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

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SECTION A. General description of the project

A.1. Title of the project:

"Modernization of Heat and Power Plant-Steam-Airblast Station to Increase Power Generation by Utilization of Blast Furnace Gas at CJSC 'Donetsksteel'-Metallurgical Plant"

Sectoral Scope 3. Energy demand

PDD version 3.7, dated 1 June 2011.

A.2. Description of the project:

The project is implemented at CJSC "Donetsksteel" – metallurgical plant" (further referred to as Donetsksteel or the Plant), which is a producer of iron, steel and steel semi-finished products. CJSC "Donetsksteel" - Metallurgical Plant" was established in August 2002, and was based on blast-furnace and open-hearth shops of Donetsk Metallurgical Plant. CJSC "Donetsksteel" - Metallurgical Plant" is recognized by English Lloyd's Register as a steel and semi-finished steel manufacturer (slabs and open-hearth process ingots of carbonic and carbonic-manganiferous steel grades of single and increased strength). Ship constructional steel slabs of single strength of GL-A and GL-B grades are certified by rule of the German Lloyd; NVA grade steel (dead-melted) of open-hearth process – by Det Norske Veritas rules. CJSC "Donetsksteel" - Metallurgical Plant" became the first Ukrainian enterprise of the branch which implemented and certified integrated quality, environmental and labour safety management system in compliance with requirements of international standards: ISO 9001:2000, ISO 14001:2004 and OHSAS 18001:1999[1].

In order to reduce GHG emissions and other negative environmental impacts of the Plant the project for modernization of combined heat and power generation-steam-air blast station (further referred to as CHP-SAS) was realized. Implementation of the project allowed increasing on-site power generation which consequently reduced the Plant's consumption of carbon intensive national grid electricity. The power is generated through utilization of previously flared blast furnace gas (BFG), the available amount of which increased after the reconstruction of blast furnace No.1 of the Plant.

Before implementation of the project activity electricity was generated by one condensing turbine with installed capacity 25 MW. Steam for the turbine was supplied by a high pressure boiler combusting a mixture of blast furnace gas (BFG), natural gas (NG) and coke oven gas (COG). Natural gas was added to ensure constant firing at the burner, while the main fuel was BFG. In 2005 after the overhaul of the blast furnace No1[2] volume of BFG available at the Plant increased. Because of the limitations of the BFG pipeline existing before the project and relatively fixed demand for BFG by blast shop, boiler house No1 and CHP-SAS, excessive BFG was to be flared at stand. On the other hand, increasing the amount of BFG utilized for power generation presented an excellent opportunity to cut GHG emissions by substituting the carbon intensive Ukrainian grid electricity.

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[1] Information from Donetsksteel official web-page: http://www.dmz.com.ua/company/

[2] JI PDD "Implementation of energy efficient measures at "Donetsksteel" – metallurgical plant". Available at http://ji.unfccc.int/JI_Projects/DB/1ZL7OZE8KMZYH7QOB0Q0FPFXN06YVH/PublicPDD/C7RBAUS79TYCUBUMAO3FFOIFL9FEZ6/view.html

The proposed JI project activity included the following key actions[3]:

1. Modernization of high pressure boiler No5 to ensure combustion of increased volume of available BFG;
2. Reconstruction of turbine generator unit TG No1 to reduce its specific energy consumption.

Realization of the activities listed above resulted in bigger share of BFG in fuel mix consumed for electricity generation, increase in utilization of power generation capacity, and reduction of specific energy consumption for power generation.

The project activities have already been implemented. The reconstruction activities took place during 2004-2006; the project was commissioned in March 2007.

All the necessary documentation was developed and approved by relevant authorities, as well as all permits and licenses were obtained. The project is environmentally beneficial as it reduced the amount of fossil fuel consumption by substituting it with previously flared BFG; decreased air pollution as well as emissions of GHGs. Estimated GHG emission reductions due to the project are **410 946 tCO_2e**.

Baseline scenario
Baseline scenario is continuation of existing before the project practice. It is assumed that in the baseline scenario power generation would remain at the same level as before realization of the project, and the excessive BFG would be flared. See section B for more details on the baseline.

Brief history of the project including its JI component

The project was developed as a separate one but closely related to reconstruction of the blast furnace No1 undertaken as JI Project “Implementation of energy efficient measures at CJSC "Donetsksteel" – Iron and Steel Works". During the development of both projects JI incentive was considered which was reflected in the relevant Donetsksteel internal documentation, such as minutes of the meetings of Energy and Financial Departments of Donetsksteel.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	CJSC "Donetsksteel" – Iron and Steel Works"	No
Netherlands	Global Carbon B.V.	No

CJSC "Donetsksteel" – Iron and Steel Works" was established on the basis of blast furnaces and open hearth furnace shops of the JSC "Donetsk Metallurgical Plant" in August 2002. CJSC "Donetsksteel" – Iron and Steel Works" is acknowledged as a producer of steel and steel semi-products by rules of Lloyd’s Register. CJSC "Donetsksteel" – Iron and Steel Works" invested in the JI project, and realizes the project activity including the monitoring phase. It is the owner of ERUs generated. CJSC "Donetsksteel" – Iron and Steel Works" is a project participant.

Global Carbon B.V. is a leading expert on environmental consultancy and financial brokerage services

[3] A new pipeline was built with capacity of 180 th. m^3/hour to supply BFG from blast shop to CHP-SAS as a part of reconstruction of Blast Furnace No1.

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

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is implemented at CJSC 'Donetsksteel'-Metallurgical Plant', located in Donetsk, Donetsk oblast, in the eastern part of Ukraine.

A.4.1.1. Host Party(ies):

Ukraine

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

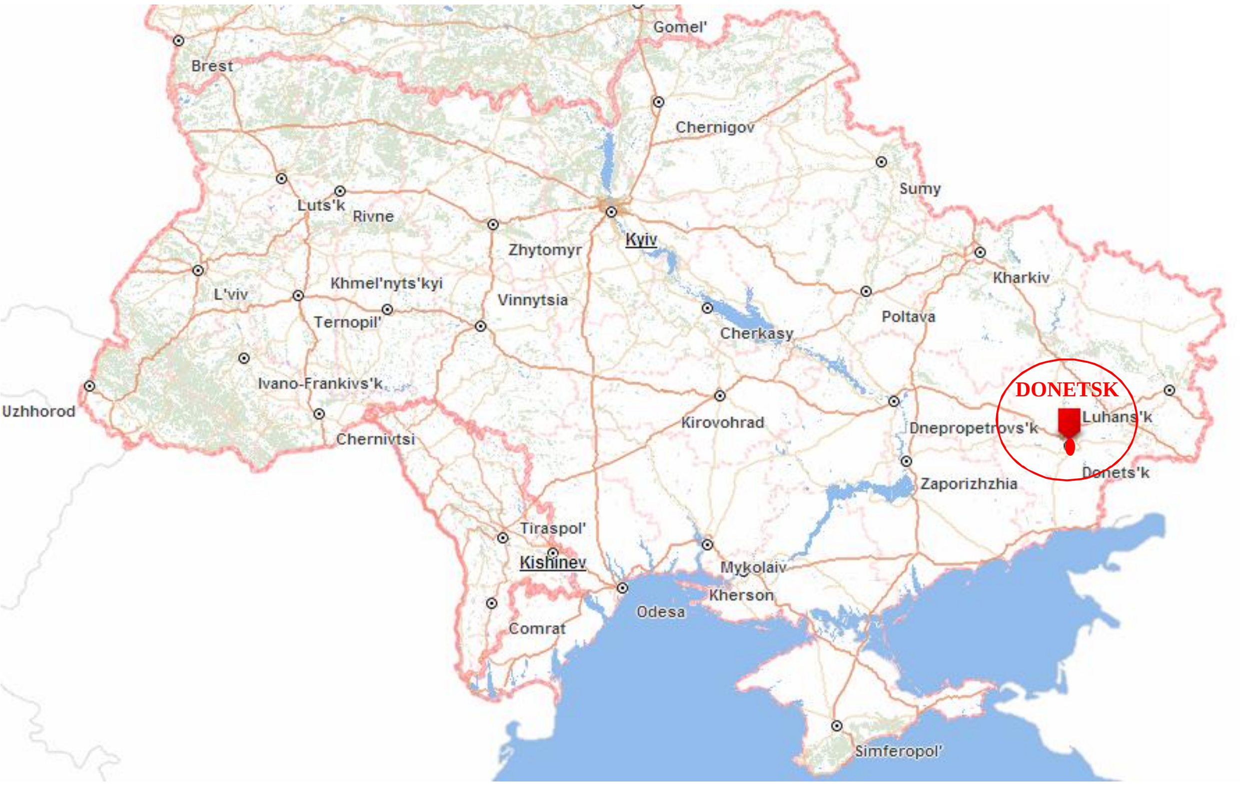

Fig. 1 Region of project location.

Donetsk Oblast is a region (province/oblast) of Eastern Ukraine. Its administrative centre is Donetsk. The area of the oblast (26,900 km²) comprises about 4.4% of the total area of the country. The oblast borders with Dnipropetrovsk and Zaporizhzhia oblasts in the South-West, Luhansk Oblast in the North-East, Rostov Oblast of Russia in the East, and on the Sea of Azov in the South.
Its longitude from north to south is 270 km, from east to west – 190 km.
No natural protected areas exist on the territory of the project implementation.

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

Donetsk, Donetsk oblast

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

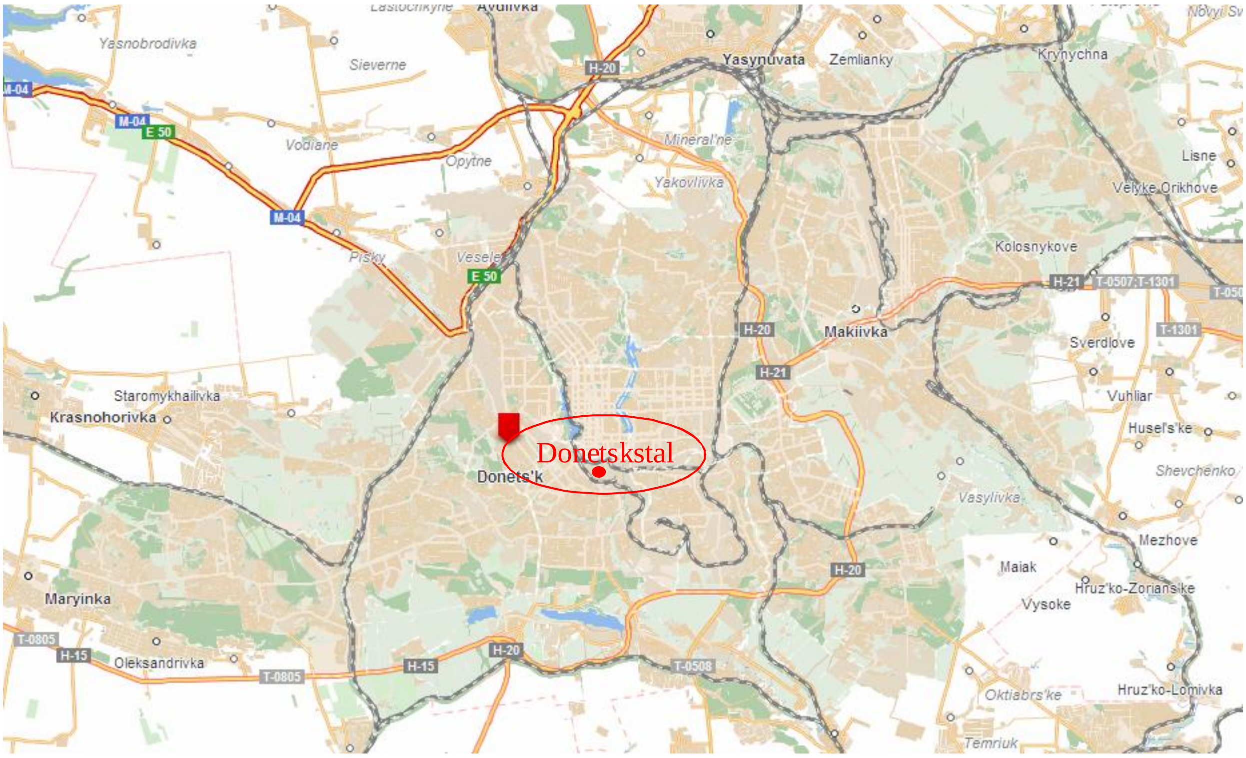

Fig. 2 Physical location of the project.

Geographical coordinates of the project: latitude 47°58'52; longitude 37°48'44".

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

Principal technology for electricity generation is rotation of electric conductor in a varying magnetic field. At Donetsksteel CHP-SAS this is realized by operating turbines with steam supplied by boilers, which combust mixture of BFG and COG in any ratio with mandatory natural gas co-firing.

General overview of CHP-SAS

The CHP-SAS is designed to supply air blow, process steam, heat (hot water), and to generate power. The CHP-SAS includes main building with steam-airblast station (SAS) and heat and power plant (CHP), as well as a separate shop for chemical treatment of water. It has 3 power turbines, 3 air-blast turbines, 3 medium pressure, 2 high pressure boilers, 3 evaporative cooling towers and other supplementary equipment (see scheme at figure 3).

CHP-SAS supplies the following energy to consumers:

- Blow for blast furnaces;
- Electrical power 6000 V;
- Heat for plant consumers;
- Process steam at 5-13 kgf/cm^2;
- Chemically treated water.

Total installed capacity of CHP-SAS:

- Medium pressure steam – 225 t/h;
- High pressure steam – 380 t/h;
- Electric power – 49000 kW;
- Blow 9600 m^3/min for blowers;
- Heat (hot water for heating) – 81.4 MW.
- Chemically treated water – 350 m^3/h.

The CHP-SAS was built employing modular design: steam turbine is connected to boiler in order to reduce steam loses in steam collectors and minimize the risk of accidents. High-pressure boiler No.5 and turbine generator No.1 constitute one module which was reconstructed in order to increase the power output from BFG utilization[4].

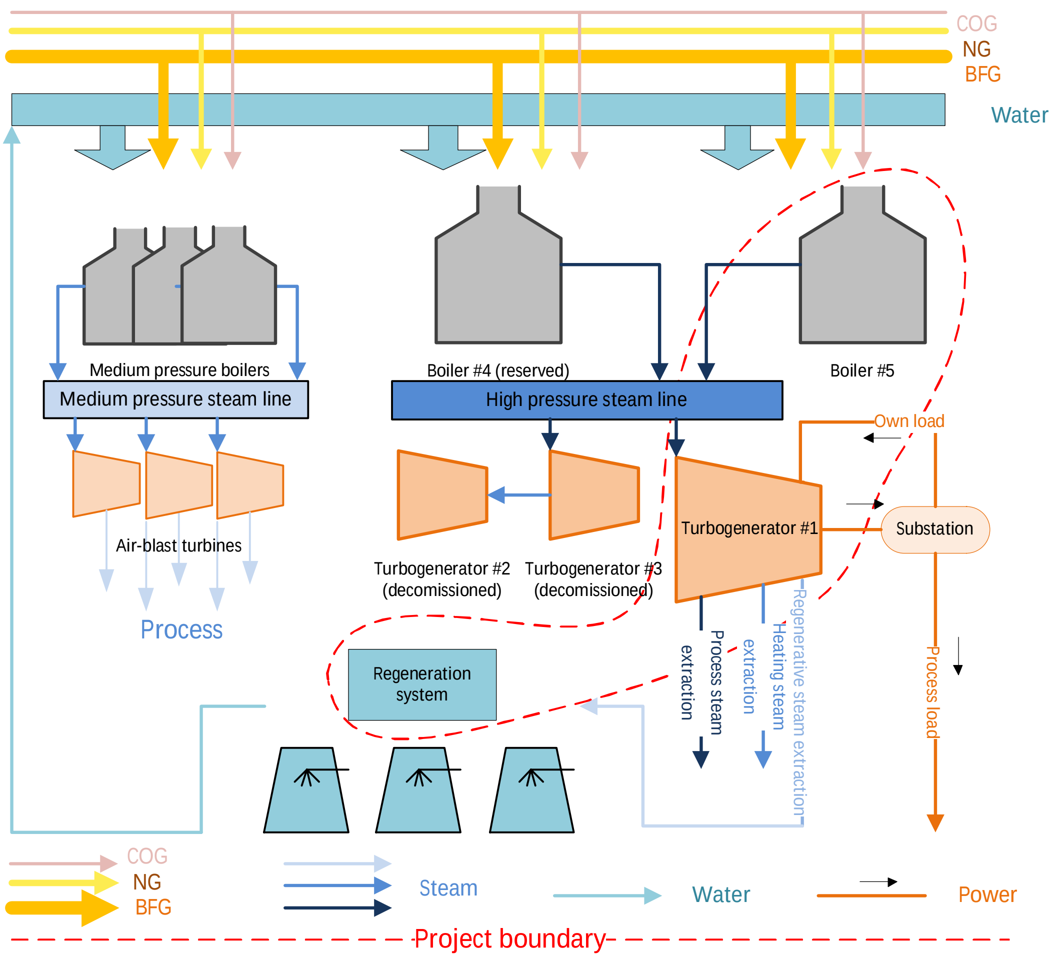

Fig. 3 CHP-SAS scheme.

Situation before the Project

[4] Following the principle of conservativeness, it is assumed that all steam produced by boiler No.5 by burning BFG, NG and COG is used for electricity generation. Such an assumption increases project emissions associated with electricity generation since utilization of energy of steam extraction from turbogenerator No1 is not taken into account. Emission reductions generated due to utilization of steam extraction energy are not claimed because transparent monitoring is not possible.

Total installed electrical capacity of CHP-SAS before the project was 49 MW, and only 11 MW of it was utilized. Electricity at Donetsksteel was produced by 1 condensing turbine (25 MW), other 2 back-pressure turbines (12 MW each) were decommissioned in 2001. Steam for the power generation was supplied by high pressure boiler combusting mixture of blast furnace gas (BFG), natural gas (NG) and coke oven gas (COG). Historically, BFG was utilized at blast shop, boiler house No.1 and CHP-SAS; the excess BFG was flared. Pre-project BFG consumption balance is in figure 4.

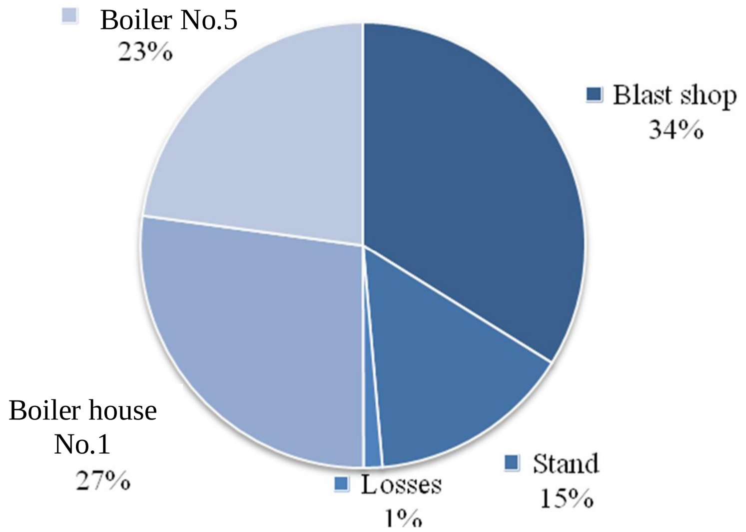

Fig. 4. BFG consumption balance before the realization of the project[5].

The main constrains which did not allow increasing on-site power generation by utilization of BFG were low condenser capacity and absence of heat regeneration system of the turbine. Increase of BFG supply for utilization at CHP-SAS was also not possible due to limited BFG pipeline capacity. At the boiler side amount of BFG combusted was limited by BFG pressure jumps which leaded to unstable boiler load which required more natural gas for mandatory co-firing.

Therefore, the project was initiated for the following reasons:

- Availability of significant amount of BFG which increased after the upgrade of blast furnace No.1 of the Plant[6], which otherwise was to be wasted through flaring;
- Significant underload of the main power generation facilities;
- GHG emission reduction potential.

Project Characteristics

The project activity is comprised of three main parts: modernization of boiler No.5 and reconstruction of turbine generator No.1.

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[5] BFG consumption balance was calculated using actual data obtained from Donetsksteel. Before-project parameters were averaged over 2002-2004.

[6] JI Project " Implementation of energy efficient measures at CJSC "Donetsksteel" – Iron and Steel Works", Donetsk. Published at UNFCCC web-page: http://ji.unfccc.int/JI_Projects/DB/1ZL7OZE8KMZYH7QOB0Q0FPFXN06YVH/PublicPDD/C7RBAUS79TYCUBUMAO3FFOIFL9FEZ6/view.html

1. Modernization of boiler No.5.

Table 1. Technical characteristics of boiler No.5.

Parameter	Value
Boiler type	TGM-159SO High pressure boiler
Producer	“Krasniy Kotelschik”, Taganrog
Year of operation start	1981
Nominal steam characteristics: kgf/cm^2 ºC	 100 540
Nominal steam output, tonne/hour	220

The following has been done:
- Replacement of economizer;
- Replacement of platen and convection steam superheaters;
- Repair of fixtures, ventilators, smoke exhaust, drum, boiler burner, furnace hydraulic lock;
- Repair of gas lines for blast furnace, coke oven and natural gases with replacement of gas meter diaphragm;
- Upgrade of control system with installation of new monitoring equipment, sensors and actuators.

2. Reconstruction of turbine generator No.1.

Table 2. Technical characteristics of turbine generator No.1.

Parameter	Value
Turbine generator type	PT-25-90/10M Condensing turbine with operational and heating steam discharge
Producer	Kaluga Turbine Plant
Year of operation start	1987
Nominal steam characteristics: kgf/cm^2 ºC	 100 540
Nominal power output, MW	25

The following has been done:
- Replacement of condenser;
- Regeneration system installation;
- Repair of rotor and blading section of turbine;
- Installation of condensation pumps.

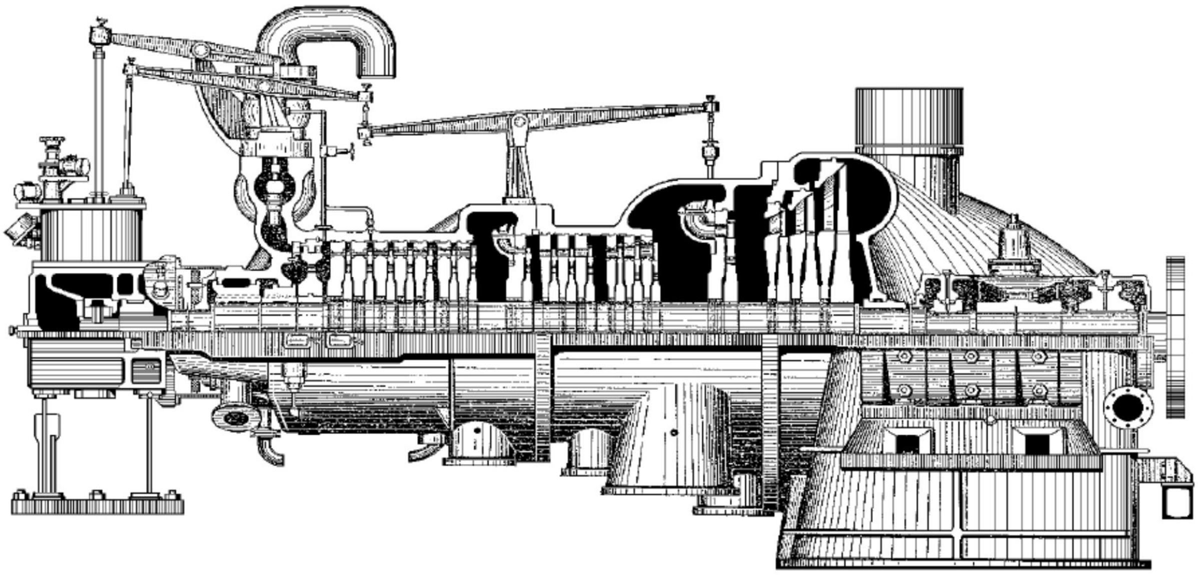

Fig. 5. Longitudinal section of turbine PT-25-90/10M.

Project results
The project activities allowed achieving the following results:
- increase of on-site power production (Fig. 6)[7];
- reduction of specific energy consumption by boiler No. 5 (ref. Table 3)[8];

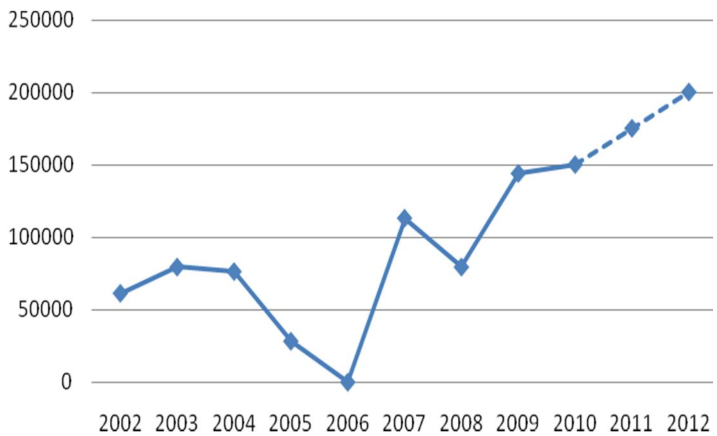

Fig. 6 Power Generation by Turbogenerator No.1, (MWh).

Table 3. Project performance data[9].

Parameter	**Before project**	**After project**
Power generation capacity utilization	11.0 MW	25.0 MW
Specific energy consumption for power generation	16.0 GJ/MWh	13.6 GJ/MWh

[7] Based on actual performance and forecast data provided by Donetsksteel.
[8] Calculated using actual performance data provided by Donetsksteel.

[9] Project performance parameters were calculated using actual data obtained from Donetsksteel. Before-project parameters were averaged over 2002-2004; after project parameters were derived from data over 2007-2009.

The project was implemented in 2004-2007[10]. The implementation schedule follows.

	2002	2003	2004	2005	2006	2007
Project design	Oct				Apr	
Equipment and materials			July			Feb
Construction works			Sept			March
Commissioning						March

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

Anthropogenic GHG emissions are reduced by JI project activity through substitution of carbon intensive Ukrainian national grid electricity with the power produced locally at CHP-SAS of Donetsksteel. In the project scenario the power generation increase resulting from implementation of project activity is carbon neutral as it is :
- produced as a result of BFG utilization, which is a waste gas that otherwise would have been flared without any utilization;
- produced due to improving of power generation efficiency at Donetsksteel and reducing specific consumption of fossil fuel. Using locally produced power also allows avoiding power transmission losses which in Ukrainian power grid are very high (up to 30%).

Taking into account that no national and/or sectoral policies oblige for such activity and that it does not provide additional profit or significant savings because of high production costs, it is proved that no similar measures would have been implemented at Donetsksteel without additional incentives provided by JI mechanism of the Kyoto Protocol. Information on the baseline setting and additionality is detailed in Section B.

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

Table 4. Estimated emission reduction before 1 January 2008.

	Years
Length of the crediting period before 1 January 2008	1
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2007	32 951
Total estimated emission reductions over the Period before 1 January 2008 (tonnes of CO_2 equivalent)	32 951
Annual average of estimated emission reductions over the period before 1 January 2008 (tonnes of CO_2 equivalent)	32 951

[10] Project design for energy efficiency projects is conducted continuously at Donetsksteel, therefore only actual implementation activities are included in implementation period 2004-2007.The implementation schedule reflects periods when the project activity was actually financed.

Table 5. Estimated amount of emission reductions over the crediting period 2008-2012.

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2008	11 290
Year 2009	52 177
Year 2010	88 137
Year 2011	115 825
Year 2012	143 514
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	410 943
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	82 189

Table 6. Estimated amount of emission reductions generated after the crediting period 2013-2026.

	Years
Length of the period after 31 December 2012	14
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Total estimated emission reductions over the period between 2013 - 2026 (tonnes of CO_2 equivalent)	2 009 196
Annual average of estimated emission reductions over the period between 2013 - 2026 (tonnes of CO_2 equivalent)	143 514

A.5. Project approval by the Parties involved:

The project has been endorsed by Ukraine. The Letter of Endorsement was issued by National Environment Investment Agency of Ukraine on 14th of October 2010 with reference number No. 1608/23/7. Letter of Approval 2011JI23 by Ministry of Economic Affairs, Agriculture and Innovation of the Netherlands was received on 4th of July 2011. The project approval by the Host Party and the Investor Party is expected after completion of the determination process.

SECTION B. Baseline

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

The baseline is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of greenhouse gases that would occur in the absence of the project[11]. Baseline was established in accordance with Appendix B to JI Guidelines and paragraph 23 through 29 of the Guidance on criteria for baseline setting and monitoring.

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

In line with the paragraph 9 of the latest version of the Guidelines on criteria for baseline setting and monitoring (Version 02, adopted by JISC 18 meeting in October 2009) the project participants may select to apply the JI specific approach for the baseline setting and monitoring. In this case a detailed theoretical description of the baseline in a complete and transparent manner has to be provided. All the information about baseline scenario required by paragraph 23 through 29 of the Guidance on criteria for baseline setting and monitoring is in the relevant parts of Section B of this document. Additional information as well as supporting data are in the Annex 2.

Key factors that affect the baseline were taken into account:

a) **Sectoral reform policies and legislation.** At the time of decision making about the project the key sectoral policy document was the State program of industry development for 2003-2011[12]. The priorities for development of mining and metallurgy sector were placed at ensuring supply of high quality raw materials; modernization of metallurgical plants, in particular implementation of new EAF plants, continuous casting machines, new technologies for raw materials processing; and diversifying product line. This program was followed by State Program for Reforming and Development of Mining and Metallurgical Complex for the Period until 2011[13] were these priorities are further detailed. Both of the documents do not contain any provisions for CHP-SASs of metallurgical plants as well as obligations to utilize BFG. Therefore, taking into account the abovementioned, it can be considered that no policies and legislation can influence the baseline;

b) **Economic situation/growth and socio-demographic factors in the relevant sector as well as resulting predicted demand. Suppressed and/or increasing demand that will be met by the project can be considered in the baseline as appropriate (e.g. by assuming that the same level of service as in the project scenario would be offered in the baseline scenario)**. It is assumed that the level of iron and steel production and demand is not influenced by the project. Main outcome of the project is increase in on-site power generation by utilization of increased amounts of BFG. In the absence of the project activity the same amount of electricity would be acquired from other alternative source such as national power grid, therefore the same level of service as in the project scenario would be offered in the baseline scenario;

c) **Availability of capital (including investment barriers).** Even though capital was available at financial market, there were number of constrains restricting access to it for some of Ukrainian companies. For instance, high interest rates made investment into new equipment unprofitable;,

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

[12] http://industry.kmu.gov.ua/control/uk/publish/article?art_id=36412&cat_id=36198

[13] http://uazakon.com/document/fpart66/idx66602.htm

positive credit history was required for large loans which was not feasible for newly established CJSC "Donetsksteel" - Metallurgical Plant"; investment programs by IFI's were focused mainly on large-scale infrastructure projects having requirements for minimal investment of 5-10 million USD. Overall, investment climate of Ukraine was considered risky, capital markets underdeveloped[14], private capital could be attracted at prohibitively high cost due to real and perceived risks of doing business in Ukraine[15]. This made Donetsksteel seek for solutions requiring minimal investment that could be covered by own funds of the Enterprise, which were very limited.

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

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

Step 2. Application of the approach chosen

Plausible scenarios

The following alternatives were open for the Plant given the increase of the volumes of available BFG as a result of reconstruction of blast furnace No.1:

G1: BFG flaring at stand;
G2: BFG utilization to generate additional electricity;
G3: BFG utilization to generate additional heat;
G4: BFG sale.

For electricity supply the alternatives were:

P1: Stop electricity generation and cover all of the demand by purchasing electricity from national power grid;
P2: Maintain the same level of on-site electricity generation at the existing generating capacity and cover the rest of the demand by importing electricity from national power grid;
P3: Increase on-site electricity generation at the existing plant and reduce the amount of imported electricity;
P4: Increase on-site electricity generation to fully cover the Plant's demand to exclude import.

Detailed description of the alternatives and their feasibility analysis is provided below.

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[14] EBA, Barriers to Investment in Ukraine, 2001 http://www.google.com.ua/url?sa=t&source=web&cd=4&ved=0CDoQFjAD&url=http%3A%2F%2Flnweb90.worldbank.org%2FECA%2FTransport.nsf%2FExtECADocByUnid%2F87A440D5B6BA3A9B85256B7A006AE9F5%2F%24file%2F1.%2520Barriers%2520to%2520Investment.doc&rct=j&q=EBA%2C%20Barriers%20to%20Investment%20in%20Ukraine%2C%202001%20&ei=D4QPTYDYLIvNjAeSx-G8Dg&usg=AFQjCNEETryrMBtd6fvuszv4eDcg27DCOA&sig2=dJ6OifVPgYy8BTFd8Ug33g&cad=rja

[15] Alan Mayhew, Foreign Direct Investment and Modernization of Ukraine's Economy, 2007.

G1: BFG flaring at stand.

This option is continuation of the practice existing before the project: flaring BFG at stand. No additional value is created from the energy resource which is wasted. No capital investment is required to realize this option. The amount of air pollutants released while flaring BFG is higher than in case of its combustion in boilers. This would worsen environmental situation at Plant's production site which would affect the population of Donetsk as the Plant is located in the center of the city. However, this activity is not restricted by national legislation, provided that all the necessary emission permits are obtained. This alternative is realistic and plausible.

G2: BFG utilization to generate additional electricity.

In this option BFG is directed to CHP-SAS for its combustion to produce steam used to generate power. Realization of this option requires construction of BFG pipeline from blast shop to CHP-SAS, modernization of boilers to allow combustion of more BFG (including capability to burn mixture of NG, BFG and COG with higher BFG share) and reconstruction of the turbogenerator. Implementing this option would be environmentally beneficial as it would reduce amount of air pollutants released into the atmosphere on site and indirectly through reduction of electricity demand.

G3: BFG utilization to generate additional heat.

In this option BFG is supplied to CHP-SAS for its combustion in boilers to generate additional heat. As heating demand of the plant was not expected to raise in the nearest future this option would require finding consumers of additional heat. To ensure efficiency of CHP-SAS operation it would be reasonable to sell extra heat in form of hot water. The nearest industrial users of heat are Donetsk Confectionery Plant "AVK" and Donetsk Coke-Chemical Plant. Both Plants have own boiler houses covering their demand for hot water for space heating and sanitary purposes. The remaining option is to supply heat for district heating in Donetsk. Realization of this option required construction of BFG pipeline between Blast Shop and CHP-SAS, modernization of boilers to allow combustion of more BFG (including capability to burn mixture of NG, BFG and COG with higher BFG share) and building infrastructure to connect to central district system (hot water pipelines, pumping stations, heat exchangers and controls). This alternative is realistic but not reasonable. The main argument against it is the low payment collection rate in Donetsk community. According to official information in 2004 Donetsk oblast had the worst collection rates of payments for heat energy in Ukraine[16]. This imposed high risk for failure or significant delay in investment return which was the reason why this option was rejected. Realization of this alternative would bring sound environmental benefits due to utilization of BFG at CHP-SAS instead of flaring it at stand. This BFG would also substitute natural gas and coal which are fossil fuels used for heat generation in Donetsk.

G4: BFG sale.

Historically, BFG from Donetsksteel used to be supplied to Donetsk Coke-Chemical Plant (DCCP) through the pipeline which was dismantled in 1990's during the times of economic recession. Theoretically, the pipeline could be rebuilt and BFG supply to DCCP restored. However, implementation of this option was restricted by local municipal authorities and environment protection office. Long distance BFG transportation imposed higher risk of pipeline leakages and break-ups.

P1: Stop electricity generation and cover all of the demand by purchasing electricity from national power grid.

In this option the Plant does not generate any electricity, but purchases everything from the grid. Even though pre-project electricity production costs were higher than the price for electricity from the grid

[16] Resolution of Collegium of State Housing Committee of Ukraine No.15 , 25.03.2005 "On performance results of housing companies in 2004 and priority tasks for governmental organizations on sectoral policy reformation" http://www.uazakon.com/document/fpart50/idx50295.htm

(149 UAH/MWh versus 133 UAH/MWh) maintaining own power generation was reasonable from the point of view of ensuring reliability of power supply for consumers of the first category[17]. In addition, this is the way to utilize part of available BFG and COG which otherwise would have to be flared. Therefore, stopping on-site generation was not technically reasonable. If realized, this activity would worsen environmental situation in Donetsk by increasing emissions of air pollutants from BFG and COG flaring on site and increase pollution in the areas of power generation through rising demand for grid electricity.

P2: Maintain the same level of on-site electricity generation at the existing generating capacity and cover the rest of the demand by importing electricity from national power grid.
This option represents continuation of existing practice. The Plant maintains own power generation at pre-project levels and purchases rest of the power from national grid; extra BFG is flared at stand. Realization of this option did not require any investment except for regular maintenance costs, ensured availability of alternative power suppliers, allowed utilization of part of the BFG and COG available at Plant. In terms of environmental impact, it is less negative than in case of option P1 and P4, but worse than P3.

P3: Increase own electricity generation at the existing plant and reduce the amount of imported electricity.
In this option own electricity generation grows due to utilization of increased amounts of BFG, while grid electricity consumption is reduced. In order to implement this option it was required to build BFG pipeline from blast shop to CHP-SAS, modernize boilers to allow combustion of more BFG (including capability to burn mixture of NG, BFG and COG with higher BFG share) and make reconstruction of the turbogenerator. This option would be the most environmentally beneficial out of all of the options open to the Plant at the time of decision making as its realization would lead to decrease in air pollution from BFG flaring at the project site, while indirectly reducing negative effect of grid power generation through lowering power demand.

P4: Increase on-site electricity generation to fully cover the Plant's demand to exclude import.
In this option the Plant would not consume any electricity from the grid, but would generate everything at own CHP-SAS. The Plant's annual power demand is close to 450 GWh, to satisfy it fully by own power generation Donetsksteel would need to install 31,25 MW of additional power generation capacity which meant building additional CHP. Besides, as there is no that much of BFG available to fuel own power generation of that scale, consumption of natural gas or coal would have to be increased. Estimated cost of such a project would be about 125 million UAH. Under economic conditions of 2004 capital for such an investment was not accessible for Donetsksteel; therefore, this option was not feasible. Due to increase of fossil fuel combustion, realization of this option would increase on-site air pollution affecting environmental situation in Donetsk.

All of the options listed above, except for option G4, were consistent with Ukrainian legislation in force at the time of decision making.

The feasible options for BFG utilization were:

G1: Flare BFG at stand;
G2: Utilize BFG to produce electricity.

The feasible options for power generation were:

P2: Maintain on-site electricity generation and cover the rest of the demand by purchasing electricity from national power grid;

[17] Facilities which when suddenly stopped are severely damaged or may cause an emergency.

P3: Increase on-site electricity generation and reduce the amount of purchased electricity.

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

Alternative 1: Maintain on-site electricity generation, cover the rest of the demand by purchasing electricity from national power grid and flare excess BFG (G1+P2);
Alternative 2: Increase on-site electricity generation by utilization of excess BFG at CHP-SAS and reduce the amount of purchased electricity (G3+P3) (project scenario without JI incentive).

Alternative 2 is proved to be unprofitable in the following part B.2. of this document.

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

Baseline assumptions
The baseline is established in a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors. Uncertainties are taken into account and conservative assumptions are used. ERUs cannot be earned for decreases in activity levels outside the project activity or due to force majeure as emission reductions calculations are based on parameters of actual project performance which is monitored (power output, consumption of natural gas).

It is assumed that in baseline scenario electricity generation equals to average over three years before implementation of the project. ERUs are only claimed for the power that was actually produced as a result of project activity and which substitute the energy which would otherwise be purchased from the grid. Following the principle of conservativeness, it is assumed that all steam produced by boiler No.5 by burning BFG, NG and COG is used for electricity generation. Such an assumption increases project emissions since utilization of energy of steam extraction from turbogenerator No.1 is not taken into account. Emission reductions generated due to utilization of steam extraction energy are not claimed because transparent monitoring is not possible. Application of such an approach to ERUs calculation guarantees that they were not earned for decreases in activity levels outside the project activity or due to force majeure. A baseline was established using multi-project emission factors.

Baseline emission calculation details are provided in the Annex 2.

Key information and data used to establish the baseline are provided below in tabular form[18]:

Data/Parameter	EG_y		
Data unit	MWh		
Description	Net electricity generation by turbine No.1		
Time of determination/monitoring	Measured continuously		
Source of data (to be) used	Project owner records		
Value of data applied[19]	**2002**	**2003**	**2004**
	61 284	79 348	76 261
	2007	**2008**	**2009**
	113 097	79 323	143 916

[18] If parameter is used in emissions calculation in both baseline and project scenarios there is no index indicating the scenario in the name of the parameter.

[19] Reconstruction activity took place in 2005-2006, therefore, no data for these years is used for calculation.

	<table><tr><td></td><td></td><td></td></tr><tr><td>**2010**</td><td>**2011**</td><td>**2012-2026**</td></tr><tr><td>150 000</td><td>175 000</td><td>200 000</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine the amount of electricity which would be generated regardless the project activity. Post-project and forecast data were used to calculate how much electricity would have to be purchased from national grid in the baseline scenario. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer.
Any comment	No

Data/Parameter	$FC_{NG,y}$
Data unit	Thousand m^3
Description	is the amount of natural gas combusted in boiler No.5 in year y
Time of determination/monitoring	Measured continuously
Source of data (to be) used	Project owner records
Value of data applied	<table><tr><td>**2002**</td><td>**2003**</td><td>**2004**</td></tr><tr><td>5 607</td><td>5 456</td><td>5 345</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	$FC_{BFG,y}$
Data unit	Thousand m^3
Description	is the amount of blast furnace gas combusted in boiler No.5 in year y
Time of determination/monitoring	Measured continuously
Source of data (to be) used	Project owner records
Value of data applied	<table><tr><td>**2002**</td><td>**2003**</td><td>**2004**</td></tr><tr><td>399 677</td><td>641 774</td><td>646 358</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	$FC_{COG,y}$
Data unit	Thousand m^3
Description	is the amount of cock oven gas combusted in boiler No.5 in year y
Time of determination/monitoring	Calculated. Data of continuous measurements are adjusted by default NCV value of 16,75 GJ/1000 m^3 by the following formula:

	$FC_{COG,y} = \frac{FC_{COGm,y} \times NCV_{COGm,y}}{NCV_{COG,y}}$, where $FC_{COG,y}$ - is the amount of cock oven gas combusted in boiler No.5 in year y, thousand m^3; $FC_{COGm,y}$ - is actually measured amount of cock oven gas combusted in boiler No.5 in year y, thousand m^3; $NCV_{COGm,y}$ – is actually measured net calorific value of cock oven gas, GJ/1000 m^3; $NCV_{COG,y}$ - is default net calorific value of cock oven gas, GJ/1000 m^3.
Source of data (to be) used	Project owner records
Value of data applied	**2002**: 300; **2003**: 1 787; **2004**: 83
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	EF_{EG}
Data unit	tCO_2e/MWh
Description	Carbon emission factor for consumption of electricity from national power grid
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Data before 2010: emission factor for the Ukrainian grid 2006 – 2012. “Standardized emission factors for the Ukrainian electricity grid” research, made by Global Carbon and positively determined by TÜV SÜD (please find in Annex 2). Data in 2010 and after: “Emission factor of specific indirect carbon dioxide emissions from electricity consumption by 2nd class electricity consumers in accordance with Procedure for determining the class of consumers, adopted by Resolution of National Electricity Regulatory Commission of Ukraine on 13 of August 1998 No.1052”. Ukrainian National Environment Investment Agency Order No.43 from 28.03.2011
Value of data applied	**2007**: 0.896; **2008**: 0.896; **2009**: 0.896; **2010**: 1.225; **2011**: 1.225; **2012-2026**: 1.225
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data before 2010: This research is the most credible source for Ukrainian grid emission factor at this moment. All calculations are based on official data obtained from the relevant Ministries. Data in 2010 and after: This is a country specific emission factor calculated and approved by Ukrainian DFP for calculating emission reductions for JI projects in Ukraine
QA/QC procedures (to be) applied	-
Any comment	One of the referenced sources provides value of this parameter

	in different data units. For convenience they were mathematically converted to tCO_2e/MWh. Data in 2010 and after: 1 tCO_2 = 1 tCO_2e 1.225 $kgCO_2/kWh$ = 1.225 tCO_2e/MWh

Data/Parameter	EF_{NG}
Data unit	tCO_2e/GJ
Description	CO_2 emission factor for natural gas combustion
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.4
Value of data applied	0.0561
Justification of the choice of data or description of measurement methods and procedures (to be) applied	As long as any national sectoral emission factors are unavailable, IPCC value has to be used as a default
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2e/ GJ: 1 tCO_2 = 1 tCO_2e 56100 kg CO_2/TJ = 0.0561 tCO_2e/GJ

Data/Parameter	$NCV_{NG,y}$
Data unit	GJ/1000 m^3
Description	Net calorific value of natural gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report 1990 – 2008 (page 258)
Value of data applied	33.94
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is a country specific value used by Ukrainian DFP for Ukrainian GHG Emissions Inventory
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/1000 m^3: 33.94 TJ/million m^3 = 33.94 GJ/1000 m^3

Data/Parameter	$NCV_{BFG,y}$
Data unit	GJ/t
Description	Net calorific value of blast furnace gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy, Table 1.2, p.1.18
Value of data applied	2.47
Justification of the choice of data or description of measurement methods and procedures (to be) applied	As long as any national sectoral emission factors are unavailable, IPCC value has to be used as a default
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/t: 2.47 TJ/Gg = 2.47 GJ/t

Data/Parameter	ρ
Data unit	t/1000 m^3
Description	Density of BFG (t= 0°C; p= 101.325 kPa)
Time of determination/monitoring	Is not monitored
Source of data (to be) used	The Engineering Toolbox[20]
Value of data applied	1.250
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value.
QA/QC procedures (to be) applied	-
Any comment	Because of low sensitivity of emission reductions calculation to this parameter the value under t= 0°C; p= 101.325 kPa was regarded to be acceptable. The difference in calculation results in case of adjustment to t= 20°C; p= 101.325 kPa was considered to be negligible. The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to t/1000 m^3: 1.250 kg/m^3 = 1.250 t/1000 m^3

Data/Parameter	$NCV_{COG,y}$
Data unit	GJ/1000 m^3
Description	Net calorific value of cock oven gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report 1990 – 2008 (page 258)
Value of data applied	16.75
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is a country specific value used by Ukrainian DFP for Ukrainian GHG Emissions Inventory
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/1000 m^3: 16.75 TJ/million m^3 = 16.75 GJ/1000 m^3

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

Anthropogenic emissions of GHGs are reduced by utilizing BFG to generate electricity. In the absence of the project BFG would be flared at stand, while electricity would be purchased from national power grid releasing much more GHGs and other pollutants compared to local power generating installations. Consumption of grid electricity is also associated with high transmission loses which are avoided in case of using locally generated power. Therefore, GHG emissions in the baseline scenario would likely exceed the emissions in the project scenario.

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

[20] http://www.engineeringtoolbox.com/gas-density-d_158.html

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

Sub-step 1a: Define alternatives to the project activity:
Alternative 1: Generating electricity at pre-project levels, conducting planned maintenance repairs, purchasing the rest of the power from the grid and flaring the excess BFG at stand;
Alternative 2: Construction of BFG pipeline, reconstruction of turbine No.1 and boiler No.5 to increase BFG utilization through electricity generation not being implemented as JI project activity.

Sub-step 1b: Consistency with mandatory laws and regulations:
All the above listed alternatives to the project activity were consistent with Ukrainian legislation in place at the time of decision making.
Realization of none of the Alternatives would be prevented by applicable legislation. Step 2 Investment analysis will be used to prove the additionality of the project.

Step 2: Investment analysis
Sub-step 2a: Determine appropriate analysis method
Due to the fact that the project generates financial benefits other than revenues from ERU sale, namely savings on electricity purchase costs and on electricity production, simple cost analysis (Option I) cannot be applied. Therefore, benchmark analysis (Option III) was chosen.

Sub-step 2b: Option III. Apply benchmark analysis
According to the "Tool for the demonstration and assessment of additionality" (Version 05.2) in order to prove that the project was additional it is necessary to "determine whether the project activity was not economically or financially feasible, without the revenue from the sale of *emission reduction units (ERUs)* [21]". NPV was chosen as appropriate financial indicator.

NPV was calculated using available data and price information as of 2004 when the decision about the project was made, in accordance with Annex to "Tool for the demonstration and assessment of additionality" (Version 05.2) "Guidance on the Assessment of Investment Analysis". Capital investments are detailed in Table 7. Operational costs were not taken into account as it was assumed that the project does not influence them. Annual operational cash flow is in Table 8. Cash flows were discounted using commercial lending rate adjusted by inflation (see Table 9).

Table 7. Budgeted costs[22].

	Unit	**Cost**
Sensors, regulators, executing mechanisms for boiler No.5	UAH	4 934 971.0
PCI for boiler No.5	UAH	415 912.1
ACS for turbogenerator No.1	UAH	178 543.6
Condenser for turbogenerator No.1	UAH	2 395 424.0
Condensate pumps for turbogenerator No.1	UAH	10 088 523.1
Total	UAH	**18 013 373.8**

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

[22] The list is not exhaustive. Was made in accordance with remaining archives of the Plant.

Table 8. Operational cash flow (UAH, VAT excluded).

Datum	Value
Excessive electricity production costs	-9 015 000
Electricity purchase costs	-9 675 000
Savings on electricity purchase	10 398 000
Savings on electricity production (baseline amount)	2 441 000

Table 9. Discount rate.

Datum	Value
Commercial lending rate (2003)[23], %	17.7
Consumer price index (2003)[24],%	8
Real discount rate, %	**9**

Thus, the following results were obtained:

Project scenario without ERU revenues
NPV: - 16 521 885

Benchmark
NPV: 0

Negative value of NPV for project scenario means that the project was not economically feasible therefore it could not have been realized without incentive of future revenues from ERU sale, which significantly improve the financial attractiveness of the project.

Sub-step 2d: Sensitivity analysis:

Variations up to 10% in electricity and natural gas prices, and investment were applied to check the sensitivity of the obtained results. The following figures were obtained:

Table 10. Sensitivity analysis results for project scenario (UAH).

	-10%	-5%	0	5%	10%
Electricity price					
NPV	-16 528 610	-16 525 247	-16 521 885	-16 518 522	-16 515 159
Natural gas price					
NPV	-16 519 919	-16 520 902	-16 521 885	-16 522 867	-16 523 850
Investment					
NPV	-14 869 001	-15 695 443	-16 521 885	-17 348 327	-18 174 769

The project's NPV is negative in all the cases. Therefore, it can be concluded that the proposed JI project is not becoming economically/financially attractive in case of reasonable variation in critical parameters. The project is unlikely to be financially/economically attractive without additional financial incentives such as, for instance, revenues from ERU's sales.

Conclusion: the results of investment analysis show that the project was unlikely to be financially and economically attractive.

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[23] Ukrainian National Bank Bulletin No.2/2004 (133), p.59.
http://www.bank.gov.ua/Publication/econom/Buleten/2004/Bull-2_04.pdf
Moved to archive at: http://www.bank.gov.ua/doccatalog/document?id=36535

[24] Ukrainian National Bank Bulletin No.2/2004 (133), p.52
http://www.bank.gov.ua/Publication/econom/Buleten/2004/Bull-2_04.pdf
Moved to archive at: http://www.bank.gov.ua/doccatalog/document?id=36535

Step 3: Barrier analysis

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

Step 4: Common practice analysis

Sub-step 4a

Because of its low calorific value (3.1 GJ/th.m^3) BFG cannot be used as fuel alone, but only in mixtures with other flammable gases, such as COG or NG. Historically, utilization of BFG as fuel was avoided because of its high toxicity due to high carbon monoxide content (about 28%)[25] in the BFG. With the low price for natural gas Iron and Steel Works preferred to flare BFG to avoid health and safety risks associated with its transportation. The situation changed with the rapid growth of prices for natural gas in Ukraine which increased six fold between 2006 and 2010.

There were no specialised studies on BFG treatment undertaken for Ukraine which state that BFG as fuel was not used in Ukraine at the time of the project implementation. However, declarations of the biggest Ukrainian plants about the plans to switch to NG blends with BFG and COG can be considered as indirect evidences. After the rapid growth of natural gas prices this option was considered by the biggest Ukrainian steel producers such as Alchevsk Iron and Steel Works, Dneprovsky Iron and Steel Works, Azovstal Iron and Steel Works[26], ArcelorMittal Steel Kryviy Rih[27].

Projects at Alchevsk Iron and Steel Works [28] and ArcelorMittal Steel Kryviy Rih[29]were actually implemented, determined under JI mechanism and cannot be considered a part of the common practice according to the "Tool for the demonstration and assessment of additionality" (Version 05.2). In 2010 utilisation of BFG was still recognized as an effective energy efficiency measure for Ukrainian metallurgical plants[30].

Sub-step 4b

A similar project involving BFG utilization for electricity generation was realized at Alchevst Iron and Steel Works. It was registered as JI project activity: "Displacement of electricity generation with fossil fuels in the electricity grid by an electricity generation project with introduction of Steel Mill Waste Gas Firing Turbine power generation system"[31], therefore, cannot be considered a part of common practice.

Overall, it can be concluded that BFG utilization for electricity generation was not a common practice for Ukraine. Similar activities are observed and can be explained by incentives provided by JI mechanism.

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

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25 http://www.osha.gov/SLTC/healthguidelines/carbonmonoxide/recognition.html
26 http://www.rusmet.ru/news.php?act=show_news_item&id=55044&sign=i
27 http://www.uaenergy.com.ua/c225758200614cc9/0/1284043d22badac1c2257735005646f3
28 http://ji.unfccc.int/UserManagement/FileStorage/XAX0XE4O3I6OUX0RG3HTY2UNM0W5D6
29 http://ji.unfccc.int/JI_Projects/DB/285ML83S8HRCTFB8Y0LFZJK23Q45TJ/PublicPDD/U781XZRM1P8BC6UFIIA6BGKNLFWIB9/view.html
30 http://www.uaenergy.com.ua/c225758200614cc9/0/1284043d22badac1c2257735005646f3
31 http://ji.unfccc.int/UserManagement/FileStorage/XAX0XE4O3I6OUX0RG3HTY2UNM0W5D6

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

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

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

Table 11. Sources of emissions included in consideration or excluded of it.

	Source	**Gas**	**Incl./ Excl.**	**Justification/Explanation**
Baseline	Baseline emissions due to grid electricity consumption	CO_2	**Incl.**	**Main source of emissions.** It is assumed that electricity from national grid would be consumed in the baseline scenario
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Baseline emissions due to natural gas combustion	**CO_2**	**Incl.**	**Main source of emissions.** Co-firing NG with BFG and COG is mandatory.
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
Project	Project emissions due to natural gas combustion	**CO_2**	**Incl.**	**Main source of emissions.** Co-firing NG with BFG and COG is mandatory.
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative

Baseline scenario
Project activities are physically limited to the territory of "Donetsksteel" – Iron and Steel Works", branch "Metallurgical Complex".
The baseline scenario is the continuation of existing before the project practice: flaring BFG, generating electricity on previous levels of production and purchasing the rest from the national grid. Consequently, baseline scenario boundary (illustrated by figure 7) is limited to Donetsksteel CHP-SAS.

Project scenario
In the project scenario CHP-SAS is reconstructed which allows utilization of increased volumes of BFG for own power generation. Therefore, project scenario boundary (illustrated by figure 8) is also limited to Donetsksteel CHP-SAS.

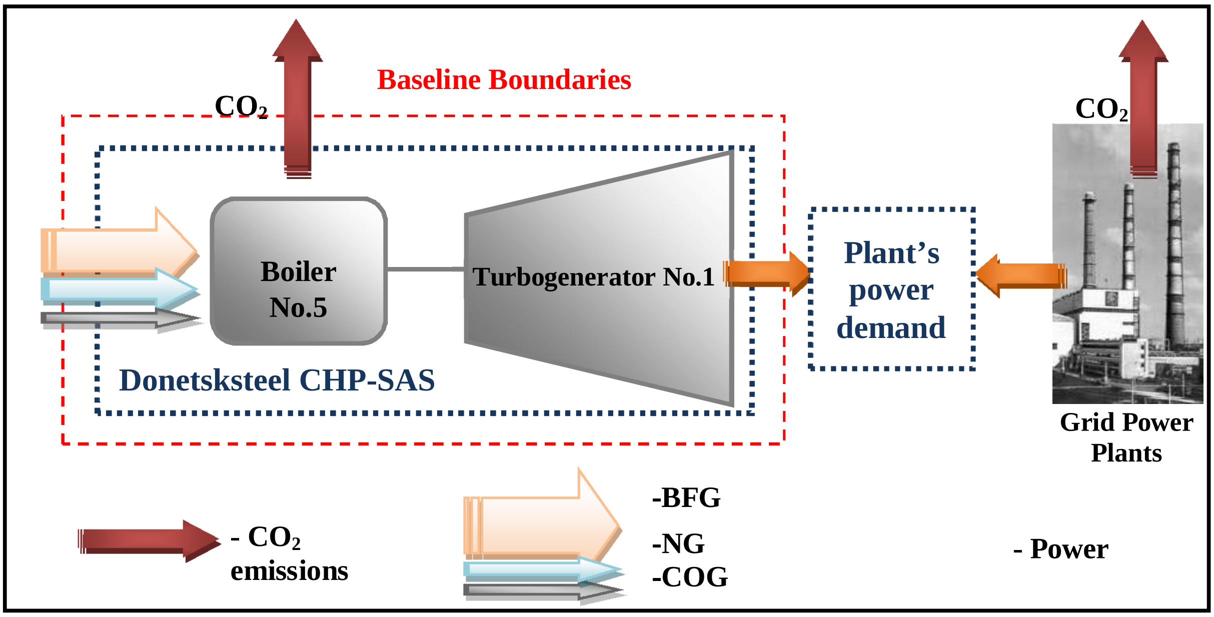

Fig. 7. Baseline scenario boundaries.

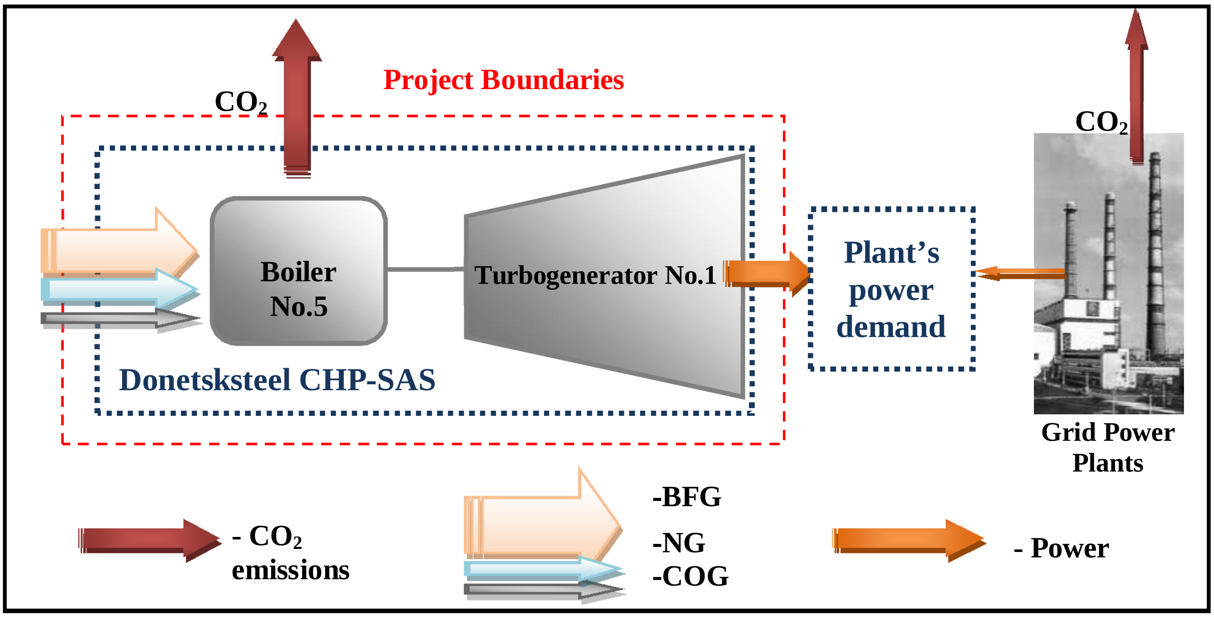

Fig. 8. Project scenario boundaries.

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

Date of baseline setting: 30/11/2010
Name of person/entity setting the baseline:

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

Global Carbon BV
Contact information is in the Annex 1.

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

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project: 2nd of August 2004

C.2. Expected operational lifetime of the project:

The lifetime of the equipment will be at least 20 years. Thus operational lifetime of the project will be 20 years or 240 months.

C.3. Length of the crediting period:

Start of the crediting period: 01.01.2008
End of the crediting period: 31.12.2012
Length of the crediting period: 5 years or 60 months

For the period from 01.01.2007 to 31.12.2007 emission reductions will be claimed to be transferred under appropriate mechanism approved by UNFCCC.
For the period from 1 January 2008 till 31 December 2012 credits will be transferred under Article 6 of the Kyoto Protocol (JI).
Emission reductions generated after the crediting period may be used in accordance with an appropriate mechanism under the UNFCCC.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

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

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

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

In accordance with the approach chosen baseline emissions will be calculated based on project level of electricity production and relevant emission factor.
The best practice for JI project monitoring should not influence (or minimally influence) common monitoring practice used in the plant. Therefore, existing statistical documents (monthly Technical Reports, etc.) will be used as a source of data. All metering devices used for metering the data, necessary for ER calculations, will be regularly checked and calibrated to provide sufficient level of certainty.
All data needed for ER calculation will be collected in statistic documents used by plant and after that recalculated into the value of emission reduction by applying method described below.
The data monitored and required for calculation of the ERUs will be archived and kept for 2 years after the last transfer of ERUs, namely at least till 31^{st} of December 2014.

Step 2. Application of the approach chosen

It is assumed that in the absence of the project the Plant would continue generating electricity at pre-project levels. Electricity generation beyond that level which was made possible by implementation of the project activity in the baseline scenario would be substituted by purchasing power from the national grid. Thus, baseline emissions are determined by monitoring project electricity generation by turbogenerator No1, calculating electricity generation increase and multiplying it to the emission factor for Ukrainian national power grid.

Natural gas combustion is monitored to determine project emissions, which will be achieved by multiplying monitoring data by default emission factor for natural gas combustion.
Emissions due to BFG and COG combustion are not monitored as combustion of these gases would take place regardless the project therefore it is assumed that the relevant GHG emissions are equal in both of scenarios.

Baseline emissions
The baseline scenario is continuation of existing before the project situation: flaring BFG, generating electricity on previous levels of production and purchasing the rest from the national grid. Emission sources in the baseline are:

- Emissions due to grid electricity consumption.

Project emissions
In the project scenario CHP-SAS is reconstructed which allows utilization of increased volumes of BFG for own power generation. Emission sources in the project scenario:

- Emissions due to natural gas consumption.

In accordance with the approach chosen project data for electricity generation and natural gas consumption will be monitored. The main sources of data will be monthly and annual Technical Reports which are statistical documents with sufficient level of reliability.

The following parameters have to be continuously monitored:
1. Natural gas combustion for power generation;
2. Net calorific value of natural gas;
3. Gross power generation;
4. Power consumption by turbo generator (auxiliary).

Calculation formulae are detailed in the following sections.
Data and parameters that are not monitored, but remain fixed once determined during PDD development, are provided in the table 12 below:

Table 12. List of constants used in the calculations of baseline and project emissions.

Data / Parameter	*Data unit*	*Description*	*Data Source*	*Value*
EF_{NG}	tCO_2e/GJ	Carbon dioxide emission factor for natural gas combustion	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.4	0.0561
EF_{EG}	tCO_2e/MWh	Carbon dioxide emission factor for grid electricity consumption	Data before 2010: emission factor for the Ukrainian grid 2006 – 2012. “Standardized emission factors for the Ukrainian electricity grid” research, made by Global Carbon and positively determined by TÜV SÜD (please find in Annex 2). Data in 2010 and after: “Emission factor of specific indirect carbon dioxide emissions from electricity consumption by 2nd class electricity consumers in accordance with Procedure for determining the class of consumers, adopted by Resolution of National Electricity Regulatory Commission of Ukraine on 13 of August 1998 No.1052”. Ukrainian National Environment Investment Agency Order No.43 from 28.03.2011. This referenced sources provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2e/MWh. 1 tCO_2 = 1 tCO_2e 1.225 $kgCO_2/kWh$ = 1.225 tCO_2e/MWh	Data before 2010: 0.896 Data in 2010 and after: 1.225
$EG_{BL,y}$	MWh	Baseline power output	Historical data over three years before the project start (2002-2004) were used to establish the baseline power output. The arithmetic average is used for the period.	72298
$FC_{BL,y}$	thousand m^3	Baseline consumption of NG co-fired with BFG and COG	Calculated using historical data over three years before the project start (2002-2004). See Annex 2 for calculation details	5551

$NCV_{NG,y}$	GJ/1000 m^3	Net calorific value of natural gas in baseline	National Inventory Report of Ukraine for 1990-2008 (page 258)[32]	33.940

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

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

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P-1 $FC_{PL,y}$	Natural gas combustion for power generation	Flow meters	m^3	m	continuously	100%	Electronic and paper	Data adjusted to conditions t=20°C; p= 101.325 kPa
P-2 $NCV_{PL,NG,y}$	Net calorific value of natural gas	Natural gas supplier data	GJ/thousand m^3	m	On sampling basis	100%	Electronic and paper	Measurement is not performed by project participants and conducted by the supplier of natural gas on sampling basis. Weighted average

[32]http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2010-nir-22may.zip

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

The project scenario envisions consumption of power that has been generated as a result of the project activity. The main GHG emission source in the project scenario is natural gas co-firing with blast furnace and coke oven gases. As blast furnace and coke oven gases would have been combusted anyway, it is considered that the corresponding GHG emissions are equal in the baseline and project scenario. Thus, they are disregarded in the project emission calculations. The following formulae will be used for project emissions calculation:

(D.1.1.) $PE_y = PE_{NG,y}$, where

PE_y is the project GHG emissions in the year *y*, tCO_2e;

$PE_{NG,y}$ is the project GHG emissions due to natural gas combustion in year *y*, tCO_2e.

(D.1.2.) $PE_{NG,y} = FC_{PL,y} \times NCV_{PL,NG,y} \times EF_{NG}$, where

$PE_{NG,y}$ is the project GHG emissions due to natural gas combustion in year *y*, tCO_2e;

$FC_{PL,y}$ is the project consumption of natural gas co-fired with the blast furnace and coke oven gases in year *y*, thousand nm^3 [Parameter P-1 in Table D.1.1.1];

$NCV_{PL,NG,y}$ is the net (lower) calorific value of natural gas in year *y*, GJ/thousand m^3 [Parameter P-2 in Table D.1.1.1];

EF_{NG} is the GHG emission factor due to burning of natural gas, tCO_2e/GJ [Parameter from Table 12 of this document].

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B-1 $GEG_{PL,y}$	Gross power generation by turbogenerator	Electricity meters	MWh	m	continuously	100%	Electronic and paper	-

B-2 $EG_{PL,y}$	Power consumption by turbogenerator	Electricity meters	MWh	m	continuously	100%	Electronic and paper	-

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

The project baseline is continuation of power generation at pre-project levels, satisfying the remaining power needs by purchasing national grid electricity and flaring of excess BFG. The main sources of GHG emissions under the baseline scenario are consuming power from the national grid and must-run NG combustion with BFG and COG. As BFG and COG would have been burned anyway without the project, it is considered that the corresponding GHG emissions are equal in the baseline and project scenarios. Thus, they were not taken into account. The baseline GHG emissions are calculated by the following equations[33]:

(D.2.1.) $BE_y = BE_{GE,y} + BE_{NG,y}$, where

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

$BE_{GE,y}$ is the GHG emissions due to grid power consumption in the baseline scenario in the year *y*, tCO_2e;

$BE_{NG,y}$ is the GHG emissions due to natural gas combustion in the baseline scenario in the year *y*, tCO_2e.

(D.2.2.) $BE_{GE,y} = (EG_{PL,y} - EG_{BL,y}) \times EF_{EG}$, where

$BE_{GE,y}$ is the GHG emissions due to grid power consumption in baseline scenario in the year *y*, tCO_2e;
$EG_{PL,y}$ is the power output in the project scenario, MWh;
$EG_{BL,y}$ is the power output in the baseline scenario, MWh [Parameter from Table 12 of this document. If the monitoring shows that the actual power output in year *y* is less than the one that was retained as baseline ($EG_{PL,y} < EG_{BL,y}$), then it is considered that in that year $EG_{BL,y} = EG_{PL,y}$];
EF_{EG} is the GHG emission factor due to national grid power consumption, t CO_2/MWh [Parameter from Table 12 of this document].

[33] If parameter is used in emissions calculation in both baseline and project scenarios there is no index indicating the scenario in the name of the parameter.

(D.2.3.) $EG_{PL,y} = GEG_{PL,y} - EC_{PL,y}$, where

$EG_{PL,y}$ is the power output by turbogenerator No.1 in the project scenario in year *y*, MWh;
$GEG_{PL,y}$ is the gross power generation by turbogenerator in year *y*, MWh [Parameter B-1 in Table D.1.1.3];
$EC_{PL,y}$ is the power consumption by turbogenerator in year *y*, MWh [Parameter B-2 in Table D.1.1.3].

(D.2.4.) $BE_{NG,y} = FC_{BL,y} \times NCV_{NG,y} \times EF_{NG}$, where

$BE_{NG,y}$ is the baseline GHG emissions due to natural gas combustion in year *y*, tCO_2e;
$FC_{BL,y}$ is the baseline consumption of natural gas co-fired with the blast furnace and coke oven gases in year *y*, thousand m^3 [Parameter from Table 12 of this document];
$NCV_{NG,y}$ is the net (lower) calorific value of natural gas in baseline, GJ/thousand m^3;
EF_{NG} is the GHG emission factor due to burning of natural gas, t CO_2e/GJ [Parameter from Table 12 of this document].

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

Not applicable.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

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

Not applicable.

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

Leakage

The only potential source of leakage or the net change of anthropogenic emissions by sources and/or removals by sinks of GHGs which occurs outside the project boundary, and that is attributable to the JI project, is increase of fugitive methane emissions due to increase of natural gas consumption for electricity generation which took place as a result of the project.

Leakage was estimated using data on fugitive emissions from Ukrainian gas transport system from the latest National Inventory Report of Ukraine[34]. The result obtained is 661 tonnes of CO_2e of average annual leakage due to fugitive methane emissions during the crediting period. Because emission factors used by IPCC and in national reporting of Ukraine vary significantly and no other source of data available, there is high uncertainty in determining the fugitive emissions from natural gas extraction, transportation, distribution and consumption. Thus, regarding the insignificant estimated amount of leakage and in the absence of reliable data on fugitive emissions of natural gas and due to the fact that Ukrainian gas transportation system is beyond control of project participants, it was decided to neglect this source of leakage.

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
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-

[34] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2010-nir-22may.zip

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

Leakages due to fugitive emissions from natural gas extraction, transportation, distribution and consumption are neglected. See D.1.3.Treatment of leakage in the **monitoring plan.**

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

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

$ER_y = BE_y - PE_y$, where

ER_y is the total emission reduction for the project in year *y*, tCO_2e;

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

PE_y is the total project GHG emissions in 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:

Collection and archiving of the information on the environmental impacts of the project will be done in accordance with the Host Party legislation based on the approved EIA and received allowances for pollution. Emissions of the following gases are continuously monitored by the Plant: NO_2, CO, SO_2. It is archived according to the rules for accounting information storage: data is available for three years minimum. Overall, due to implementation of the project activity emissions of these gases are reduced.

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

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
(*P-1*) $FC_{PL,y}$	*low*	Natural gas combustion for power generation will be continuously measured by gas flow meter at CHP-SAS. It is to be calibrated each 2 years according to Plant's internal procedures and requirements of the producer, uncertainty is 0.25%.
(P-2) $NCV_{PL,NG,y}$	*low*	Natural gas net calorific value is provided by RPD "Donbastransgas" - the natural gas supplier. The accuracy of the equipment is set fixed according to manufacturer's data; calibration of the equipment will be done in accordance with the internal procedures of the laboratory.
(B-1) $GEG_{PL,y}$	*low*	Gross power generation by turbogenerator in the project scenario will be continuously monitored by electricity meters. The data will be obtained from monthly and annual reports. It is to be calibrated each 3 years according to Plant's internal procedures and requirements of the producer, uncertainty is 2%.
(B-2) $EG_{PL,y}$	*low*	Power consumption by turbogenerator in the project scenario will be continuously monitored by electricity meters. The data will be obtained from monthly and annual reports. It is to be calibrated each 6 years according to Plant's internal procedures and requirements of the producer, uncertainty is 2%.

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

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

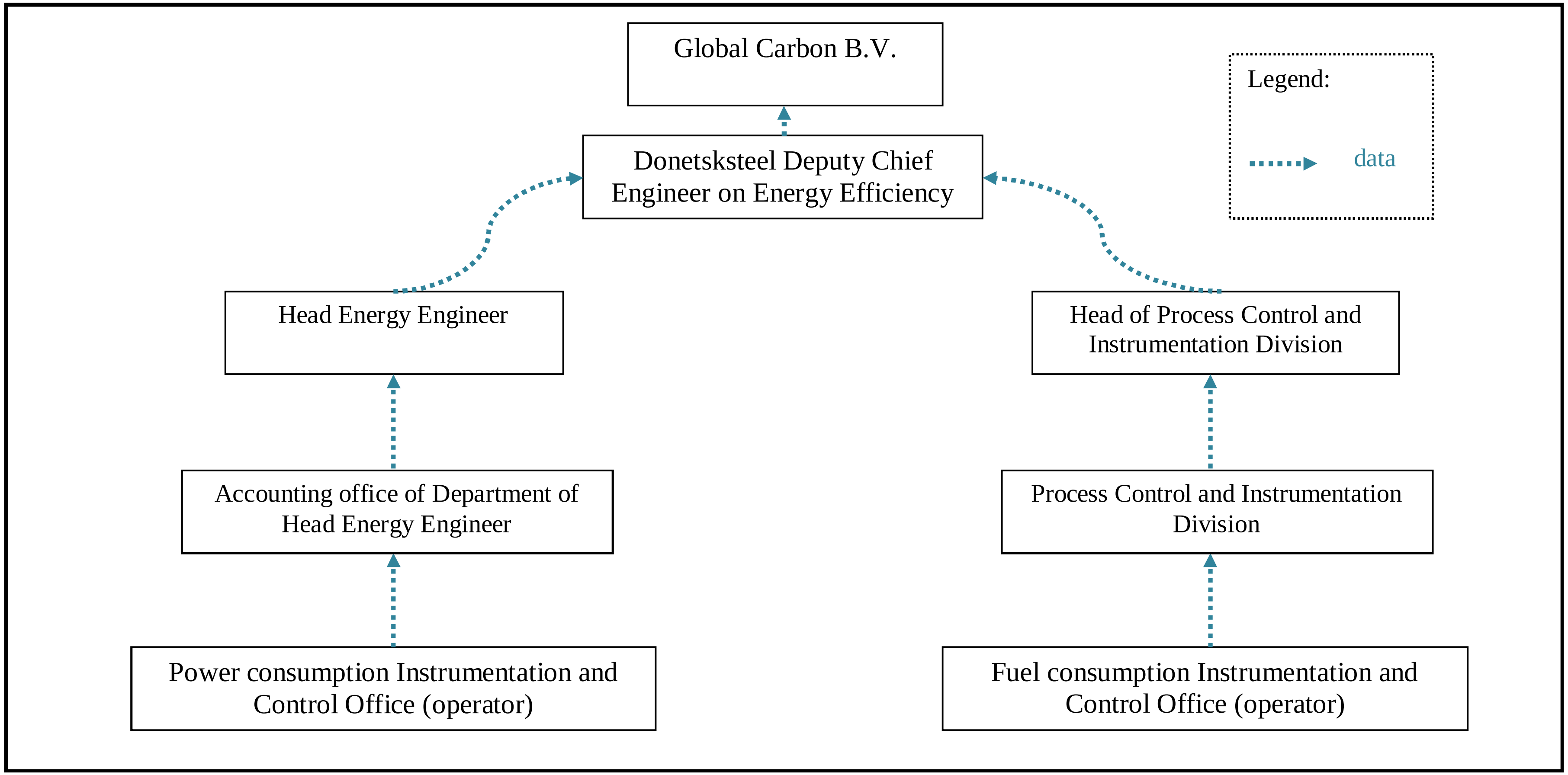

Fig. 9: Monitoring and quality control system at Donetsksteel.

Data storage and responsibilities

Principal scheme for data recording and reporting on electricity generation is as follows:

electricity generation is monitored by electronic meter directly connected with computer system at accounting office of Department of Head Energy Engineer; data is transferred with no human intervention. However, readings of the power meter are also recorded on hourly basis to the operational logs for cross-check.

Data on electricity consumption for generation is monitored by induction meters, readings of which are recorded to operational logs. Figures from those logs are filled in daily reports reflecting the readings of the power meters for each 24 hours, the daily reports are then submitted to accounting office of Department of Head Energy Engineer. Daily reports are analysed, difference in readings with data for the previous day is inputted into Excel based computer system, where data are accumulated and aggregated into monthly reports.

Principal scheme for data recording and reporting on fuel consumption follows:

consumption of NG, BFG and COG is monitored by flow meters, data of which are displayed through electronic logger. On daily basis the recorded data in electronic format is transferred to Process Control and Instrumentation Division (PCI Division), where it is downloaded into Excel based computer system, where data are accumulated and aggregated into monthly reports.

Specific details (serial numbers, calibration dates etc.) of flow meters used for monitoring will be provided in the monitoring reports with the aim to ensure maximal accuracy of reporting for the corresponding periods.

Installation and maintenance of metering devices is performed according to Plant Standard STP 54C-7.6-01-2006. According to this standard the responsibilities on installation, calibration and maintenance of metering devices are carried out by the Heads of the Department who assign responsible executors. In case with CHP-SAS these are Head of CHP-SAS with Deputy Head of Boiler Workshop and Deputy Head of Electrical Workshop respectively who organize execution of the relevant data collection procedures, periodic calibration according to the requirements of producers of the metering devises, maintaining them in working order and their repair.

Data recording process during the time of repair of metering devices is regulated by Instruction for Data Recording on Gas Fuel Consumption, paragraph 5.7: in case of absence of the flow meters due to their calibration or repair the average readings for the previous three days has to be recorded. The maximum acceptable period for the flow meter absence is 3 days. The same principle originating from USSR standards is applied to recording data of electricity meters.

The accuracy of reported monitoring data is ensured on the stage of preparing the monthly reports used as a primary data for emission reductions calculation. Each parameter in the report is cross-checked with the readings of gas flow-meters measuring the overall fuel consumption of CHP-SAS. The fuel consumption of individual installations is determined by deducting the sum of readings of the individual consumers from the overall consumption of CHP-SAS. If the difference does not correspond to the readings being cross-checked, the reason for it is determined and data are adjusted accordingly taking into account accuracy class of the metering devise. Once, the monthly report is prepared it is signed by the Head Energy Engineer and its data is used for official reporting, calculation of specific consumption norms and other purposes of the Plant.

Copies of the monthly reports are provided to Global Carbon B.V. which performs emission reductions calculation and prepares Monitoring reports.

Employees' qualification

The employees responsible for the CHP-SAS operation and for the monitoring control were dully trained.

Donetsksteel has a comprehensive system for education and training of staff. All of the staff members receive professional education which imply theoretical studies, practical supervised training at worksite and qualification exam. At worksite all the staff members are periodically instructed to refresh their knowledge of their responsibilities and safety rules. Training of monitoring personnel takes place in line with general professional training system working at the Plant. Training of the monitoring personnel at CHP-SAS is organized by Head of CHP-SAS, executed through Deputy Head of Boiler Workshop and Deputy Head of Electrical Workshop. Job descriptions are available at each workplace.

Health and safety rules, as well as preparedness to emergency situations are covered by the above mentioned training program which ends with an exam. In addition, each month employees are instructed at the work places. The instruction registration logs are kept at each work place and were available to AIE during the site visit.

Treatment of unintended emissions

Inside the project boundary unintended emissions could be related to the gas fuel used: NG, BFG and COG. In case of any emergency the supply of the fuel to CHP-SAS is to be stopped immediately after the automatic emergency signal from CHP-SAS. The gases supply is cut at gas distribution station of the Plant, blast shop or coke-chemical plant respectively.

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

Name of person/entity establishing the monitoring plan:

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

Global Carbon BV
Contact information is in the Annex 1.

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

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Table 13 Estimated project emissions during the crediting period

		2008	2009	2010	2011	2012	Total
Project emissions due to natural gas combustion	[tCO_2e/y]	5 573	22 561	17 617	20 554	23 490	**89 795**
Total Project emissions during the crediting period	[tCO_2e]	5 573	22 561	17 617	20 554	23 490	**89 795**

Table 14 Estimated project emissions after the crediting period

		2013-2026	Total
Project emissions due to natural gas combustion	[tCO_2e/y]	23 490	**328 860**
Total Project emissions after the crediting period	[tCO_2e]	23 490	**328 860**

Table 15 Estimated project emissions before the crediting period

		2007	Total
Project emissions due to natural gas combustion	[tCO_2e/y]	14 174	**14 174**
Project emissions before the crediting period	[tCO_2e]	14 174	**14 174**

E.2. Estimated leakage:

The only potential source of leakage or the net change of anthropogenic emissions by sources and/or removals by sinks of GHGs which occurs outside the project boundary, and that is attributable to the JI project, is increase of fugitive methane emissions due to increase of natural gas consumption for electricity generation which took place as a result of the project.

Leakage was estimated using data on fugitive emissions from Ukrainian gas transport system from the latest National Inventory Report of Ukraine[35]. The result obtained is 661 tonnes of CO_2e of average annual leakage due to fugitive methane emissions during the crediting period. Because emission factors used by IPCC and in national reporting of Ukraine vary significantly and no other source of data available, there is high uncertainty in determining the fugitive emissions from natural gas extraction, transportation, distribution and consumption. Thus, regarding the insignificant estimated amount of leakage and in the absence of reliable data on fugitive emissions of natural gas and due to the fact that Ukrainian gas transportation system is beyond control of project participants, it was decided to neglect this source of leakage.

35 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2010-nir-22may.zip

Table 16 Estimated leakage during the crediting period

		2008	2009	2010	2011	2012	Total
Leakage during the crediting period	[tCO_2e]	0	0	0	0	0	**0**

Table 17 Estimated leakage after the crediting period

		2013-2026	Total
Leakage after the crediting period	[tCO_2e]	0	**0**

Table 18 Estimated leakage before the crediting period

		2007	Total
Leakage before the crediting period	[tCO_2e]	0	**0**

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

Table 19 Estimated total project emissions during the crediting period

		2008	2009	2010	2011	2012	Total
Total Project emissions during the crediting period	[tCO_2e]	5 573	22 561	17 617	20 554	23 490	**89 795**

Table 20 Estimated total project emissions after the crediting period

		2013-2026	Total
Total Project emissions after the crediting period	[tCO_2e]	23 490	**328 860**

Table 21 Estimated total project emissions before the crediting period

		2007	Total
Total Project emissions before the crediting period	[tCO_2e]	14 174	**14 174**

E.4. Estimated baseline emissions:

Table 22 Estimated baseline emissions during the crediting period

		2008	2009	2010	2011	2012	Total
Baseline emissions due to consumption of grid electricity	[tCO_2e/y]	6 294	64 169	95 185	125 810	156 435	**447 893**
Baseline emissions due to natural gas combustion	[tCO_2e/y]	10 569	10 569	10 569	10 569	10 569	**52 845**
Baseline emissions during the crediting period	[tCO_2e]	16 863	74 738	105 754	136 379	167 004	**500 738**

Table 23 Estimated baseline emissions after the crediting period

		2013-2026	Total
Baseline emissions due to consumption of grid electricity	[tCO_2e/y]	156 435	**2 190 090**
Baseline emissions due to natural gas combustion	[tCO_2e/y]	10 569	**147 966**
Baseline emissions after the crediting period	[tCO_2e]	**167 004**	**2 338 056**

Table 24 Estimated baseline emissions before the crediting period

		2007	Total
Baseline emissions due to consumption of grid electricity	[tCO_2e/y]	36 556	**36 556**
Baseline emissions due to natural gas combustion	[tCO_2e/y]	10 569	**10 569**
Baseline emissions before the crediting period	[tCO_2e]	47 125	**47 125**

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

Table 25 Estimated emission reductions during the crediting period

		2008	2009	2010	2011	2012	Total
Emission reductions during the crediting period	[tCO_2e]	11 290	52 177	88 137	115 825	143 514	**410 943**

Table 26 Estimated emission reductions after the crediting period

		2013-2026	Total
Emission reductions after the crediting period	[tCO_2e]	143 514	**2 009 196**

Table 27 Estimated emission reductions before the crediting period

		2007	Total
Baseline emissions before the crediting period	[tCO_2e]	32 951	**32 951**

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

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2007	14 174	-	47 125	32 951

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2008	5 573	-	16 863	11 290
Year 2009	22 561	-	74 738	52 177
Year 2010	17 617	-	105 754	88 137
Year 2011	20 554	-	136 379	115 825
Year 2012	23 490	-	167 004	143 514
Total (tonnes of CO_2 equivalent) over the crediting period	89 795	-	500 738	410 943

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Year 2013	23 490	-	167 004	143 514
Year 2014	23 490	-	167 004	143 514
Year 2015	23 490	-	167 004	143 514
Year 2016	23 490	-	167 004	143 514
Year 2017	23 490	-	167 004	143 514
Year 2018	23 490	-	167 004	143 514
Year 2019	23 490	-	167 004	143 514
Year 2020	23 490	-	167 004	143 514
Year 2021	23 490	-	167 004	143 514
Year 2022	23 490	-	167 004	143 514
Year 2023	23 490	-	167 004	143 514
Year 2024	23 490	-	167 004	143 514
Year 2025	23 490	-	167 004	143 514
Year 2026	23 490	-	167 004	143 514
Total estimated emission reductions over the period 2013-2026	328 860		2 338 056	2 009 196

SECTION F. Environmental impacts

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

According to Ukrainian legislation[36] environmental impacts of a project are to be analyzed in EIA which is a part of project documentation which receives approval after its integrated expertise. For the proposed JI project development of a united project document was not necessary as the project is constituted of modernization of individual parts of an existing facility. The project was implemented according to documentation for its components (replacement of condenser, installation of condensation pumps, upgrade of control system with installation of new monitoring equipment, sensors and actuators etc.) which are not subject for EIA. Therefore, it didn't go through the approval procedure part of which is collection of stakeholder comments. The existing EIA covering the overall activities undertaken at CHP-SAS for its modernization was undertaken on voluntary basis as improvement under Donetsksteel environment management system (Donetsksteel is certified in ISO 14001).

Main environmental impacts of the project are caused by exhaust gases emitted by boilers of CHP-SAS (NO_2, CO, SO_2). These gases are annually monitored and reported to State environmental monitoring service of the Committee on natural resources in Donetsk through official annual statistical form 2-tp (air) *Data on protection of atmospheric air*. Emissions of these gases are within the permitted levels.
All the necessary permissions were obtained in compliance with the existing Ukrainian legislation, namely: the Laws of Ukraine "On Protection of Environment", "On Ecological Expertise", "On Protection of Atmospheric Air", "On Ensuring Sanitary and Epidemic Welfare of the Population", and "On Local Councils and Local Government", as well as the applicable Water Code, Land Code, and Forest Code.

Compared to the baseline scenario the level of negative environmental impact is much lower. According to EIA the execution of the project caused positive impact on the environment, especially on the quality of atmospheric air. The positive environmental impact of the project was the reason for its inclusion into the list of measures to improve air quality in Donetsk in the course of Donetsk Clean Air Program[37]. As a result of project implementation emissions of air pollutants from CHP-SAS were reduced by 23%. Additional positive effect is achieved by reducing the amount of BFG flared at stand.

This is also important in terms of transboundary effects of the project as air pollutants are transported on big distances from the emission sourse. Reduction of air pollution achieved by the project also has positive transboundary impact.

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

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[36] Law of Ukraine "On Environmental Expertise" http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=45%2F95-%E2%F0
[37] Donetsk Clean Air Program, Volume 1, 2008, http://doneco.org.ua/download.php?id=108

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

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

SECTION G. Stakeholders' comments

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

According to the Host Party's legislation no stakeholder consultations are to be collected during project documentation approval process as a part of EIA. As explained earlier, the existing EIA of Donetsksteel CHP-SAS which covers modernization and reconstruction of boiler No5 and turbogenerator No.1 was undertaken on voluntary basis as improvement under Donetsksteel environment management system (Donetsksteel is certified in ISO 14001). Therefore, no formal requirements concerning collecting stakeholders' comments are applicable to the project.

However, news items about all significant reconstruction plans are regularly published on the Plant's web-page. Information about project CHP-SAS Modernization Project for BFG Utilization was also published and is available online[38]. It is also mentioned in the Environmental Management Plan and Environmental Impact Assessment of Donetsksteel Export Subproject which were also publicly available through Donetsksteel official web page[39].

Stakeholder comments of the proposed JI project are to be collected during the determination process of the proposed JI project.

[38] http://www.dmz.com.ua/news/actual/?id=347

[39] http://www.dmz.com.ua/company/img/eko_plan.pdf

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION[40]

In order to calculate baseline and project emissions and to monitor emission reductions of the project a JI specific approach was used in accordance with the JI Guidance on Criteria for Baseline Setting and Monitoring, Version 02. No approved CDM methodologies were applied.
As shown in Section B.1.above, the most plausible baseline scenario is continuation of previous practice: using blast furnace and coke oven gases for power generation at pre-project rates, satisfying remaining power needs by purchasing national grid electricity and flaring the excess blast furnace gas.
The main sources of GHG emissions under the baseline scenario are consuming power from the national grid and mandatory co-firing natural gas with blast furnace and coke oven gases. As blast furnace and coke oven gases would have been burned anyway without the project, it is considered that the corresponding GHG emissions are equal in the baseline and project scenarios. Thus, they are disregarded in the project emission estimates.
Baseline GHG emissions are calculated using the following equation:

(1.1.) $$BE_y = BE_{GE,y} + BE_{NG,y}$$, where

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

$BE_{GE,y}$ is the GHG emissions due to grid power consumption in the baseline scenario in the year *y*, tCO_2e;

$BE_{NG,y}$ is the GHG emissions due to natural gas combustion in the baseline scenario in the year *y*, tCO_2e.

(1.2.) $$BE_{GE,y} = (EG_y - EG_{BL,y}) \times EF_{EG}$$, where

$BE_{GE,y}$ is the GHG emissions due to grid power consumption in baseline scenario in the year *y*, tCO_2e;
EG_y is the power output in the project scenario, MWh [Project performance data is used for 2007-2009; forecast data for 2010-2026];
$EG_{BL,y}$ is the power output in the baseline scenario, MWh [Historical data over three years before the project start (2002-2004) were used to establish the baseline power output. The arithmetic average is used for the period];
EF_{EG} is the GHG emission factor due to national grid power consumption, tCO_2e/MWh.

(1.3.) $$EG_{PL,y} = GEG_{PL,y} - EC_{PL,y}$$, where

$EG_{PL,y}$ is power output in the project scenario, MWh;
$GEG_{PL,y}$ is gross power generation by turbogenerator No.1, MWh;
$EC_{PL,y}$ is power consumption by turbogenerator No.1, MWh.
$EG_{PL,y}$ is derived from project performance data over 2007-2009.

[40] If parameter is used in emissions calculation in both baseline and project scenarios there is no index indicating the scenario in the name of the parameter.

(1.4.) $BE_{NG,y} = FC_{BL,y} \times NCV_{NG,y} \times EF_{NG}$, where

$BE_{NG,y}$ is the baseline GHG emissions due to natural gas combustion in year *y*, tCO_2e;
$FC_{BL,y}$ is the baseline consumption of natural gas co-fired with the blast furnace and coke oven gases in year *y*, thousand m^3;
$NCV_{NG,y}$ is the net (lower) calorific value of natural gas in baseline, GJ/thousand m^3;
EF_{NG} is the GHG emission factor due to burning natural gas, tCO_2e /GJ.

The amount of natural gas combusted in 2010-2012 was calculated using the following equation:

(1.5.) $FC_{BL,y} = \frac{EG_{BL,y} \times ECR_{EG,y} \times f_{NG,y}}{NCV_{NG,y}}$, where

$FC_{BL,y}$ is the baseline consumption of natural gas, thousand m^3;
$EG_{BL,y}$ is the baseline power output, MWh;
$ECR_{EG,y}$ is the specific energy consumption to generate 1 MWh of power, GJ/MWh;
$f_{NG,y}$ is the share of natural gas in the total consumed fuel, fraction;
$NCV_{NG,y}$ is the net (lower) calorific value of natural gas in baseline, GJ/ thousand m^3.

The specific energy consumption to generate 1 MWh of power was found from equation 1.6 based on the actual data over 3 years before the project start. The average value is used to model the baseline natural gas consumption.

(1.6.) $ECR_{EG,y} = \frac{FC_{NG,y} \times NCV_{NG,y} + FC_{BFG,y} \times \rho \times NCV_{BFG,y} + FC_{COG,y} \times NCV_{COG,y}}{EG_{BL,y}}$, where

$ECR_{EG,y}$ is the specific energy consumption to generate 1 MWh of power, GJ/MWh;
$EG_{BL,y}$ is the baseline power output, MWh;
$FC_{NG,y}$ is the baseline consumption of natural gas, m^3;
$FC_{BFG,y}$ is the baseline consumption of blast furnace gas, thousand m^3;
$FC_{COG,y}$ is the baseline consumption of coke oven gas, m^3;
ρ is density of BFG, t/ thousand m^3;
$NCV_{NG,y}$ is the net (lower) calorific value of NG in baseline, GJ/ thousand m^3;
$NCV_{BFG,y}$ is the net (lower) calorific value of BFG in baseline, GJ/ t;
$NCV_{COG,y}$ is the net (lower) calorific value of COG in baseline, GJ/ thousand m^3;

(1.7.) $f_{NG,y} = \frac{FC_{NG,y} \times NCV_{NG,y}}{FC_{NG,y} \times NCV_{NG,y} + FC_{BFG,y} \times \rho \times NCV_{BFG,y} + FC_{COG,y} \times NCV_{COG,y}}$, where

$f_{NG,y}$ is the share of natural gas in the total consumed fuel, fraction;
$FC_{NG,y}$ is the baseline consumption of natural gas, thousand m^3;
$FC_{BFG,y}$ is the baseline consumption of blast furnace gas, m^3;
$FC_{COG,y}$ is the baseline consumption of coke oven gas, m^3;

ρ is density of BFG, t/ thousand m^3;
$NCV_{NG,y}$ is the net (lower) calorific value of NG in baseline, GJ/ thousand m^3;
$NCV_{BFG,y}$ is the net (lower) calorific value of BFG in baseline, GJ/ t;
$NCV_{COG,y}$ is the net (lower) calorific value of COG in baseline, GJ/ thousand m^3;

Table 28. List of constants used in the calculations of baseline emissions.

Data / Parameter	***Data unit***	***Description***	***Data Source***	***Value***
$EG_{BL,y}$	MWh	Baseline power output	Historical data over three years before the project start (2002-2004) were used to establish the baseline power output. The arithmetic average is used for the period.	72 298
$FC_{BL,y}$	thousand m^3	Baseline consumption of NG co-fired with BFG and COG	Calculated using historical data over three years before the project start (2002-2004).	5 551

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

Data/Parameter	EG_y
Data unit	MWh
Description	Net electricity generation by turbogenerator No.1
Time of determination/monitoring	Measured continuously
Source of data (to be) used	Project owner records
Value of data applied[41]	<table><tr><th>2002</th><th>2003</th><th>2004</th></tr><tr><td>61 284</td><td>79 348</td><td>76 261</td></tr><tr><td></td><td></td><td></td></tr><tr><th>2007</th><th>2008</th><th>2009</th></tr><tr><td>113 097</td><td>79 323</td><td>143 916</td></tr><tr><td></td><td></td><td></td></tr><tr><th>2010</th><th>2011</th><th>2012-2026</th></tr><tr><td>150 000</td><td>175 000</td><td>200 000</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine the amount of electricity which would be generated regardless the project activity. Post-project and forecast data were used to calculate how much electricity would have to be purchased from national grid in the baseline scenario. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer.
Any comment	No

[41] Reconstruction activity took place in 2005-2006, therefore, no data for these years is used for calculation.

Data/Parameter	$FC_{NG,y}$
Data unit	Thousand m^3
Description	is the amount of natural gas combusted in boiler No.5 in year y
Time of determination/monitoring	Measured continuously
Source of data (to be) used	Project owner records
Value of data applied	**2002**: 5 607; **2003**: 5 456; **2004**: 5 345
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	$FC_{BFG,y}$
Data unit	Thousand m^3
Description	is the amount of blast furnace gas combusted in boiler No.5 in year y
Time of determination/monitoring	Measured continuously
Source of data (to be) used	Project owner records
Value of data applied	**2002**: 399 677; **2003**: 641 774; **2004**: 646 358
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	$FC_{COG,y}$
Data unit	Thousand m^3
Description	is the amount of cock oven gas combusted in boiler No.5 in year y
Time of determination/monitoring	Calculated. Data of continuous measurements are adjusted by default NCV value of 16,75 GJ/1000 m^3 by the following formula: $FC_{COG,y} = \frac{FC_{COGm,y} \times NCV_{COGm,y}}{NCV_{COG,y}}$, where $FC_{COG,y}$ - is the amount of cock oven gas combusted in boiler No.5 in year y, thousand m^3; $FC_{COGm,y}$ - is actually measured amount of cock oven gas combusted in boiler No.5 in year y, thousand m^3; $NCV_{COGm,y}$ – is actually measured net calorific value of cock oven gas, GJ/1000 m^3; $NCV_{COG,y}$ - is default net calorific value of cock oven gas, GJ/1000 m^3.
Source of data (to be) used	Project owner records
Value of data applied	**2002**: 300; **2003**: 1 787; **2004**: 83

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is the key parameter to determine baseline specific energy consumption rate for electricity generation. Data are collected for technological purposes of the project owner.
QA/QC procedures (to be) applied	Meters calibrated according to internal procedures of the Plant and requirements of producer
Any comment	No

Data/Parameter	EF_{EG}
Data unit	tCO_2e/MWh
Description	Carbon emission factor for consumption of electricity from national power grid
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	Data before 2010: emission factor for the Ukrainian grid 2006 – 2012. "Standardized emission factors for the Ukrainian electricity grid" research, made by Global Carbon and positively determined by TÜV SÜD (please find in Annex 2). Data in 2010 and after: "Emission factor of specific indirect carbon dioxide emissions from electricity consumption by 2nd class electricity consumers in accordance with Procedure for determining the class of consumers, adopted by Resolution of National Electricity Regulatory Commission of Ukraine on 13 of August 1998 No.1052". Ukrainian National Environment Investment Agency Order No.43 from 28.03.2011
Value of data applied	**2007**: 0.896; **2008**: 0.896; **2009**: 0.896; **2010**: 1.225; **2011**: 1.225; **2012-2026**: 1.225
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data before 2010: This research is the most credible source for Ukrainian grid emission factor at this moment. All calculations are based on official data obtained from the relevant Ministries. Data in 2010 and after: This is a country specific emission factor calculated and approved by Ukrainian DFP for calculating emission reductions for JI projects in Ukraine
QA/QC procedures (to be) applied	-
Any comment	One of the referenced sources provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2e/MWh. Data in 2010 and after: $1\ tCO_2 = 1\ tCO_2e$ $1.225\ kgCO_2/kWh = 1.225\ tCO_2e/MWh$

Data/Parameter	EF_{NG}
Data unit	tCO_2e/GJ
Description	CO_2 emission factor for natural gas combustion
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1, Table 1.4
Value of data applied	0.0561
Justification of the choice of data or description of measurement methods	As long as any national sectoral emission factors are unavailable, IPCC value has to be used as a default

and procedures (to be) applied	
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to tCO_2e/ GJ: 1 tCO_2 = 1 tCO_2e 56100 kg CO_2/TJ = 0.0561 tCO_2e/GJ

Data/Parameter	$NCV_{NG,y}$
Data unit	GJ/1000 m^3
Description	Net calorific value of natural gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report 1990 – 2008 (page 258)
Value of data applied	33.94
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is a country specific value used by Ukrainian DFP for Ukrainian GHG Emissions Inventory
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/1000 m^3: 33.94 TJ/million m^3 = 33.94 GJ/1000 m^3

Data/Parameter	$NCV_{BFG,y}$
Data unit	GJ/t
Description	Net calorific value of blast furnace gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy, Table 1.2, p.1.18
Value of data applied	2.47
Justification of the choice of data or description of measurement methods and procedures (to be) applied	As long as any national sectoral emission factors are unavailable, IPCC value has to be used as a default
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/t: 2.47 TJ/Gg = 2.47 GJ/t

Data/Parameter	ρ
Data unit	t/1000 m^3
Description	Density of BFG (t= 0°C; p= 101.325 kPa)
Time of determination/monitoring	Is not monitored
Source of data (to be) used	The Engineering Toolbox[42]
Value of data applied	1.250
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Default value.
QA/QC procedures (to be) applied	-
Any comment	Because of low sensitivity of emission reductions calculation to

[42] http://www.engineeringtoolbox.com/gas-density-d_158.html

	this parameter the value under t= 0°C; p= 101.325 kPa was regarded to be acceptable. The difference in calculation results in case of adjustment to t= 20°C; p= 101.325 kPa was considered to be negligible. The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to t/1000 m^3: 1.250 kg/m^3 = 1.250 t/1000 m^3

Data/Parameter	$NCV_{COG.y}$
Data unit	GJ/1000 m^3
Description	Net calorific value of cock oven gas in baseline
Time of determination/monitoring	Fixed ex ante
Source of data (to be) used	National Inventory Report 1990 – 2008 (page 258)
Value of data applied	16.75
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This is a country specific value used by Ukrainian DFP for Ukrainian GHG Emissions Inventory
QA/QC procedures (to be) applied	-
Any comment	The referenced source provides value of this parameter in different data units. For convenience they were mathematically converted to GJ/1000 m^3: 16.75 TJ/million m^3 = 16.75 GJ/1000 m^3

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 exist a similar need 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[43];

- The "Operational Guidelines for the Project Design Document", further referred to as ERUPT approach or baseline [44];

- The approved CDM methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" [45];

- Specific circumstances for Ukraine as described below.

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

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

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

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 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 29: 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 showed 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 30: Electricity demand in Ukraine on 31 March 2005[46]

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

Development of the Ukrainian electricity sector

The National Energy Strategy[47] 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[48]:

- 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.

	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 31: Installed capacity[49] in Ukraine in 2004

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'[50].

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 32: Peak load in Ukraine in 2001 - 2005[51]

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

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

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

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

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

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)[52].

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;
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 33: Imports and exports balance in Ukraine[53]

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

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

ACM0002 offers several choices for calculating the OM. Dispatch data analyze cannot be applied, since the grid data is not available[54]. 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 34: Share of power plants in the annual electricity generation of Ukraine[55]

The simple OM is calculated using the following formula:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum GEN_{j,y}} \qquad \textbf{(Equation 1)}$$

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 CO_2 emission coefficient of fuel I (tCO_2e / 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.

The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad \textbf{(Equation 2)}$$

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, fraction;

$EF_{CO2,i}$ is the CO_2 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[56]. The majority of the electricity (up to 95%) is generated centrally and therefore the data is comprehensive[57].

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

[55] "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 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[58] 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 35: Grid losses in Ukraine[59]

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[60] 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:

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[56] “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.

[57] 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.

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

[59] “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.

[60] 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.

- 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[61];

- 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:

$$EF_{grid,produced,y} = EF_{OM,y} \qquad \textbf{(Equation 3)}$$

and

$$EF_{grid,reduced,y} = \frac{EF_{grid,produced,y}}{1 - loss_{grid}} \qquad \textbf{(Equation 4)}$$

where:

$EF_{grid,produced,y}$ is the emission factor for JI projects supplying additional electricity to the grid (tCO_2e/MWh);
$EF_{grid,reduced,y}$ is the emission factor for JI projects reducing electricity consumptionfrom the grid (tCO_2e/MWh);
$EF_{OM,y}$ is the simple OM of the Ukrainian grid (tCO_2e/MWh);
$loss_{grid}$ is the technical losses in the grid (%).

The following result was obtained:

Type of project	**Parameter**	**EF (tCO_2e/MWh)**
JI project producing electricity	$EF_{grid,produced,y}$	0.807
JI projects reducing electricity	$EF_{grid,reduced,y}$	0.896

Table 36: Emission Factors for the Ukrainian grid 2006 - 2012

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);

[61] "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.

- Electricity produced by the project and consumed on-site in year y (in MWh).

The baseline emissions are calculated as follows:

(Equation 5)

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

where:

BE_y	are the baseline emissions in year y (tCO_2e);
$EF_{grid,produced,y}$	is the emission factor of producing projects (tCO_2e /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 (tCO_2e /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.

Acknowledgements

The development of this new baseline has been made possible by funding of the EBRD and the Netherlands' Ministry of Economic Affairs. The authors would further like to thank the Ukrainian Ministry of Energy for supplying the data and the Ministry of Environmental Protection for their support. This baseline study can be used freely in case of proper reference.

Global Carbon B.V.

Version 5, 2 February 2007

TÜV SÜD
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Ukraine - Assessment of new calculation of CEF

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 an integrated electricity grid exists, a standardized baseline should be used to estimate the amount of CO_2 emission reductions on the national grid.

The Ukraine is one of the major JI host countries where many grid related projects have been developed or will be implemented. In order to enhance the project development and reliability in emission reductions from the Ukraine a standardized and common agreed grid factor expressing the carbondioxid density per kWh is crucial.

Objective

Global Carbon B.V. is one of the pioneers developing JI projects in Ukraine who has developed a baseline approach for determining the Ukrainian grid factor. The approach is implied from the approved CDM methodology ACM0002.

The team of Carbon Management Service (CMS) of TÜV SÜD Industrie Service GmbH with its accredited certification body "Climate and Energy" has been ordered to verify the developed approach and the calculated grid factor.

Once an approach is agreed it should be used for calculating the grid by using current available data served from the Ukraine Ministry for Fuel and Energy. Such annual grid factor shall be used as a binding grid factor for JI projects developed in the Ukraine.

Scope

The baseline approach to which this confirmation is referring is attached. The confirmation includes the inherent approach if the algorithms are developed reasonable and from a technical point of view correct. Furthermore the verified the

Date: 17.08.2007

Our reference:
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This document consists of
4 Pages
Page 1 of 4

The test results refer exclusively to the units under test.

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Industrie Service

origin of the data. The team consists of:

- Werner Betzenbichler (Head of the certification Body "Climate and Energy"),
- Thomas Kleiser (Head of division JI/CDM, GHG-Auditor and Project Manager)
- Markus Knödlseder (GHG-Auditor and Project Manager)

Mr. Kleiser and Betzenbichler assessed the baseline approach and agreed with Global Carbon on the conclusive approach. Mr. Kleiser and Mr. Knödlseder assessed the calculation model whereas Mr. Knödlseder interviewed also Mr. Nikolay Andreevich Borisov, Deputy Director for Strategic Development in Ministry of Fuel and Energy (+380 (44) 2349312 // borisov@mintop.energy.gov.ua) who explained the process of data gathering in the Ukraine. He also confirmed that GlobalCarbon B.V. uses the served data.

Conclusion

The conclusive assessment does not include potential uncertainties that might be occurred in the data gathering process of the ministry. Considering that we confirm that applied data served by Ministry of Fuel and Energy are reliable and correctly used.

Based on submitted calculation method, developed baseline study (see attachment), applied data and written confirmation from Ministry of Fuel and Energy (see attached documents) the team of Carbon Management Service of TÜV SÜD Industrie Service GmbH with its accredited certification body "Climate and Energy" confirms further that developed approach is eligible to determine the Ukrainian electricity grid factor as a standard value for JI project in the Ukraine.

The team recommends updating the calculation annually depending on point of time when national consolidated data are available.

Munich,17/08/2007	Munich, 17/08/2007
Markus Knödlseder	Werner Betzenbichler
GHG-Auditor and Project Manager	Head of the certification Body "Climate and Energy" and Carbon Management Service

Annex 3

MONITORING PLAN

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

Data/Parameter	**Gross power generation by turbogenerator No.1** $GEG_{PL,y}$
Data unit	MWh
Source of data (to be) used	Monthly technical report
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Monthly technical reports are prepared based of recordings of electricity meter performed at CHP-SAS.
OA/QC procedures (to be) applied	The relevant metering devices will be calibrated according to the host Party's legislation and requirements of the supplier.

Data/Parameter	**Power consumption by turbogenerator No.1** $EG_{PL,y}$
Data unit	MWh
Source of data (to be) used	Monthly technical report
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Monthly technical reports are prepared based of recordings of electricity meter performed at CHP-SAS.
OA/QC procedures (to be) applied	The relevant metering devices will be calibrated according to the host Party's legislation and requirements of the supplier.

Data/Parameter	**Natural gas combustion for power generation** $FC_{NG,y}$
Data unit	m^3
Source of data (to be) used	Monthly technical report
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Monthly technical reports are prepared based of recordings of gas flow meter performed at CHP-SAS.
OA/QC procedures (to be) applied	The relevant metering devices will be calibrated according to the host Party's legislation and requirements of the supplier.

Data/Parameter	**Net calorific value of natural gas** $NCV_{PL,NG,y}$
Data unit	GJ/thousand m^3
Source of data (to be) used	Certificate provided by RPD "Donbastransgas"
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Natural gas supplier data obtained by conducting measurements in certified laboratory.
OA/QC procedures (to be) applied	The relevant metering devices will be calibrated according to the host Party's legislation and requirements of the supplier.