameters will be monitored to measure the amount of supplied methane (in nm^3):

#	**Data**	**Unit**	**Method**	**Frequency of Measurement**	**Source**	**Responsible**
1	Methane concentration	vol. %	Concentration measurement	Permanent	Gas-analyzer	Operator
2	CMM mix pressure	mbar	Pressure measurement	Permanent	Manometer	Operator
3	CMM mix temperature	°C	Temperature measurement	Permanent	Temperature sensors	Operator

4	Pure methane volume	nm^3	Calculation	Permanent		Operator

Table 18: Monitoring of parameters to determine the volume of CMM supplied

Emergency operations

In case of break down 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, natural gas will be fed into gas treatment plant and consequently into the inlets of engines and into pre-chambers.

Employees' qualification

All basic equipment for CHP plant that is cogeneration to be supplied by the GE Jenbacher company (Austria). As stipulated in the delivery contract education of staff that will operate those units will be provided in Austria. Additional training will be provided by GE Jenbacher technicians during installation and commissioning works. The employees responsible for the monitoring control also will be dully trained during installation of such system.

Data storage and responsibilities

All operators are responsible for data administration. All relevant data will be summarized daily and archived electronically and as a printout. All data will be stored at least five years long. Besides, operators prepare standardized daily, weekly, monthly and yearly reports.

Responsibilities

- VPS operator controls data before VPS and after VPS (at the gas treatment plant) including CMM and natural gas flow parameters;
- Two cogeneration plant operators control data at the inlets of cogeneration modules (at the gas treatment plant), work process parameters, and heat and power output;
- Substation operator controls data on electric power amounts dispatched to and supplied from the grid as well as in-house electricity consumption.

All the information will be channelled to the workstation of Coal Mine central dispatching office and on-line monitored by the head of the shift who will be responsible for calculation of CO_2 equivalent emission reduction. Such calculations will be implemented on monthly basis. The general supervision of the monitoring system will be executed by Zasyadko Coal Mine administration under the existing control and reporting system.

Internal reviews and adjustment procedures

The general project management will be implemented by the Deputy General Director of the Zasyadko Coal Mine through supervising and coordinating activities of his subordinates, such as deputy director on surface degasification, chief power engineer, chief heating engineer, and heads of safety engineering departments. On-site day-to- day management will be implemented by the manager of cogeneration station who will direct two shift operators responsible for cogeneration modules and gas treatment plant performance. Besides on-duty electrician will be work at the plant. In the daytime a group of mechanics who will be responsible for preventive measures and maintenance of all technological equipment, measuring instruments as well as of automation tools and telemechanics will be present on-site. On-line information will be transmitted directly to the head of shift into the Coal Mine Central Dispatching Office. The cogeneration plant will be in round-the-clock operation. Three shifts by 8 hours will be introduced.

Introduction of the modern computerized control system allows for efficient on-line monitoring and reviewing work process performance at the Zasyadko Central Dispatching office. Any considerable deviation of monitored data from given work parameters will be promptly noticed and source of such deviation will be easily identified. In turn this enables the head of shift to efficiently coordinate adjustment actions of his shift subordinates including on-duty technical staff that will improve work process and eliminate such deviations.

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

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SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

		2004	2005	2006	2007	2008	2009	2010	2011	2012
Project emissions	[tCO2e/yr]	5,022	4,756	53,586	137,084	254,008	255,439	255,439	255,439	255,439
Total 2006 - 2012	[tCO2e]	1,476,214								

Table 19: Project emissions

E.2. Estimated leakage:

In case of the project activity no leakage is expected

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

		2004	2005	2006	2007	2008	2009	2010	2011	2012
Project emissions	[tCO2e/yr]	5,022	4,756	53,586	137,084	254,008	255,439	255,439	255,439	255,439
Total 2006 - 2012	[tCO2e]	1,476,214								

Table 20: Project emissions

E.4. Estimated baseline emissions:

		2004	2005	2006	2007	2008	2009	2010	2011	2012
Baseline emissions	[tCO2e/yr]	40,854	38,692	481,904	1,248,835	2,393,841	2,405,486	2,405,486	2,405,486	2,405,486
Total 2006 - 2012	[tCO2e]	13,826,069								

Table 21: Baseline emissions

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

		2004	2005	2006	2007	2008	2009	2010	2011	2012
Emission reductions	[tCO2e/yr]	35,832	33,936	428,318	1,111,751	2,139,833	2,150,046	2,150,046	2,150,046	2,150,046
Total VERs/ERUs	**[tCO2e]**	**1,609,837**				**10,740,018**				
Total 2004-2012	**[tCO2e]**	**12,349,855**								

Table 22: Emission reductions

An overview of the emission reductions per measure can be found in section A.4.3. The emissions of 2004, 2005, and 2006 are based on actual measurements.

Emission reductions generated in 2004 - 2007 will be transferred as AAUs in the frame of International Emissions Trading mechanism of the Kyoto Protocol. The emission reductions generated during 2008-2012 are to be transferred as ERUs in the frame of Joint Implementation mechanism of the Kyoto Protocol. The baseline setting and monitoring of reductions is done identical for the whole period, i.e. 2006-2012.

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

Please refer to section E.5.

Risks in estimation emission reductions:

While estimating the amount of emission reductions, some assumptions have been made. The following risks can be identified in the estimation:

- Amount of methane extracted. The exact amount of gas that will be extracted by the mine is difficult to determine precisely. However, the amount of methane utilized is lower that the expected amount that will be extracted. Therefore, even if the amount of extracted methane is lower, it will not reduce the amount of emission reductions;
- Amount of methane utilized. The amount of methane utilized depends on the working time of the CHP modules. Given the reliability of those modules, it is not expected that the amount of working hours will be much lower;
- Heat delivered by the CHP modules to the production sites and the DH-system. The amount of heat delivered depends on the heat needs of the different production sites and of the DH-system. Lower demand (e.g. due to mild winters) will reduce the heat needs and hence the amount the emission reductions. However, the heat component only contributes with 6% to the emission reduction potential so lower heat demand will have a minor effect;
- Methane delivered to the vehicle. The amount of methane supplied to the vehicle could be lower than expected and will lower the amount the emission reductions. However, the vehicle component only contributes with 2% to the emission reduction potential so any change will have a minor effect.

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:

CHP is very efficient technology for generating electricity and heat together. A CHP plant is an installation where there is simultaneous generation of usable heat and electricity in a single process. A CHP can provide a secure and highly efficient method of generating electricity and heat at the point of use. Due to the utilization of heat from electricity generation and the avoidance of transmission losses because electricity is generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage compared with power stations and heat only boilers. This allows for economic savings where there is a suitable balance between the heat and power loads.

Another important factor that witness for benefits of cogeneration and CHP is its high environmental purity. CHP have lower ranges of pollutant emissions and allow to reducing heat pollution of atmosphere. CHP installation on average achieves a reduction of 10 per cent in CO2 emissions in comparison with gas fired combined cycle gas turbine.

According to Ukrainian law "On the ecological examination" all projects that can result in violation of ecological norms and/or negative influence on the state of natural environment are subject to ecological examination that is a form of Environmental Impact Assessment. In order to comply with regulation Zasyadko Coal Mine submitted a business plan that envisages CMM utilization activities at both production sites to the Ukrainian Ministry of ecology and natural resources for preliminary state ecological expertise. The expertise was positive and particularly emphasized reduction of coal mine methane and other pollutants emissions.

Project specific EIA is being carried out by "Sinapse" and is integral part of the project technical documentation. In its work on EIA Sinapse totally adhere to existing norms, regulation and instructions, that among others include:

- GKD 34.02.305-202 "Pollutant emissions of the energy plants to the atmosphere".
- Digest of the legislative, standard-and-methodical and instructions documents in environmental protection. - Kharkov, 1998.
- Instruction in execution and contents of the draft standard of the maximum permissible emissions of the contaminants emitted by the stationary sources into the atmospheric air/Ministry of Environmental protection and Nuclear Safety of Ukraine. - K: 1996.
- Emissions of the contaminants emitted by the energy plants into the atmosphere. Methods of determination. Kiev, 2002.
- State sanitary rules of protection of the atmospheric air of the inhabited localities. Donetsk, 1998.
- Maximum allowable concentrations and approximate safety levels of impact of the contaminants in the atmospheric air of the inhabited localities. Donetsk, 1998.
- Manual in planning of the draft section (working draft) "Environmental protection" to SNiP 1.02.01-85.-M., 1988.
- Instruction about the order of consideration, coordination and expertise of the air-protection measures and issuance of permissions for the emission of the contaminants to the atmosphere in the project decision: OND 1-84.-L.: Gidrometeoizdat, 1984.
- Standard instruction in organization of the control system for the industrial emissions in the branches of industry. - L.: Goskomgidromet, 1986.
- Digest of methods in calculation of pollutant emissions of different plants to the atmosphere - L.: Gidrometeoizdat, 1986.

- Methods of calculation of concentrations of the hazardous substances in the atmospheric air of the enterprises: OND-86. - L.: Gidrometeoizdat, 1987.
- Method instructions in regulating of the emissions in case of origination of the adverse conditions: RD 52.04.52-85.-L.: Gidrometeoizdat, 1987.
- Methods of calculation of concentrations of the hazardous substances in the atmospheric air of the enterprises: OND-86. - L.: Gidrometeoizdat, 1987.
- Method instructions in regulating of the emissions in case of origination of the adverse conditions: RD 52.04.52-85.-L.: Gidrometeoizdat, 1987.
- Method instructions in installation of the signaling devices and gas-analyzers for control of the highly explosive and maximum allowable concentrations of the chemical agents in the air of the production areas: VSN 64-86/Ministry of the Chemical Industry of the USSR/VNIITB.
- Manual in control of the air pollution sources: OND-90.-S.-P.: PDNTP, 1992.
- Temporal instruction in control of the source of emissions of contaminants into the atmosphere with application of gas-analytic devices. - L.:Goskomgidromet, 1986.
- Methods of estimation of the unorganized emissions of the gas-processing plants: RD 39-014306-413-88, 1988.
- Basic directions of the state policy of Ukraine in the sphere of the environmental protection, resource management and provision of the environmental safety. - Donetsk.: VAT "UkrNTEK", 1988.

According to the schedule technical documentation as well as full EIA was accomplished by the June 2005. It also should be noted that "Sinapse" has got necessary experience, qualification and expertise in conducting EIA. In fact EIA as well as technical documentation for cogeneration modules that are being installed at Vostochnaya has been done by this company.

Under existing environmental legislation Zasyadko coal mine is obliged to monitor and report annually certain contaminant emissions (nitrogen dioxide, sulfurous anhydride, carbon oxide, dust etc.). Therefore there are already well established and fully functional procedures for environmental monitoring at the Zasyadko coal mine. The office of environmental engineer is responsible for relevant data monitor, collection and compilation of quarterly reports. One a year report is submitted to Ministry of Environment Protection.

Environmental performance of the project will be monitored in the framework of existing procedures and data that will be collected will be incorporated into total environmental report that Zasyadko coal mine prepares annually.

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:

Please refer to section F.1.

SECTION G. Stakeholders' comments

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

The project owner, Zasyadko Coal Mine have undertaken intensive public consultation and disclosure activities in order to disseminate information about the project among wide range of stakeholders and invite for their comments, opinions and suggestions. Main influential groups of the stakeholders identified for the project include Administration of Donetsk oblast, miners that work at coal mine, various local non-government and public organizations and other mining companies.

Publications in specialized and general mass-media (e.g. newspapers and magazines) were selected and are being used as primary channel for communication with stakeholders. In particular information about the project was presented in:

- Magazine "Environmental protection", issue 5, 2003:
- Magazine "Protection of labour", issue 8, 2003;
- Magazine "Coal of Ukraine", December 2003;
- "Rock geology, rock mechanics and mine surveying", scientific papers bulletin, Donetsk, 2004, National Academy of Sciences of Ukraine.

Copies of the articles are available on request.

Summary of the comments received
All comments received by the coal mine were positive towards implementation of the project. It was especially noted that utilization of coal mine methane will increase safety of the work, reduce emissions of GHG and other pollutants and will have positive social impact with creation of new working places.

Stakeholder consultations also revealed that there is substantial interest to the technical details of project implementation as well as expected results from other coal mines not only in Ukraine but also in neighbor countries, in particularly in Russia. Other mining companies look forward to replicating the experience of Zasyadko Coal Mine if project is successful.

Zasyadko Coal Mine intends to continue interacting with stakeholders during project realization and operation.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

Baseline Carbon Emission Factor of DH boilers ($EF_{DH,y}$)
Natural gas is current the fossil fuel that is used in the DH-system of Donetsk. The boiler efficiency of the off-site Donetsk DH-system (the Ionina boiler house, the block 287 boiler house and the block 518) were not available when this PDD was prepared. To be conservative a boiler efficiency of 90% was taken. Please note that in accordance with the monitoring plan of section D, both the boiler efficiency and the fuel type will be annually monitored as the boiler will not be decommissioned.

Boiler	Fossil fuel	Efficiency [%]	$EF_{CO2,i}$ [tC/TJ]	EF_{heat} [tCO2/GJ]
DH-boilers	NG	90	15.3	0.063

Table 23: Baseline carbon emission factors of DH boilers

Baseline Carbon Emission Factor of on-site boilers
The carbon factors have been calculated and fixed ex-ante for the on-site boilers using the formulae as described in section D of the PDD.

Boiler	Fossil fuel	Efficiency [%]	$EF_{CO2,i}$ [tC/TJ]	EF_{heat} [tCO2/GJ]
Boiler Vostochnaya	NG	90	15.3	0.063
Boiler Yakovlevskaya	NG	90	15.3	0.063
Boiler Centralnaya	Coal	80	31.3[20]	0.143

Table 24: Baseline carbon emission factors of on-site boilers

Baseline Carbon Emission Factor of vehicles (EF_v)
There are several types of vehicles that are being used by the Zasyadko mine. On average these vehicles use approximate 50% diesel and 50% gasoline. Therefore the average factor of diesel and gasoline has been taken as the fuel in the baseline scenario. In order to be conservative a vehicle engine efficiency of 100% has been taken. The formula to fix the emission factor ex-ante is given in section D.

Fuel type	Efficiency [%]	$EF_{CO2,diesel}$ [tC/TJ]	$EF_{CO2,gasoline}$ [tC/TJ]	$EF_{vehicle}$ [tCO2/GJ]
50% diesel/50% gasoline	100%	20.2	18.9	0.072

Table 25: Baseline carbon emission factor of vehicles

Emission factor of the Ukrainian grid ($EF_{grid,produced,y}$ and $EF_{grid,reduced,y}$)
The recent developed Ukrainian grid factors have used. Below a description of these emission factors are given. For this project the grid factors have been fixed ex-ante.

[20] Based on a LHV of 28.047 GJ/t and a mass content of coal of 87.87%.

Standardized emission factors for the Ukrainian electricity grid

Introduction

Many Joint Implementation (JI) projects have an impact on the CO_2 emissions of the regional or national electricity grid. Given the fact that in most Economies in Transition (IET) an integrated electricity grid exists, a standardized baseline can be used to estimate the amount of CO_2 emission reductions on the national grid in case of:

a) Additional electricity production and supply to the grid as a result of a JI project (=producing projects);
b) Reduction of electricity consumption due to the JI project resulting in less electricity generation in the grid (= reducing projects);
c) Efficient on-site electricity generation with on-site consumption. Such a JI project can either be a), b), or a combination of both (e.g. on-site cogeneration with partial on-site consumption and partial delivery to the grid).

So far most JI projects in EIT, including Ukraine, have used the standardized Emission Factors (EFs) of the ERUPT programme. In the ERUPT programme for each EIT a baseline for producing projects and reducing projects was developed. The ERUPT approach is generic and does not take into account specific local circumstances. Therefore in recent years new standardized baselines were developed for countries like Romania, Bulgaria, and Estonia. In Ukraine a similar need exist to develop a new standardized electricity baseline to take the specific circumstances of Ukraine into account. The following baseline study establishes a new electricity grid baseline for Ukraine for both producing JI projects and reducing JI projects.

This new baseline has been based on the following guidance and approaches:

- The "Guidance on criteria for baseline setting and monitoring" for JI projects, issued by the Joint Implementation Supervisory Committee[21];
- The "Operational Guidelines for the Project Design Document", further referred to as ERUPT approach or baseline [22];
- The approved CDM methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" [23];
- Specific circumstances for Ukraine as described below.

ERUPT

The ERUPT baseline was based on the following main principles:

- Based mainly on indirect data sources for electricity grids (i.e. IEA/OECD reports);
- Inclusion of grid losses for reducing JI projects;
- An assumption that all fossil fuel power plants are operating on the margin and in the period of 2000-2030 all fossil fuel power plants will gradually switch to natural gas.

The weak point of this approach is the fact that the date sources are not specific. For example, the Net Calorific Value (NCV) of coals was not determined on installation level but was taken from IPCC default values. Furthermore the IEA data included electricity data until 2002 only. ERUPT assumes that Ukraine would switch all its fossil-fuel plant from coal to natural gas. In Ukraine such an assumption is unrealistic as the tendency is currently in the opposite direction.

ACM0002

The ACM0002 methodology was developed in the context of CDM projects. The methodology takes a combination of the Operating Margin (OM) and the Build Margin (BM) to estimate the emissions in absence

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[21] Guidance on criteria for baseline setting and monitoring, version 01, Joint Implementation Supervisory Committee, ji.unfccc.int

[22] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Ministry of Economic Affairs of the Netherlands, May 2004

[23] Consolidated baseline methodology for grid-connected electricity generation from renewable sources, version 06, 19 May 2006, cdm.unfccc.int

of the CDM project activity. To calculate the OM four different methodologies can be used. The BM in the methodology assumes that recent built power plants are indicative for future additions to the grid in the baseline scenario and as a result of the CDM project activity construction of new power plants is avoided. This approach is valid in electricity grids in which the installed generating capacity is increasing, which is mostly the case in developing countries. However, the Ukrainian grid has a significant overcapacity and many power plants are either operating below capacity or have been moth-balled.

Nuclear is providing the base load in Ukraine
In Ukraine nuclear power plants are providing the base load of the electricity in Ukraine. To reduce the dependence on imported fuel the nuclear power plants are running at maximum capacity where possible. In the past five years nuclear power plants provide almost 50% of the total electricity:

Year	2001	2002	2003	2004	2005
Share of AES	44%	45%	45%	48%	48%

Table 26: Share of nuclear power plant in the annual electricity generation

All other power stations are operating on the margin. This includes hydro power plants which is show in the table below.

	Minimum; 03:00	Maximum; 19:00
Consumption, MW	21,287	27,126
Generation, MW	22,464	28,354
Thermal power plants	*10,049*	*13,506*
Hydro power plants	*527*	*3,971*
Nuclear power plants	*11,888*	*10,877*
Balance imports/export, MW	-1,177	-1,228

Table 27: Electricity demand in Ukraine on 31 March 2005[24]

Development of the Ukrainian electricity sector
The National Energy Strategy[25] sets the approach for the overall energy complex of Ukraine and the electricity sector in particular. The main priority of Ukraine is to reduce the dependence of imported fossil fuels. The strategy sets the following priorities[26]:

- increased use of local coal as a fuel;
- construction of the new nuclear power plants;
- energy efficiency and energy saving.

Due to the sharp increase of imported natural gas prices a gradual switch from natural gas to coal at the power plants is planned in the nearest future. Ukraine possesses a large overcapacity of the fossil-powered plants of which many are mothballed. These moth-balled plants might be connected to the grid in case of growing demand.

In the table below the installed capacity and load factor is given in Ukraine. As one can see the average load factor of thermal power plant is very low.

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[24] Ukrenergo, http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/article?art_id=39047&cat_id=35061

[25] http://mpe.kmu.gov.ua/fuel/control/uk/doccatalog/list?currDir=50505

[26] Energy Strategy of Ukraine for the Period until 2030, section 16.1, page 127.

	Installed capacity (GW)	Average load factor, %
Thermal power plants	33.6	28.0
Hydro power plants	4.8	81.4
Nuclear power plants	13.8	26.0
Total	**52.2**	**39.0**

Table 28: Installed capacity in Ukraine in 2004[27]

According to IEA's estimations, about 25% of thermal units might not be able to operate (though there is no official statistics). This means that still at least 45% of the installed thermal power capacity could be utilized, but is currently not used. In accordance with the IEA report the 'current capacity will be sufficient to meet the demand in the next decade'[28].

In the table below the peak load of the years 2001- 2005 are given which is approximately 50% of the installed capacity.

	2001	2002	2003	2004	2005
Peak load (GW)	28.3	29.3	26.4	27.9	28.7

Table 29: Peak load in Ukraine in 2001 - 2005[29]

New nuclear power plants will take significant time to be constructed will not get on-line before the end of the second commitment period in 2012. There is no nuclear reactor construction site at such an advanced stage remaining in Ukraine, it is unlikely that Ukraine will have enough resources to commission any new nuclear units in the foreseeable future (before 2012)[30].

Latest nuclear additions (since 1991):

- Zaporizhzhya NPP unit 6, capacity 1 GW, commissioned in 1995;
- Rivne NPP unit 4, capacity 1 GW, commissioned in 2004;
- Khmelnitsky NPP unit 2, capacity 1 GW, commissioned in 2004.

Nuclear power plants under planning or at early stage of construction:

- South Ukraine NPP one additional unit, capacity 1 GW;
- Khmelnitsky NPP two additional units, capacity 1 GW each.

Approach chosen

In the selected approach of the new Ukrainian baseline the BM is not a valid parameter. Strictly applying BM in accordance with ACM0002 would result in a BM of zero as the latest additions to the Ukrainian grid were nuclear power plants. Therefore applying BM taking past additions to the Ukrainian grid would result in an unrealistic and distorted picture of the emission factor of the Ukrainian grid. Therefore the Operating Margin only will be used to develop the baseline in Ukraine.

The following assumptions from ACM0002 will be applied:

1) The grid must constitute of all the power plants connected to the grid. This assumption has been met as all power plants have been considered;
2) There should be no significant electricity imports. This assumption has been met in Ukraine as Ukraine is a net exporting country as shown in the table below;

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[27] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 272, table 8.1

[28] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 269

[29] Ministry of Energy, letter dated 11 January 2007

[30] http://www.xaec.org.ua/index-ua.html

3) Electricity exports are not accounted separately and are not excluded from the calculations.

	2001	2002	2003
Electricity produced, GWh	175,109	179,195	187,595
Exports, GWh	5,196	8,576	12,175
Imports, GWh	2,137	5,461	7,235

Table 30: Imports and exports balance in Ukraine[31]

ACM0002 offers several choices for calculating the OM. Dispatch data analysis cannot be applied, since the grid data is not available[32]. Simple adjusted OM approach is not applicable for the same reason. The average OM calculation would not present a realistic picture and distort the results, since nuclear power plants always work in the base load due to the technical limitations (and therefore cannot be displaced) and constitute up to 48% of the overall electricity generation during the past 5 years.

Therefore, the simple OM approach is used to calculate the grid emission factor. In Ukraine the low-cost must-run power plants are nuclear power stations. Their total contribution to the electricity production is below 50% of the total electricity production. The remaining power plants, all being the fossil-fuel plants and hydro power plants, are used to calculate the Simple OM.

%	2001	2002	2003	2004	2005
Nuclear power plants	44.23	45.08	45.32	47.99	47.92
Thermal power plants	38.81	38.32	37.24	32.50	33.22
Combined heat and power	9.92	11.02	12.28	13.04	12.21
Hydro power plants	7.04	5.58	5.15	6.47	6.65

Table 31: Share of power plants in the annual electricity generation of Ukraine[33]

The simple OM is calculated using the following formula:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum GEN_{j,y}}$$ *(Equation 19)*

Where:

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y* (2001-2005);

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid;

$COEF_{i,j,y}$ is the CO2 emission coefficient of fuel *I* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

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[31] Source: State Committee of Statistics of Ukraine. Fuel and energy resources of Ukraine 2001-2003. Kyiv, 2004

[32] Ministry of Energy, letter dated 11 January 2007

[33] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

The CO2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad \textit{(Equation 20)}$$

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;
$OXID_i$ is the oxidation factor of the fuel;
$EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel *i*.

Individual data for power generation and fuel properties was obtained from the individual power plants[34]. The majority of the electricity (up to 95%) is generated centrally and therefore the data is comprehensive[35].

The Net Calorific Value (NCV) of fossil fuel can change considerably, in particular when using coal. Therefore the local NCV values of individual power plants for natural gas and coal were used. For heavy fuel oil, the IPCC[36] default NCV was used. Local CO_2 emission factors for all types of fuels were taken for the purposes of the calculations and Ukrainian oxidation factors were used. In the case of small-scale power plants some data regarding the fuel NCV is missing in the reports. For the purpose of simplicity, the NCV of similar fuel from a power plant from the same region of Ukraine was used.

Reducing JI projects

The Simple OM is applicable for additional electricity production delivered to the grid as a result of the project (producing JI projects). However, reducing JI projects also reduce grid losses. For example a JI project reduces on-site electricity *consumption* with 100,000 MWh and the losses in the grid are 10%. This means that the actual reduction in electricity *production* is 111,111 MWh. Therefore a reduction of these grid losses should be taken into account for reducing JI projects to calculate the actual emission reductions.

The losses in the Ukrainian grid are given in the table below and are based on the data obtained directly from the Ukrainian power plants through the Ministry of Energy.

Year	Technical losses %	Non-technical losses %	Total %
2001	14,2	7	21,2
2002	14,6	6,5	21,1
2003	14,2	5,4	19,6
2004	13,4	3,2	16,6
2005	13,1	1,6	14,7

Table 32: Grid losses in Ukraine[37]

[34] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

[35] The data for small units (usually categorized in the Ukrainian statistics as 'CHPs and others') is scattered and was not always available. As it was rather unrealistic to collect the comprehensive data from each small-scale power plant, an average CO2 emission factor was calculated for the small-scale plants that provided the data. For the purpose of simplicity it was considered that all the electricity generated by the small power plants has the same average emission factor obtained.

[36] IPCC 1996. Revised guidelines for national greenhouse gas inventories.

[37] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

As one can see grid losses are divided into technical losses and non-technical losses. For the purpose of estimating the EF only technical losses[38] are taken into account. As can been seen in the table the technical grid losses are decreasing. The average decrease of grid losses in this period was 0.275% per annum. Extrapolating these decreasing losses to 2012 results in technical grid losses of 12% by 2012. However, in order to be conservative the grid losses *over the full period 2006-2012* have been taken as 10%.

Further considerations

The "Guidance on criteria for baseline setting and monitoring" for JI projects requires baselines to be conservative. The following measures have been taken to adhere to this guidance and to be conservative:

- The grid emission factor is actually expected to grow due to the current tendency to switch from gas to coal;
- Hydro power plants have been included in the OM. This is conservative;
- With the growing electricity demand, out-dated mothballed fossil fired power plants are likely to come on-line as existing nuclear power plants are working on full load and new nuclear power plants are unlikely to come on-line before 2012. The emission factor of those moth-balled power plants is higher as all of them are coal of heavy fuel oil fired[39];
- The technical grid losses in Ukraine are high, though decreasing. With the current pace the grid losses in Ukraine will be around 12% in 2012. To be conservative the losses have been taken 10%;
- The emissions of methane and nitrous oxide have not taken into consideration, which is in line with ACM0002. This is conservative.

Conclusion

An average CO_2 emission factor was calculated based on the years 2003-2005. The proposed baseline factors is based on the average constituting a fixed emission factor of the Ukrainian grid for the period of 2006-2012. Both baseline factors are calculated using the formulae below:

$$EF_{grid,produced,y} = EF_{OM,y} \qquad \text{(Equation 21)}$$

and

$$EF_{grid,reduced,y} = \frac{EF_{grid,produced,y}}{1 - loss_{grid}} \qquad \text{(Equation 22)}$$

Where:

$EF_{grid,produced,y}$ is the emission factor for JI projects supplying additional electricity to the grid (tCO2/MWh);
$EF_{grid,reduced,y}$ is the emission factor for JI projects reducing electricity consumptionfrom the grid (tCO2/MWh)factor of the fuel;
$EF_{OM,y}$ is the simple OM of the Ukrainian grid (tCO2/MWh);
$loss_{grid}$ is the technical losses in the grid (%).

The following result was obtained:

Type of project	**Parameter**	**EF (tCO2/MWh)**
JI project producing electricity	$EF_{grid,produced,y}$	0.807
JI projects reducing electricity	$EF_{grid,reduced,y}$	0.896

Table 33: Emission Factors for the Ukrainian grid 2006 - 2012

[38] Ukrainian electricity statistics gives two types of losses – the so-called 'technical' and 'non-technical'. 'Non-technical' losses describe the non-payments and other losses of unknown origin.

[39] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

Monitoring

This baseline requires the monitoring of the following parameters:

- Electricity produced by the project and delivered to the grid in year y (in MWh);
- Electricity consumption reduced by the project in year (in MWh);
- Electricity produced by the project and consumed on-site in year y (in MWh);

The baseline emissions are calculated as follows:

$$BE_y = EF_{grid,produced,y} x EL_{produced,y} + EF_{grid,reduced,y} x \left(EL_{reduced,y} + EL_{consumed,y} \right) \quad \textit{(Equation 23)}$$

Where:

BE_y	are the baseline emissions in year y (tCO2);
$EF_{grid,produced,y}$	is the emission factor of producing projects (tCO2/MWh);
$EL_{produced,y}$	is electricity produced and delivered to the grid by the project in year y (MWh);
$EF_{grid,reduced,y}$	is the emission factor of reducing projects (tCO2/MWh);
$EL_{produced,y}$	is electricity consumption reduced by the project in year y(MWh);
$EL_{consumed,y}$	is electricity produced by the project and consumed on-site in year y (MWh).

This baseline can be used as ex-ante (fixed for the period 2006 – 2012) or ex-post. In case an ex-post baseline is chosen the data of the Ukrainian grid have to be obtained of the year in which the emission reductions are being claimed. Monitoring will have to be done in accordance with the monitoring plan of ACM0002 with the following exceptions:

- the Monitoring Plan should also include monitoring of the grid losses in year y;
- power plants at which JI projects take place should be excluded. Such a JI project should have been approved by Ukraine and have been determined by an Accredited Independent Entity.

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Annex 3

MONITORING PLAN

Please refer to Section D.