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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Introduction of a 12.5MWe CHP with a coke plant's flue gases utilization at the branch of ISTEK LLC "Horlivka Coke Plant"
Version of the document: 1.2.
Date of the document: 25 February 2009.

A.2. Description of the project:

Ukraine is one of the most energy intensive countries in the world. In Ukraine the primary energy consumption has been quite the same during the 2004-2007. About 79 % of the total energy consumption in Ukraine in the past few years was produced using fossil fuels like coal, oil and natural gas. Ukraine's self-sufficiency in fossil fuels is less than 50 %. In oil consumption, the self-sufficiency is 10 - 15 %, in gas 20 - 25 %, in coal 80 - 85% and in uranium 100 %.

Coke production is an energy intensive process. One tonne of dry blast furnace coke required about 3.7 GJ (0.89 Gcal) of energy input. On the other hand, coke oven gas producing in the coke battery as a by product is suitable for energy production.

The proposed JI project is planning to be implemented at Horlivka Coke Plant (HCP) owned by ISTEK LLC. The main product of the HCP is metallurgical coke. HCP is one of the oldest coke plants in Ukraine. It was put into operation in 1928 with two coke batteries. During the Second World War the HCP was totally destroyed and rebuilt in the year 1950. HCP was stopped in December 1997 because of lack of raw materials. Only on December 13 of 2005, the coke production was restarted on HCP. The plant is currently operating one coke battery, which is consisting of 57 ovens, and all supply facilities. The design capacity of the coke battery is 466 000 tonnes per year of coke with 6% moister content. HCP has not any own electricity production facilities. Plant consists of the following workshops:

- Coal preparation workshop;
- Coke workshop;
- Coking products trapping workshop;
- Boiler house.

The coking coal comes to HCP's Coal preparation workshop by railway. Then, coals are unloaded and stored at the open-air depot with a volume 8000 tonnes and at closed depots. During winter the railroad cars proceed through the garage-defrosting unit. After the depots, coking coals proceed through the dose and crusher unit. The main purpose of the crusher unit is preparation of coal blend (furnace charge) by coals mixing and crushing.

The coal blend is then charged into the coke battery, which consists of 57 ovens. The coking period is 16 hours. The final temperature of the process is 1050 ± 50 ºC. The coal blend is transferred into coke, coke oven gas and other by-products. The finished coke is loaded into extinguishing railroad car and directed to the quenching house, where coke quenching is taking place. The finished quenched coke is separated by particle size, loading and supplying to the consumers.

The main by-product of the process is coke oven gas (COG). The net calorific value (NCV) of the COG is about 15.42 MJ/Nm^3 (3683 kcal/Nm^3). The COG with a temperature of 650 ± 750 ºC is taking off from the ovens to the gas collector where temperature decreasing to the 82 ± 85 ºC. After scavenging, COG is distributed to on-site consumers: coke battery, boiler house, flare unit and garage-defrosting unit. COG is distributed between on-site facilities at the moment, as presented in the following table.

COG consumer	Share of the COG, %
Heating of the coke battery	51.2
Generation of the process steam in the boiler house	13.1
Burning on garage-defrosting unit	1.1
Burning on flare unit	34.6

Table 1: Consumption of COG

The proposed JI project consists of the installation of a steam boiler and a steam turbo generator with all necessary auxiliary equipment. The steam boiler will be able to generate 85 tonnes of steam per hour with pressure 3.82 MPa (39 kgf/sm^2) and temperature 440 ºC. The steam turbo generator will have a capacity of 12.5 MW$_e$. The combined heat and electricity production (CHP) will be fuelled by COG available for energy production – namely flared and used in the existing boiler house at the moment. The existing boiler house will be switch to stand-by mode and used during maintenance of the proposed CHP.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	"Horlivka Coke Plant"	No
Netherlands	Global Carbon BV	No

Table 2: Project participants

Horlivka Coke Plant is the project host. Global Carbon BV is developer of this JI project.

A.4. Technical description of the project:

A.4.1. Location of the project:

Premises of the Horlivka Coke Plant.

A.4.1.1. Host Party(ies):

Ukraine.

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

Donetsk region.

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

City of Horlivka.

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

Figure 1. Map of Ukraine and location of the town of Horlivka.

The physical location of the project is at the premises of HCP located in the town of Horlivka, Donetsk region, Ukraine. Location of the Donetsk region and location of the city of Horlivka are shown on the following figure. The global position of the town of Horlivka is 48°20'24.57"N 38° 2'11.54"E. The town of Horlivka was established in 1779. The population is about 316 000 inhabitants (2005).

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

HCP operates one coke battery with a design capacity 466 000 tonnes per year of coke with 6% moister content. During the coke production COG is generated. COG is a waste gas suitable for energy production and with a NCV of about 15.42 MJ/Nm3 (3683 ccal/Nm3). A part of the gas (about 34.6%) is flared now. Another parts are used for heating of coke battery (51.2%), producing of the process steam (13.1%) and on garage-defrosting unit (1.1%). The proposed project idea is to utilize the COG, now being flared and burned for the steam generation, for combined heat and power generation.

CHP will consist of the following main equipment:

- Boiler;
- Turbo generator;
- Condenser;
- Feed water heaters;
- Deaerator;
- Water treatment unit;
- Other supply and auxiliary equipment (valves, pumps, smoke exhauster, fan, pipelines, etc.) and constructions.

A simplified flow diagram of the CHP is shown on Figure 2.

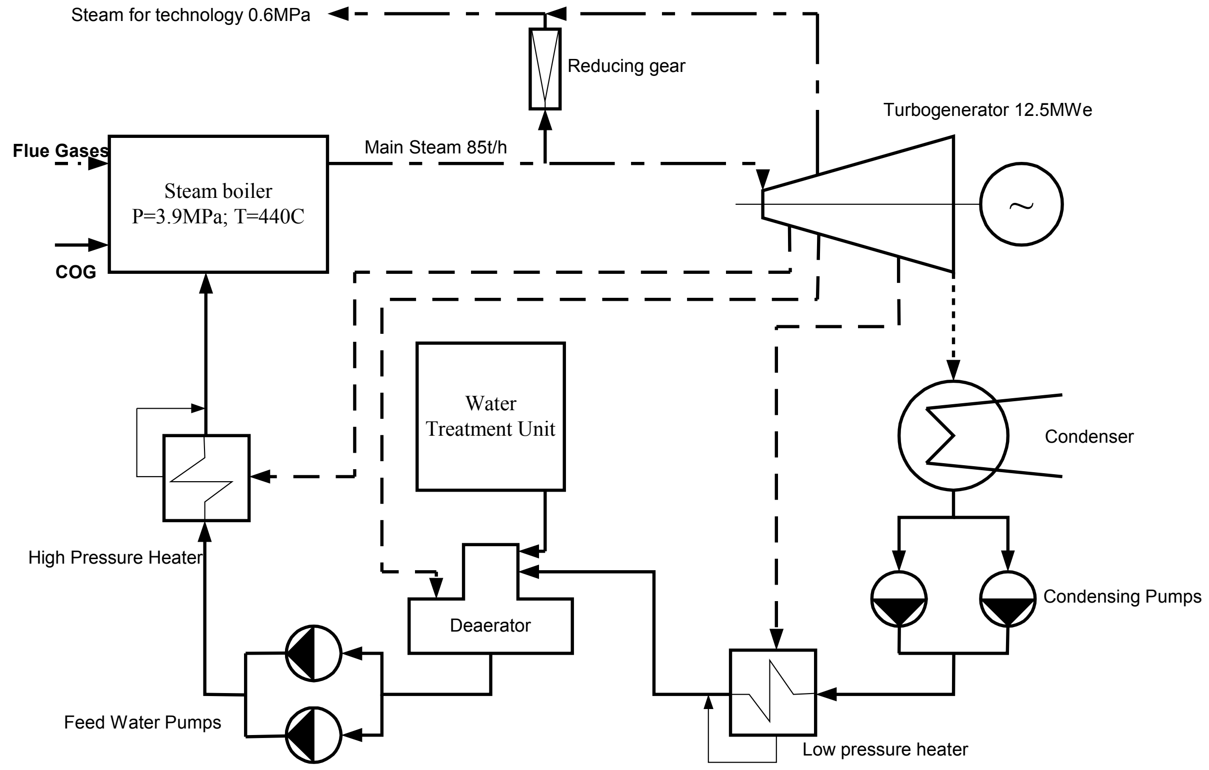


Figure 2. Flow diagram of the CHP

The COG, currently being flared and burnt in the existing boiler house, will be supplied to the new steam boiler. The flue gases of the coke battery, having a temperature about 360-370 ^{0}C, will be used in new boiler for the improvement of the CHP efficiency. In addition, afterburning of flue gases will reduce emissions of CO, H_2, and other contaminants into atmosphere.

COG will be supplied to the new boiler by the existing gas transporting system and will be utilized in the boiler by burners developed especially for COG.

The flue gases of the coke battery are be taken away now through the system of channels and two chimneys. In the proposed layout of the CHP, the hot flue gases of the coke battery will be supplied to the boiler and taken out by special system of channels and existing chimneys. This configuration will allow continuing no-failure operation of coke battery in case of a CHP emergency stop.

The boiler will generate super heated steam (P=3.9MPa, T=440^{0}C) with a design capacity of 85t/h. A part of steam for technological needs would lead either directly after the boiler through the pressure reduction unit or through the steam extraction on the turbine.

The steam turbine has been chosen taking into account two points:

- Maximum electricity generation;
- Securing steam supply to plant consumers.

Based on the two points mentioned above, a condensing turbine with steam extraction will be installed. The electrical capacity will be 12.5MW_e.

All auxiliary equipment as heaters, deaerator, pumps, etc. and building will be constructed as well. The existing boiler house will remain in a stand-by mode as a back-up.

The service water for the existing boiler house is purchased from a neighbour plant at the moment. A modern water treatment system, based on reverse osmosis, is proposed in the project lay-out. This will increase independence and reliability of the CHP.

Electrical sub-station will be constructed to supply electricity from CHP to the national grid.

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

The proposed project is directed to the electricity production through the waste gas utilization. At the moment COG is partially burnt in the boiler house for steam production only and is utilized in the coke battery and defrosting unit. The excess of the COG is flared without any energy production. So, heat energy demand of the HCP is covered by COG utilization, while the electricity for the HCP needs is being purchasing from the national grid. In case of national electricity grid, GHG emissions occur during fossil fuels combustion on Ukrainian power plants. The emission factor for the Ukrainian electricity grid, presented in Annex 2 and developed by Global Carbon, is accepted by TUV SUD.

On the other hand, utilization of the COG in the planned CHP will generate carbon neutral electricity, because in the absence of the proposed project all COG will be burnt without electricity generation. It should be noted that the planned electrical capacity of the planned CHP is much more then the average electricity load of the HCP. So a significant part of carbon neutral electricity will be supply to the national grid. In that case, GHG emission will be reduced by two assets:

- Carbon neutral electricity produced by the project and delivered to the grid;
- Carbon neutral electricity produced by the project and consumed on-site.

The National Energy Strategy[1] of Ukraine 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[2]:

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

Based on the mentioned above, the proposed project is answer the purpose of the National Energy Strategy of Ukraine.

Detailed description on baseline setting and full additionality test can be found in section B of this PDD.

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

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

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

	Years
Length of the crediting period	3
Year	**Estimate of annual emission reductions in tonnes of CO2 equivalent**
Year 2010	58 263
Year 2011	58 263
Year 2012	58 422
Total estimated emission reductions over the period within which emission reduction units are to be earned (tonnes of CO_2 equiv.)	174 947
Annual average of estimated emission reductions over the crediting period/period (tonnes of CO2 equiv.)	58 316

Table 3: Estimated amount of emission reductions over the crediting period

	Years
Period after 2012, for which emission reductions are estimated	8
Year	**Estimate of annual emission reductions in tonnes of CO2 equiv.**
Year 2013	58 263
Year 2014	58 263
Year 2015	58 263
Year 2016	58 422
Year 2017	58 263
Year 2018	58 263
Year 2019	58 263
Year 2020	58 422
Total estimated emission reductions over the period indicated (tonnes of CO_2 equiv.)	466 422

Table 4: Estimated amount of emission reductions after the crediting period

A.5. Project approval by the Parties involved:

The Project Idea Note had been submitted for review to the Ministry of Environment of Ukraine. A Letter of Endorsement # 4913/11/10-08 for the proposed project was issued 15 April 2008. After the project has completed the determination process, the PDD and the Determination Protocol will be presented to the National Environmental Investment Agency of Ukraine to obtain a Letter of Approval from the Host Party.

SECTION B. Baseline

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

The "Guidance on criteria for baseline setting and monitoring", issued by the Joint Implementation Supervisory Committee allows using approved methodologies of the CDM.
Approved consolidated baseline and monitoring methodology ACM0012 (version 03.1)"Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" is used. The full text of the methodology could be found at http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_PCTTVEWT2HFO0BEYZ9042QPQC41VPH

The proposed methodology (ACM0012) has been chosen because the applicability conditions are passed through, as could be seen from the following table.

Applicability criteria	Execution of criterion
If project activity is use of waste pressure to generate electricity, electricity generated using waste gas pressure should be measurable	Project activity does not use waste pressure. The waste gas (namely COG) that will be used to generate electricity is measurable.
Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility	Electricity that will be generated at the premises of HCP, will be supplied to the plant's consumers and exported to the grid as well.
The electricity generated in the project activity may be exported to the grid or used for captive purposes	The part of electricity that will be generated at the premises of HCP will be supplied to the grid.
Energy in the project activity can be generated by the owner of the industrial facility producing the waste gas/heat or by a third party (e.g. ESCO) within the industrial facility	Electricity that will be generated within the proposed project activity will be generated by the owner of the industrial facility, namely HCP. No third party is involved.
Regulations do not constrain the industrial facility generating waste gas from using the fossil fuels being used prior to the implementation of the project activity	There are no regulations that constrain the HCP from using the fossil fuels to cover own energy demand.
The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity. If capacity expansion is planned, the added capacity must be treated as a new facility	The amount of the COG producing at HCP depends on coke production capacity of the coke battery. The configuration of the proposed project's equipment has been selected due to the amount of COG available at the existing HCP's coke battery. Thus, there is not any capacity expansion planned within proposed project activity. The methodology applies to existing capacity.
The emission reductions are claimed by the generator of energy using waste energy	The emission reductions will be claimed by HCP – the generator of energy using waste energy
In cases where the energy is exported to other facilities, an official agreement exists between the owners of the project energy generation plant (henceforth referred to as generator, unless specified otherwise) with the recipient plant(s) that the emission reductions would not be claimed by recipient plant(s) for using a zero-	The part of carbon neutral electricity will be supplied to the national grid. The Ukrainian electricity grid has a certain emission factor (see Annex 2). This emission factor would not change as a result of the proposed project. Thus, any consumer of electricity connected to the grid will not be able to claim the emission reductions

emission energy source	generated by the proposed project.
For those facilities and recipients, included in the project boundary, which prior to implementation of the project activity (current situation) generated energy on-site (sources of energy in the baseline), the credits can be claimed for minimum of the following time periods: • The remaining lifetime of equipments currently being used; and • Credit period.	HCP has no own electricity generation facility on-site, which generated electricity prior to implementation to the project activity. For the electricity generated to the grid from fossil fuels in the baseline scenario, credits will be claimed for the credit period.
Waste gas/pressure that is released under abnormal operation (emergencies, shut down) of the plant shall not be accounted for	In case of abnormal operation (emergencies, shut down) of the CHP carbon neutral electricity will not be generated, so ERUs will not be generated as well.

Table 5: Execution by the proposed project applicability criterion of ACM0012

Step 1: Define the most plausible baseline scenario for the generation of electricity

Step 1a: Define alternative scenarios to the proposed JI project activity

The baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternatives. All realistic and credible alternatives are listed and described below.

1. **Alternative** *"Introduction of the Coke Oven Gas CHP without JI incentive"*.

This scenario combined the following baseline options from the methodology ACM0012:

- W4 - Waste energy is used for meeting energy demand;
- P1 - Proposed project activity not undertaken as a JI project activity;
- H1 - Proposed project activity not undertaken as a JI project activity.

In this scenario a CHP will be constructed on the site of the HCP. The main revenue will come from two sources:

- Export of the electricity to the grid;
- Stopping import of the electricity from the grid.

No additional revenue from the ERUs generating and selling will be earned. This alternative is identical to the proposed JI project activity, however without the JI incentive.

2. **Alternative** *"Continuation of the existing situation"*.

This scenario combined the following baseline options from the methodology ACM0012:

- W2 - Waste gas is released into the atmosphere after incineration or waste heat is released into the atmosphere (waste pressure energy is not utilized);
- W4 - Waste energy is used for meeting energy demand;
- P6 - Sourced Grid-connected power plants;
- H8 - Steam/ Process heat generation from waste gas, but with lower efficiency;

In this scenario electricity will be imported from the grid. COG available for the energy production will be flared and burnt in the existing boiler house without electricity generation. No additional revenue from the ERUs generating and selling will be earned.

This scenario can continue at least until the end of 2012 as there is no direct need to replace the existing boiler house.

3. Alternative *"COG is used for heat energy production".*

This scenario combined the following baseline options from the methodology ACM0012:

- W4 - Waste energy is used for meeting energy demand;
- P6 - Sourced Grid-connected power plants;
- H8 - Steam/ Process heat generation from waste gas, but with lower efficiency.

In this scenario electricity will be imported from the grid. The new boiler house with higher capacity will be constructed. COG currently flared and burnt in the old boiler house, will be directed to the new boiler(s). Steam will be used on site (as it is now) and sold to the external consumers. In addition to the new boiler house, steam and condensate pipelines to external consumers should be constructed.

Sub-step 1b. Consistency with mandatory applicable laws and regulations

All the alternatives defined in the Step 1 above are compliant with the national law and regulations.

Step 2: Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of alternative scenarios

2a.1. Investment barrier.

The power/heat generating industry is a capital intensive industry and the proposed scenarios require a significant amount of financing. For HCP it would be difficult to obtain financing on the domestic financial market, since the sources for project financing are very limited, and the interest rates are high. On the international market obtaining financing for this project would also be difficult due to the low credit rating of Ukraine and the high perceived risks of the country's market.

2a.2. Technological barrier.

The proposed project activity consists of the equipment (steam turbine, generator, water treatment unit) and requires well trained staff. This staff is not available at the plant right now. So, this situation could leads to an unacceptability high risk of equipment disrepair and malfunctioning or other underperformance.

2a.3. Other barriers.

Coke is mainly used for iron production. Metal production in Ukraine is growing now and demand for the coke is growing as a consequence. At the moment Ukrainian coking plants' load is shared as follows - about 57-60% of coking coals are domestic, and other 40-43% are imported from abroad. The Ukrainian metal plants' coke demand is satisfied now at the level of 95%. The disaster on the Zasyadko mine, being the main local supplier of the coking coals (about 30% of local coking coals), obviously increased shortage of the raw materials on the market. Taking into account that according coke production technology coke battery could not be stopped, the case of raw material (coking coals) shortage will lead to the situation when coking period will be increased as much as possible. This means that the whole amount of the COG will be directed to the coking battery – the battery will be switch to the heating mode. Heat production from the COG will be stopped. This situation leads to high risks of low performance of the new facilities.

Sub-step 2b. Identification of at least one of the alternatives which are not prevented by identified barriers

2b.1. **Alternative** *" Introduction of the Coke Oven Gas Power Plant without JI incentive".*

In section B.2 it is shown that the proposed project without JI revenue is financially not attractive and faces barriers.

2b.2. **Alternative** *"Continuation of the existing situation".*

This alternative scenario does not require any investment, construction works and technological improvements. Thus, this scenario does not face any barriers.

2b.3. **Alternative** *"COG is used for heat energy production".*

This scenario requires a significant investment to construct boiler house, auxiliary equipment, pipelines, etc. This scenario would face the unstable steam/heat demand because of the potential customer's conditions. This is an additional risk of this alternative.

Conclusion: Only one alternative scenario "Continuation of the existing situation" does not prevented by identified barriers and would be accept as the baseline scenario.

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

The most recent "Tool for the demonstration and assessment of additionality (version 05.1)" http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf is applied to prove that the anthropogenic emissions are reduced below those that would have occurred in the absence of the JI project.

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

Step 1a: Define alternative scenarios to the proposed JI project activity

All realistic and credible alternatives are listed and described below.

Alternative 1.1. *Introduction of the Coke Oven Gas CHP without JI incentive.*

In this scenario a CHP will be constructed on site of the HCP. The main revenue will come from the two sources:

- Export of the electricity to the grid;
- Stopping import of the electricity from the grid.

No additional revenue from the ERUs generating and selling will be earned. This alternative is identical to the proposed JI project activity, however without the JI incentive.

Alternative 1.2. Continuation of the existing situation.

In this scenario electricity will be imported from the grid. COG available for the energy production will be flared into the atmosphere and burnt in the existing boiler house without electricity generation. No additional revenue from the ERUs generating and selling will be earned.

This scenario can continue at least until the end of 2012 as there is no direct need to replace the existing boiler house.

Alternative 1.3. COG is used for heat energy production.

In this scenario electricity will be imported from the grid. The new boiler house with higher capacity will be constructed. COG currently flared into the atmosphere and burnt in the old boiler house will be directed to the new boiler(s). Steam will be used on site (as it is now) and sold to external consumers. In addition to the new boiler house, steam and condensate pipelines to external consumers should be constructed.

Sub-step 1b. Consistency with mandatory applicable laws and regulations

All the alternatives defined in the Step 1 above are compliant with the national law and regulations.

Step 2: Investment analysis

The investment analysis in line with the Methodological Tool "Tool for the demonstration and assessment of additionality" version 05.1 (further in the text CDM Additionality Tool ver.05.1) should determine whether the proposed project activity is not:

a) The most economically or financially attractive; or

b) Economically of financially feasible without revenue from the sales of CERs (ERUs for JI).

In analysis provided below option (a) will be considered.

Sub-step 2a: Determination of the analysis method

Option II: Investment comparison analysis will be considered below for three reasons:

1. As soon as the JI project generates financial benefits other than JI related income, the simple cost analysis (Option I) can not be applied;
2. The above identified alternative to the JI project activities is realistic to be implemented. Financial information is available and cash flow analysis will demonstrate below that JI project activity is not the most financially attractive option for the HCP;
3. Option III: The benchmark analysis is not applicable as it is not possible to justify and substantiate an IRR benchmark as HCP has no its internal benchmark.

Sub-step 2b: Option II. Apply investment comparison analysis

The following indicators: NPV, IRR and pay back period (PBP) will be used for comparison of financial attractiveness of project activities and identified alternative's cash flows. Pay back period is being calculated undiscounted and not as discounted cash flow. This undiscounted indicator is still being widely used in the post communist area. Based on the financial analysis theory joint consideration of these three indicators enables avoiding the drawbacks of each indicator being used alone and make analysis more strength and transparent.

The investment comparison analysis is being provided for the JI project activity and alternative 1.3 as soon as the only one remaining alternative is the business as usual. Alternative 1.3 de facto looks more attractive as investment cost is twice less then for the JI project activity due to the high cost of turbo generator and auxiliary equipment needed for electricity generation. The difference is more than Euro 10 million that is significant amount bearing in mind the high cost of borrowed money and lack of long term money opportunities.

The project and alternative's cash flows are based on the following assumptions:

- All prices and tariffs are constant as per 1 April 2007 due to the fact that the first investment disbursements for preparation of a feasibility study were done at that time and Feasibility Study on the basis of which the decision was made by the HCP was based on these price indicators;
- Heat production cost is lower in Alternative 1.3 due to the lower labour and maintenance cost (maintenance is being calculated as percentage of depreciation);
- Project lifetime is 30 years which equals the service time for the main project equipment (boiler and turbine);

- The revenues from heat and electricity sales are due to the generation on-site and partial consumption for the own needs instead of purchase from the grid as well as sales to the grid (electricity) or external consumers (heat);
- Service water is being saved due to the own water treatment unit construction;
- Discount rate for NPV calculation is taken equal to the National Bank of Ukraine official discount rate at that time.

Sub-step 2c: Calculation and comparison of financial indicators

The table 6 demonstrates financial indicators calculated for the JI project activity and Alternative 1.3

N	Indicator	JI project activity	Alternative 1.3
1	NPV (thousand Euro)	5,454	6,832
2	IRR (%)	11.1	14.8
3	PBP (years)	11	10

Table 6: Financial indicators of the JI project activity and alternative 1.3

As it can be seen from the Table 6 the Alternative 1.3 has the better financial performance indicators then the JI project activity. So the JI project activity can not be considered as the most financially attractive.

Sub-step 2d: Sensitivity Analysis

The sensitivity analysis is supposed to demonstrate the robustness of preliminary conclusions made in the previous section.

Usually fluctuation of financial indicators within plus-minus 5 % is being considered in the theory of sensitivity analysis. We apply here 10% fluctuation to the key prices to demonstrate a stronger robustness. Only upward trends are applied as it is unlikely that electricity and heat tariffs as well as production cost will go down in the present economic situation in Ukraine (constant price growth of local coal prices and imported natural gas).

The following scenarios were considered for JI project Activity and Alternative 1.3:

Scenario 1: Energy price from the grid (savings on cost from heat energy on needs) – 10% increase;

Scenario 2: Energy (heat) price to the grid (external consumers) – 10% increase;

Scenario 3: Energy (heat) production cost 10% increase;

Scenario 4: Service water price – 10% increase.

Energy and heat prices in Ukraine follow the same trend as soon as the main price basic is natural gas or coal price. The fluctuations in price growth can be within the quarter i.e. of short term character. That is why the same assumptions were considered for electricity and heat price and cost.

The table below presents the overview of financial indicators for JI project activity and Alternative 1.3.

N of Scenario	JI Project Activity			Alternative 1.3		
	NPV (th. Euro)	IRR (%)	PBP (y.)	NPV (Th. Euro)	IRR (%)	PBP (y)
1	6,299	11,5	10,88	7,233	15,1	8
2	7,445	12,1	9,91	9,157	16,9	10

3	4,804	10,8	11,02	2,125	12,28	13,61
4	5,539	11,2	11,77			

Table 7: Sensitivity analysis of the JI project activity and alternative 1.3

As it can clearly be seen from the table 7, in all scenarios Alternative 1.3 looks more financially attractive then the JI project activity. Thus, the sensitivity analysis results presented above demonstrate the robustness of conclusions made in sub-step 2c. As soon as Alternative 1.3 has all the best IRR indicator as a result of sensitivity analysis in line with CDM Additionality Tool ver. 05 the JI project activity can not be considered as the most financially attractive.

Step 3. Barrier analysis (optional)

3.1. Investment barrier

The power generating industry is a capital intensive industry and the proposed project requires a significant amount of financing. For HCP it would be difficult to obtain financing on the domestic financial market, since the sources for project financing are very limited and the interest rates are high. On the international market obtaining financing for this project would even be more difficult due to the low credit rating of Ukraine and the high perceived risks of the country's market.

3.2. Technological barrier.

The proposed project activity consists of the equipment (steam turbine, generator, water treatment unit) and requires well trained staff. This staff is not available at the plant right now. So, this situation could leads to an unacceptability high risk of equipment disrepair and malfunctioning or other underperformance.

3.3. Other barriers.

Coke is mainly used for the iron production. Metal production in Ukraine is growing now and demand for the coke growing as a consequence. At the moment Ukrainian coking plants' load is sharing as follows - about 57-60% of coking coals are domestic, and other 40-43% are imported from abroad. The Ukrainian metal plants' coke demand is satisfied now at the level of 95%. The disaster on the Zasyadko mine, being the main local supplier of the coking coals (about 30% of local coking coals), obviously have increased shortage of the raw materials on the market. Taking into account that according coke production technology a coke battery could not be stopped, the case of raw material (coking coals) shortage will lead to the situation when coking period will be increased as much as possible. This means that the whole amount of the COG will be directed to the coking battery – the battery will be switch to the heating mode. COG export as an energy source or heat production from the COG will be stopped. This situation leads to high risks of low performance of the new facilities.

In addition to barriers mentioned above the proposed JI project is unique and first of its kind as it will be prove in Step 4.

Step 4. Common practice analysis

According to the commonly used in Ukraine coke production technology, about 50% of the coke gas is using on the coke battery for the coking process. Other part - is free waste gas which could be used as a secondary energy source.

Finished coke is mainly used in blast furnaces during iron production. So, there are two ways of the coke plant location.

- First option is a construction of the coke plant as a part of the full cycle metallurgical plant;
- Second option is a construction of the coke plant separately from the metallurgical plant.

The full cycle metallurgical plants usually include:

- Sinter plant;
- Pig iron plant;
- Steel plant;
- Auxiliary plants and workshops (such as coke plant, CHP, etc).

The coke is a main energy source for the iron production in the blast furnaces. The average coke consumption is 400-500kg per tonne of pig iron. Most of full cycle metallurgical plants in Ukraine have a coke plants as a division of the structure.

In case of the first option, COG's excess could be used directly on-site, to meet the energy demand of the metallurgical plant. Metallurgical plants usually have own CHP's. So, those types of projects consist of infrastructure (gas transport system) construction and are excluded from the common practice analysis because of specific location of the HCP and significant distinctions from proposed JI project.

HCP is located separately from the metallurgical plant. This means that there is no direct demand for the coke gas excess. So, the common practice for these types of coke plants is a flaring of the coke gas excess without any energy production. Exception to this rule is one Ukrainian coke plant - Zaporijie Coke Plant. Plant already introduced the CHP. The distinctions of this CHP from the proposed project are the following: steam Turbo Generator was introduced in December 2007. The main steam for the turbine is generating in the steam boilers which was already existed and operated on the plant since 2002. So, the project was not so capital intensive and did not faced investment barrier as proposed project does.

The facts mentioned above allow concluding that the proposed JI project is not common practice.

Conclusion: The project is additional to what would have occurred otherwise.

Since the project scenario (see A.4.2) comparing with the baseline scenario will lead to reduction of the electricity generation from the fossil fuels, anthropogenic emissions of GHG at Ukrainian energy system will be reduced below those that would have occurred in the absence of the JI project.

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

The project activities are limited physically by the premises of the HCP. At the same time, the source of GHG emission is indirect - Ukrainian electricity grid, as a result of electricity generation using fossil fuels.

In the table below an overview of all emission sources in the baseline and project scenarios process is given. The all possible sources of emissions have been chosen according to methodology ACM0012.

	Source	Gas	Included/Excluded	Justification / Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
		N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.

Fossil fuel consumption in boiler for thermal energy	CO_2	Excluded	As continuation of existing situation has been established as the baseline, fossil fuel consumption in existing boiler house is excluded, because only COG is used as a fuel.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
Fossil fuel consumption in cogeneration plant	CO_2	Excluded	There is no cogeneration plant in the baseline scenario, so this source of emissions is excluded.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	The steam used in the flaring process supplying by existing boiler house. The fuel for the boiler house is a COG.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
Supplemental electricity consumption.	CO_2	Included	Proposed CHP has some own electricity consumption under normal operational conditions. This is the main source of project emissions. Another source is consumption electricity from the grid during CHP maintenance periods.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.

Electricity import to replace captive electricity, which was generated using waste gas in absence of project activity	CO_2	Excluded	In a baseline scenario all electricity is imported from the grid. COG is not used for the electricity production.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
Project emissions from cleaning of gas	CO_2	Excluded	Waste gas (namely COG) does not need any additional cleaning before utilization in the proposed CHP.
	CH_4	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.
	N_2O	Excluded	Excluded for simplification in accordance with ACM0012. This is conservative.

Table 8: Sources of emissions in the baseline and project scenarios

Baseline scenario

Baseline scenario is continuation of the existing situation. Thus, the source of emissions is Ukrainian electricity grid, namely the emissions from the fossil fuels combustion for the electricity generation.

The following figure shows the project boundaries and sources of emissions in the baseline scenario.

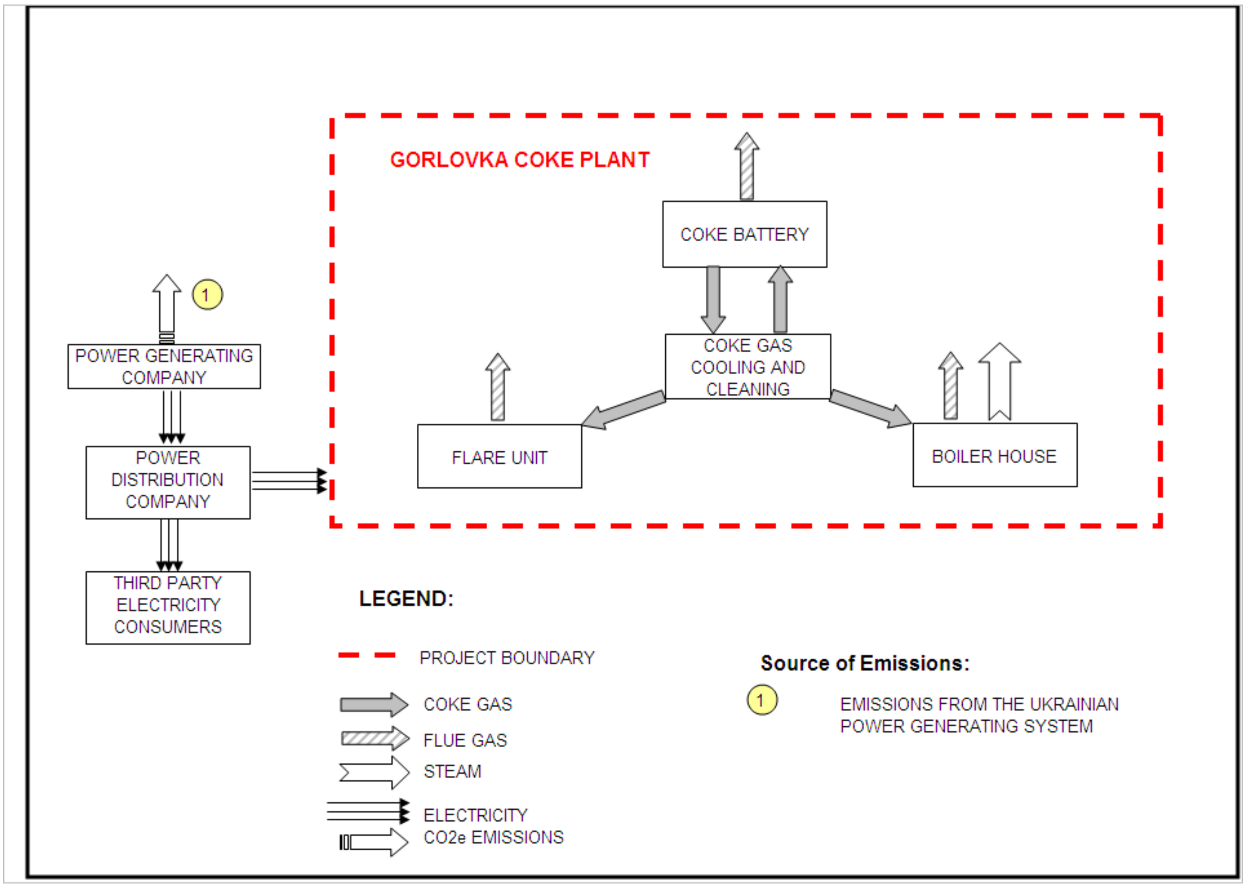


Figure 3. Project boundaries in the baseline scenario

Project scenario

There is no combustion of auxiliary fuel to supply waste gas. Electricity is not used for cleaning of COG before being used for generation of electricity under proposed project activity. The project emissions are limited by the two following sources:

- **Supplemental carbon neutral electricity consumption.** Additional electricity will be consumed by new equipment installed within the limits of the proposed CHP during operation (e.g. pumps, funs, control system, etc.). This electricity is carbon neutral, because the CHP will be fuelled by COG, which is flared and burnt in the existing boiler house in the baseline scenario. However, auxiliary electricity consumption would not occur in the absence of the proposed project, so it needs to be considered as a projects emissions source.
- **Supplemental electricity consumption from the grid.** It is planned that the CHP will be operational 8000 hours per year and 760 hours will be spent for maintenance. During this time electricity will be imported from the grid to meet HCP's demand.

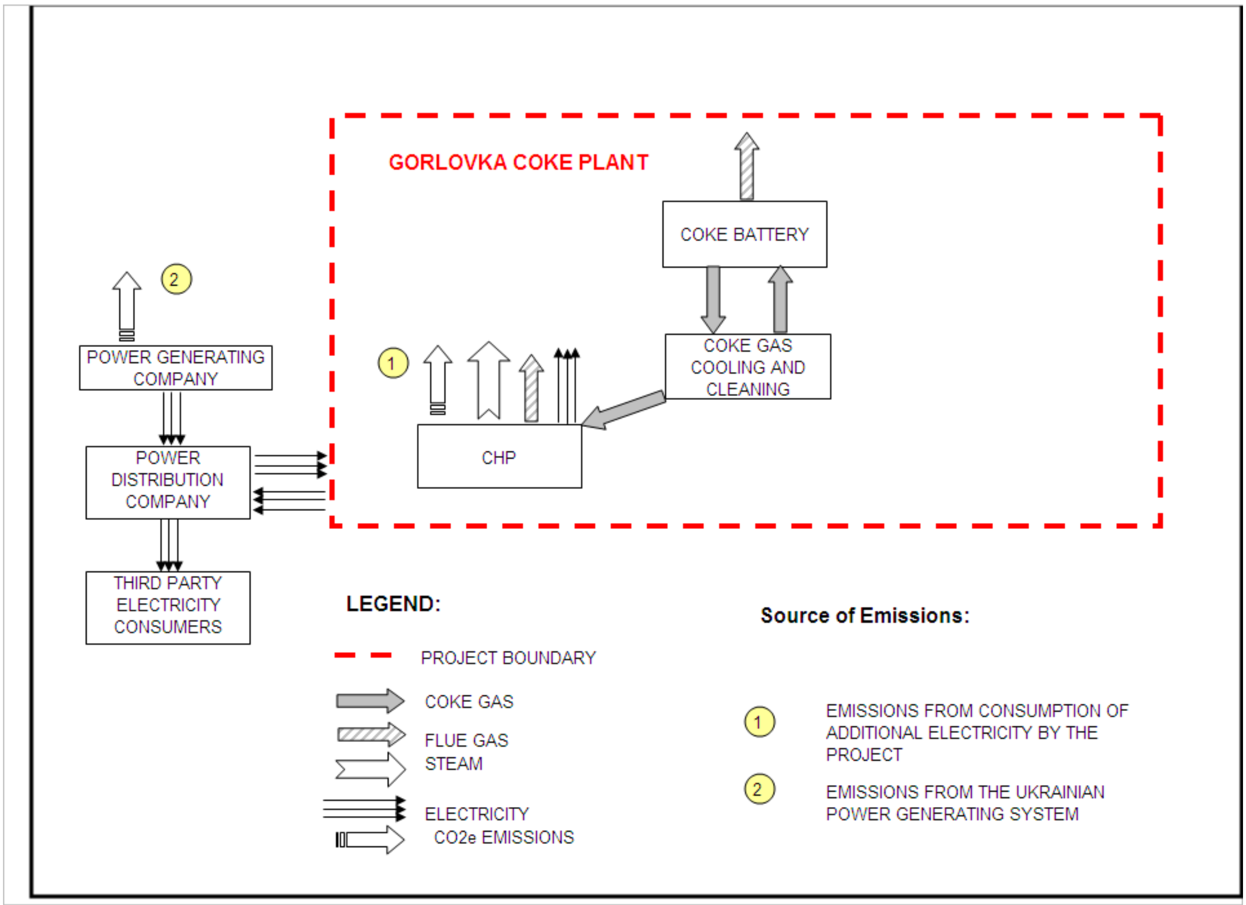


Figure 4. Project boundaries in the project scenario

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

Date of completion of the baseline study: 19/08/2008
Name of person/entity determining the baseline:
Global Carbon B.V.
Oleg Bulany
For the contact details please refer to Annex 1.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project is 1 January 2010.

C.2. Expected operational lifetime of the project:

The lifetime of equipment will be at least 30 years. Thus operational lifetime of the project will be 30 years or 360 months.

C.3. Length of the crediting period:

Start of crediting period: 01/01/2010.
Length of crediting period: 3 years or 36 months.

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:

Approved consolidated monitoring methodology ACM0012 "Consolidated monitoring methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system" is used. The emission factor for the Ukrainian electricity grid, developed by Global Carbon BV and accepted by TUV SUD will be used for the baseline emissions calculation.

Project scenario emissions

According to ACM0012, project emissions include emissions due to combustion of auxiliary fuel to supplement waste gas and electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of heat/energy/electricity.

In case of the proposed project there is no auxiliary fuel to supplement COG due to the CHP design.

The proposed CHP does not requires any additional COG cleaning before fuelling the boiler, so there is no consumption of electricity for cleaning of COG. Additional electricity will be consumed by new equipment installed within the limits of the proposed CHP during operation (e.g. pumps, funs, control system, etc.). This electricity is carbon neutral, because CHP will be fuelled by COG, which is flared and burnt in the existing boiler house at the moment. However, auxiliary electricity consumption would not occur in the absence of the proposed project, so it needs to be considered as a projects emissions source.

Also, some electricity will be imported from the grid during maintenance of the CHP.

Baseline scenario emissions

The baseline emissions would occur in the absence of the project from the electricity imported from the grid and would have two sources:

- Electricity consumed by HCP's equipment, which in the absence of the project would have been imported from the grid;
- Electricity supplied to the grid, which in the absence of the project would have been generated by fossil fuels power plants.

The baseline emissions will be calculated based on the following inputs:

- All electricity generated by the project from the COG is carbon neutral;
- Electricity generated by the project from the COG and consumed by CHP's auxiliaries is considered as project emissions.
- Electricity generated by the project from the COG and consumed by HCP's auxiliaries apply an EF=0.896 tCO_2/MWh as a project reducing electricity consumption from the grid (see Annex 2);

- Electricity generated by the project from the COG, exported to the grid and consumed by third parties apply an EF=0.807 tCO_2/MWh as a project producing electricity to the grid (see Annex 2).

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
1.	PE_y – Project Emissions in the year y	Monitoring of GHG emissions in year y	tCO_2	c	Yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
2.	$PE_{EL,y}$ – Project Emissions from electricity consumed by CHP's auxiliary equipment i in the year y	Monitoring of GHG emissions in year y	tCO_2	c	Yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.2
3.	$EL\_CHP_{,y,i}$ – Electricity consumed by CHP's auxiliary equipment i in the year y	Plant records, electricity counters	MWh	m	Continuously/Daily	100%	Electronic and paper	
4.	$EL_{grid,y}$ – Electricity consumed from the grid during maintenance of	Plant records, electricity counters	MWh	m	Continuously/Daily	100%	Electronic and paper	

	the CHP in year y							
5.	EF_{red} - Emission factor of Ukrainian grid for reducing projects	See annex 2	tCO_2/MWh	c	fixed ex-ante	100%	Electronic and paper	Ukrainian grid EF = 0.896 tCO_2/MWh

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

Project Emissions will be estimated by the following formulas:

$$PE_y = PE_{EL,y} \qquad \textit{(Equation 1)}$$

where:
PE_y = Project Emissions in the year y (tCO_2);
$PE_{EL,y}$ = Project Emissions from electricity consumed by CHP's auxiliary equipment and electricity consumed from the grid during maintenance of the CHP in year y in the year y (tCO_2);

$$PE_{EL,y} = \sum_{i=1}^{n} EL\_CHP_{y,i} \times EF_{red} + EL_{grid,y} \times EF_{red} \qquad \textit{(Equation 2)}$$

where:
$EL\_CHP_{y,i}$ = Electricity consumed by COG Power Plant's auxiliary equipment i in the year y (MWh);
$EL_{grid,y}$ = Electricity consumed from the grid during maintenance of the CHP in year y (MWh);
EF_{red} = Emission factor of Ukrainian grid for reducing projects (tCO_2/MWh).

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*	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?	Comment

cross-referencing to D.2.)							(electronic/ paper)	
6.	BE_y – Baseline Emissions in the year y	Monitoring of GHG emissions in year y	tCO_2	c	yearly	100%	Electronic and paper	Calculated using the formulae in Section D.1.1.4
7.	$EL_{HCP,y}$ – Amount of electricity consumed by HCP's equipment, which in the absence of the project would have been imported from the grid	Plant records, electricity counters	MWh	m	continuously	100%	Electronic and paper	
8.	$EL_{grid,y}$ – Amount of electricity supplying to the grid, which in the absence of the project would have been generated by fossil fuels power plants	Plant records, electricity counters	MWh	m	continuously	100%	Electronic and paper	

9.	f_{cap} - Energy that would have been produced in project year y using COG generated in base year expressed as a fraction of total energy produced using COG in year y	See annex 2	Non-dimensional	c	yearly	100%	Electronic and paper	This factor has been include according to ACM0012
10.	$Q_{COG,BL}$ – Amount of COG generated prior to the start of the proposed project	See annex 2	nm^3	c	fixed ex-ante	100%	Electronic and paper	
11.	$Q_{COG,y}$ – Amount of COG generated during year y	Plant records	nm^3	m	yearly	100%	Electronic and paper	
12.	EF_{red} - Emission factor of Ukrainian grid for reducing projects	See annex 2	tCO_2/MWh	c	fixed ex-ante	100%	Electronic and paper	
13.	EF_{prod} - Emission factor of Ukrainian grid for producing projects	See annex 2	tCO_2/MWh	c	fixed ex-ante	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):

Baseline Emissions will be estimated by the following formulas:

$$BE_y = EL_{HCP,y} \times EF_{red} + f_{cap} \times EL_{grid,y} \times EF_{prod}$$ (Equation 3)

$$f_{cap} = \frac{Q_{COG,BL}}{Q_{COG,y}}$$ (Equation 4)

where:
BE_y = Baseline Emissions in year y (tCO_2);
$EL_{HCP,y}$ = Amount of electricity consumed by HCP's equipment, which in the absence of the project would have been imported from the grid (MWh);
$EL_{grid,y}$ = Amount of electricity supplying to the grid, which in the absence of the project would have been generated by fossil fuels power plants (MWh);
f_{cap} = Energy that would have been produced in project year y, using COG generated in base year expressed as a fraction of total energy produced using COG in year y;
$Q_{COG,BL}$ = Amount of COG generated prior to the start of the proposed project (nm^3);
$Q_{COG,y}$ = Amount of COG generated during year y (nm^3);
EF_{red} = Emission factor of Ukrainian grid for reducing projects (tCO_2/MWh);
EF_{prod} = Emission factor of Ukrainian grid for producing projects (tCO_2/MWh).

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

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

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

Not applicable

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

Not applicable

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

No leakages are applicable under methodology ACM0012.

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

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

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

Not applicable

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

The annual emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{(Equation 5)}$$

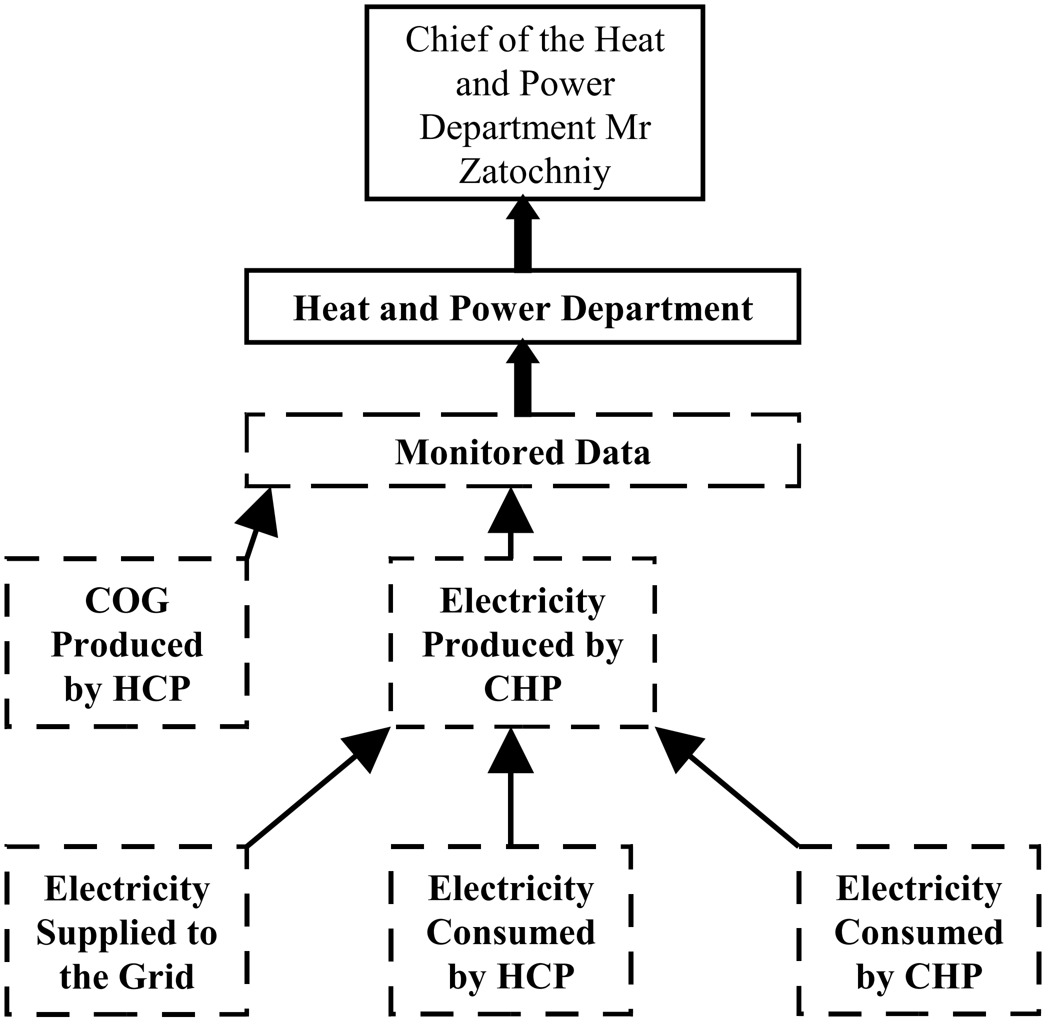
where:
ER_y = Emissions reductions of the JI project in year y (tCO_2);
BE_y = Baseline Emission in year y (tCO_2);
PE_y = Project Emission in year y (tCO_2);

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:

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.
1-2	Low	These data are a calculation of project emissions
3-4	1%	The electricity meters will be calibrated once in three years
5	Low	This is a fixed ex-ante value
6	Low	These data are a calculation of baseline emissions
7	1%	The electricity meters will be calibrated once in three years
8	1%	The electricity meters will be calibrated once in three years
9	low	These data are results of ratio calculations
10	Low	This is fixed ex-ante value
11	1%	The COG meters will be calibrated once in three years
12-13	Low	This is fixed ex-ante value

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

For monitoring, collection, registration, visualization, archiving, reporting of the monitored dates and periodical checking of the measurement devices the measurement team from Chief Energy's Department and its Chief Mr Zatochniy are responsible. A detailed structure of the team and team members will be established in the Monitoring Manual prior to initial and first verification. The principle structure presents on the following flow-chart:


Chief of the Heat and Power Department Mr Zatochniy
Heat and Power Department
Monitored Data
COG Produced by HCP
Electricity Produced by CHP
Electricity Supplied to the Grid
Electricity Consumed by HCP
Electricity Consumed by CHP

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

Name of person/entity determining the monitoring plan:
Global Carbon B.V.
Oleg Bulany
For the contact details please refer to Annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

		2010-2012	2013-2020	Total
Project emissions	[tCO2/yr]	36 371	96 970	**133 341**

Table 9: Estimated project emissions

E.2. Estimated leakage:

		2010-2012	2013-2020	Total
Leakage	[tCO2/yr]	0	0	**0**

Table 10: Estimated leakage

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

		2010-2012	2013-2020	Total
Project emissions	[tCO2/yr]	36 371	96 970	**133 341**

Table 11: Estimated total project emissions

E.4. Estimated baseline emissions:

		2010-2012	2013-2020	Total
Baseline emissions	[tCO2/yr]	211 318	563 393	**774 711**

Table 12: Estimated baseline emissions

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

		2010-2012	2013-2020	Total
Emission reductions	[tCO2/yr]	**174 947**	466 423	**641 370**

Table 13: Estimated emission reduction

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

YEAR	Estimated Project Emissions (tonnes CO_2 equivalent)	Estimated Leakage (tonnes CO2 equivalent)	Estimated Baseline Emissions (tonnes CO_2 equivalent)	Estimated Emissions Reductions (tonnes CO_2 equivalent)
2010	12 114	0	70 377	58 263
2011	12 114	0	70 377	58 263
2012	12 143	0	70 565	58 422
Total (tonnes CO_2 Equivalent)	**36 371**	**0**	**211 318**	**174 947**

Table 14: Estimated balance of emissions under the proposed project over the crediting period

YEAR	Estimated Project Emissions (tonnes CO_2 equivalent)	Estimated Leakage (tonnes CO2 equivalent)	Estimated Baseline Emissions (tonnes CO_2 equivalent)	Estimated Emissions Reductions (tonnes CO_2 equivalent)
2013	12 114	0	70 377	58 263
2014	12 114	0	70 377	58 263
2015	12 114	0	70 377	58 263
2016	12 143	0	70 565	58 422
2017	12 114	0	70 377	58 263
2018	12 114	0	70 377	58 263
2019	12 114	0	70 377	58 263
2020	12 143	0	70 565	58 422
Total (tonnes CO_2 Equivalent)	**96 970**	**0**	**563 393**	**466 423**

Table 15: Estimated balance of emissions under the proposed project after the crediting period

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, an Environmental Impact Assessment (EIA), as a part of the project design documents, has been done for the proposed project and approved by local authority. Analysis of this document shows that introduction of the CHP will have a lot of positive environmental effects. Among others the following:

- Decreasing of the CO concentration in the flue gases of the coke battery;
- Afterburning of the H_2 and C_mH_m;
- Decreasing of the solid carbonaceous up to 75%.

According to calculations made in EIA, emissions of air pollutants will be reduce up to 1300 tones per year after start up of the CHP. Construction of the proposed CHP will be done at the premises of HCP and does not require any felling of the green plantation.
Extracts of important sections of EIA will be available to the AIE by request.

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:

Not applicable.

SECTION G. Stakeholders' comments

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

In accordance with Ukrainian legislation, HCP has consulted the regional authority to obtain the necessary approvals for construction of the CHP. No stakeholder consultation is required by Host Party for JI project. Stakeholder comments will be gathered during one month after publication of this PDD at UNFCCC website in the frame of determination process.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Represented by:	
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Annex 2

BASELINE INFORMATION

The coke production was restarted on HCP on 13 December 2005. The plant is currently operating one coke battery, which is consisting of 57 ovens, and all supply facilities. The design capacity of the coke battery is 466 000 tonnes per year of coke with 6% moister content. The following table presents basic materials and energy resources flow on the site of HCP.

INDEX	U/M	2006	2007
coke production (6% moister content)	t	298 276	417 300
coke oven gas production	nm^3	119 403 410	170 798 680
coke oven gas consumption on the oven battery	nm^3	60 288 560	87 584 660
coke oven gas consumption on the boiler	nm^3	8 339 450	22 414 620
coke oven gas consumption on the garage-defrosting unit	nm^3	0	280 800
coke oven gas consumption on the flare	nm^3	50 775 400	60 518 600
Natural gas consumption on boiler	nm^3	2 458 360	0
electricity consumption	MWh	8 036,305	10 103,279
service water consumption	m^3	598 098	489 040
feed water consumption	m^3	89 672	133 087
Steam production	Gcal	52 218	93 537

Table A2.1. Energy resources consumption.

As it could be seen from the table the year 2006 was spent for adjusting and tune up of facilities. That is why the level of design capacity of the coke battery was almost reached only in 2007. Natural gas was consumed until the May 2006, because the existing boiler house, was switched to the fuelling by COG in the May of 2006.
According to ACM0012, calculation of the baseline scenario emissions from the electricity (see Equation 4, section D) should take into account amount of waste gas produced in the year y (see Equation 4, section D). This factor is expressed as:

$$f_{cap} = \frac{Q_{COG,BL}}{Q_{COG,y}} \qquad \textit{(Equation 1)}$$

where:
f_{cap} = Energy that would have been produced in project year y using COG generated in base year expressed as a fraction of total energy produced using COG in year y;
$Q_{COG,BL}$ = Amount of COG generated prior to the start of the proposed project (nm^3);
$Q_{COG,y}$ = Amount of COG generated during year y (nm^3);

$Q_{COG,y}$ is a value measured every project year.
$Q_{COG,BL}$ is a fixed ex ante value and determined below based on the coke battery designed values.
For type of coke ovens, installed at HCP, design COG production capacity is 320 m^3/t of dry coal blend (furnace charge). Design amount of COG, calculated based on this parameter is present in the following table.

INDEX	U/M	Value
specific coke oven gas production	m^3/t of dry coal blend	320
One oven load by dry coal blend	t	17.6
Amount of ovens	pc	57
Design coking period	h	15
Annual working period	h	8 760
Maximum amount of COG generated in a baseline year	**nm^3**	**187 478 016**

Table A2.2. Annual design production of COG.

Standardized emission factors for the Ukrainian electricity grid

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

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

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

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

- The “Guidance on criteria for baseline setting and monitoring” for JI projects, issued by the Joint Implementation Supervisory Committee[3];
- The “Operational Guidelines for the Project Design Document”, further referred to as ERUPT approach or baseline [4];
- The approved CDM methodology ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” [5];
- Specific circumstances for Ukraine as described below.

ERUPT
The ERUPT baseline was based on the following main principles:

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

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

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

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

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

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 16: Share of nuclear power plant in the annual electricity generation

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

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

Table 17: Electricity demand in Ukraine on 31 March 2005[6]

Development of the Ukrainian electricity sector
The National Energy Strategy[7] 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[8]:

- 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-

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

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

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

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 18: Installed capacity in Ukraine in 2004[9]

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'[10].

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 19: Peak load in Ukraine in 2001 - 2005[11]

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)[12].

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

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

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

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

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

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 20: Imports and exports balance in Ukraine[13]

ACM0002 offers several choices for calculating the OM. Dispatch data analysis cannot be applied, since the grid data is not available[14]. 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 21: Share of power plants in the annual electricity generation of Ukraine[15]

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

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

[15] “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 simple OM is calculated using the following formula:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum GEN_{j,y}} \qquad \textit{(Equation 6)}$$

Where:

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

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

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

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

The CO2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad \textit{(Equation 7)}$$

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;

$OXID_i$ is the oxidation factor of the fuel;

$EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel *i*.

Individual data for power generation and fuel properties was obtained from the individual power plants[16]. The majority of the electricity (up to 95%) is generated centrally and therefore the data is comprehensive[17].

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[18] 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.

[16] "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.

[17] 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.

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

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 22: Grid losses in Ukraine[19]

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

Further considerations

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

- The grid emission factor is actually expected to grow due to the current tendency to switch from gas to coal;
- Hydro power plants have been included in the OM. This is conservative;
- With the growing electricity demand, out-dated mothballed fossil fired power plants are likely to come on-line as existing nuclear power plants are working on full load and new nuclear power plants are unlikely to come on-line before 2012. The emission factor of those moth-balled power plants is higher as all of them are coal of heavy fuel oil fired[21];
- 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.

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[19] "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.

[20] 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.

[21] "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.

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:

$$EF_{grid,produced,y} = EF_{OM,y} \qquad \textit{(Equation 8)}$$

and

$$EF_{grid,reduced,y} = \frac{EF_{grid,produced,y}}{1 - loss_{grid}} \qquad \textit{(Equation 9)}$$

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

The following result was obtained:

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

Table 23: 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);
- Electricity produced by the project and consumed on-site in year y (in MWh);

The baseline emissions are calculated as follows:

$$BE_y = EF_{grid,produced,y} x EL_{produced,y} + EF_{grid,reduced,y} x \left(EL_{reduced,y} + EL_{consumed,y}\right) \qquad \textit{(Equation 10)}$$

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

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

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

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

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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:
IS-USC-MUC/

This document consists of
4 Pages
Page 1 of 4

The test results refer exclusively to the units under test.

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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

Markus Knödlseder
GHG-Auditor and Project Manager

Munich, 17/08/2007

Werner Betzenbichler
Head of the certification Body "Climate and Energy" and Carbon Management Service

Annex 3

MONITORING PLAN

For the monitoring plan please refer to section D of this PDD.