JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM FOR SMALL-SCALE PROJECTS
Version 01.1 - in effect as of: 27 October 2006

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SECTION A. General description of the small-scale project

A.1. Title of the small-scale project:

Introduction of heat and power complex 'Motor Sich'

Project pertains to the sectoral scope 1 Energy industries (renewable/non-renewable sources), Group I.

SS JI PDD version number: 2.3

Data of Completion: 9th November, 2010

A.2. Description of the small-scale project:

Situation before project implementation

Prior to the starting date of the Project the electricity demand of JSC 'Motor Sich' was secured by its supply from the national grid. The heat energy has been produced by natural gas fired boilers.

Baseline scenario

The situation existing prior to the starting date of the Project would have continued in the absence of the proposed joint implementation activity and thus constitutes the baseline scenario of the project (see also section B for details). Baseline scenario foresees covering electricity demand through the supplies from the national grid and covering heat energy demand using natural gas fired boilers.

Purpose of the project

The purpose of the project is the improvements of energy resources consumption efficiency and subsequent greenhouse gases emission reductions due to implementation of modern technologies of combined heat and electricity generation based on gas turbine units at JSC 'Motor Sich'.

Generated electricity will be used for covering power demand of the Enterprise substituting electricity from national grid, which has high carbon intensity factor. The project owner could also analyse and consider the option of exporting generated electricity to the national grid in the future. Heat energy will be used both for covering the heat demand of the Enterprise and also for heating of residential area, substituting heat energy produced by natural gas fired boilers.

Concept of the project

JSC 'Motor Sich' is planning to construct two combined heat and power stations (heat and power complexes) based on gas turbine units PAES 2500 and EG 6000 with the electric installed capacity of 2.5 MW and 6 MW respectively and two exhaust boilers.

The project consists of two stages:

- construction of CHP station TEK-3 with the electric capacity of 2.5 MW and heat capacity 5.6 Gkal/hour in 2010;
- construction of CHP station TEK-6 with the electric capacity of 6 MW and heat capacity 10 Gkal/hour in 2011;

Expected result of the project:

Project activity aims to achieve the following results:

- greenhouse gases emission reductions in the amount of 86 401 tonnes of CO_{2e},
- reduction of the amount of electricity purchased from the national grid,
- more efficient utilisation of energy resources (natural gas in particular).

Implementation schedule and cost of the project

Project implementation started in February 2007, when the decision regarding project development was made by Scientific and Technical Council of JSC 'Motor Sich'. The decision on the project implementation has been made taking into account additional incentives due to application of Kyoto Protocol flexible mechanisms (joint implementation). Estimation of greenhouse gases emissions reduction potential due to project implementation has been made simultaneously with the overall project feasibility assessment. The substantiating materials for the proposed joint implementation project have been provided to national designated focal point for consideration and issuing Letter of Endorsement in February 2008. The Ministry of environmental protection of Ukraine issued a Letter of Endorsement #5937/11/10-08 at May 12th, 2008.

The development of CHP station TEK-3 with the electric capacity of 2.5 MW (**first stage** of the project activity) began in the fourth quarter of 2007. Construction and installation works lasted from May 2008 till March 2010. Start of operation was expected in the first quarter of 2010 (approximately in March). The Act on the readiness-state of the finished constructional object for the cogeneration unit has been issued on the August 4th, 2010.

The development of CHP station TEK-6 with the electric capacity of 6 MW (**second stage** of the project activity) will be started in the first quarter of 2010. The end of construction of CHP station TEK-6 with the electric capacity of 6 MW is the first quarter of 2011. Start of operation is expected in the first quarter of 2011 (approximately in January).

The total cost of the project implementation is UAH 63.87 million.

Grounds for the project implementation

Project implementation was started on the grounds of the necessity to optimize energy resources consumption at the Enterprise. Information about energy consumption by the Enterprise presented in the table below.

Data	2006	2007	2008
Electricity consumption, MWh	117 980	118 102	118 357
Heat energy consumption, Gkal	183 134	167 256	146 725
Natural gas consumption, m^3	33 275 738	33 732 332	31 296 266
Residual fuel oil consumption, tonnes	953.50	4.95	19.94

Project implementation will significantly reduce electricity consumption from national grid and reduce associated greenhouse gases emissions.

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)
Party A: Ukraine (Host Party)	JSC 'Motor Sich' Project owner	No
Party B:		

JSC Motor Sich a company engaged in development, production, testing and repair of modern aviation engines. Products of the Enterprise are being used at the plants and helicopters in 120 countries. Besides, the company is involved in engine, energy generating units, and other outputs production as well as in provision of aviation services. The number of employees is 21 236 as for 2008. JSC 'Motor Sich' includes 14 structural units.

JSC 'Motor Sich' is authorised by the Host Party to implement the joint implementation project 'Introduction of heat and power complex 'Motor Sich''. The designated focal point of the Host Party has provided a Letter of Endorsement #5937/11/10-08 from 12.05.2008 supporting further development of JI project by JSC 'Motor Sich'. The Letter of Approval for the JI project will be issued after the determination stage.

A.4. Technical description of the small-scale project:

A.4.1. Location of the small-scale project:

Project area location – Ukraine, Zaporizhzhya region, Zaporizhzhya city.

Fig. A 4-2. Project area location, Zaporizhzhya, Ukraine

Fig. A 4-2. Detailed project area location

A.4.1.1. Host Party(ies):

Ukraine

Article 5 of the Kyoto Protocol requires 'Annex 1 Parties to having in place, no later than 2007, national systems for the estimation of greenhouse gas emissions by sources and removal by sinks.' National Inventory System of Ukraine was created by Government Decision "Procedure of the Functioning National System of the Estimation of Anthropogenic Emissions by Sources and Removals by Sinks of GHG not Controlled by the Montreal Protocol" (21.04.06, №554).

According to Article 7 of the Kyoto Protocol Ukraine have submitted annual greenhouse gas inventories on a regular basis. First National Inventory report was submitted on 20th of February, 2004. The last one was submitted on 25th of May, 2009. Ukraine has also submitted its Fifth National Communication report on 29th of December 2009.

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

Zaporizhzhya region

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

Zaporizhzhya

A.4.1.4. Detail of physical location, including information allowing the unique identification of the small-scale project:

Project will be implemented at two project sites in Zaporizhzhya city.

The geographical coordinates of the project sites are the following:

1) Project site #1, where the first stage of the project will be implemented (CHP unit with electricity capacity of 2.5 MW – TEK-3) - 47° 82' 77"N, 35° 19' 80" E

2) Project site #2, where the second stage of the project will be implemented (CHP unit with electricity capacity of 6 MW – TEK-6) - 47° 83' 92"N, 35° 00' 65" E

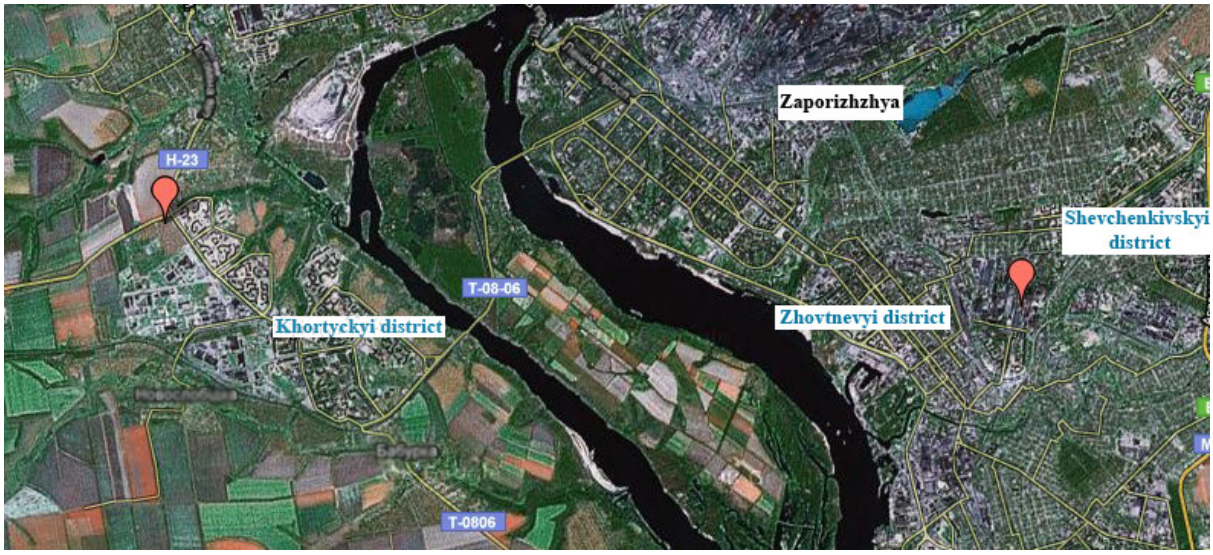

Fig. A 4-3. Information allowing the unique identification of the small-scale project

A.4.2. Small-scale project type(s) and category(ies):

Proposed SSC JI project pertains to Type II JI SSC projects: Energy efficiency improvement projects which reduce energy consumption, on the supply and/or demand side, by up to 60 gigawatt hours (GWh) per year (or an appropriate equivalent) category F. Supply-side energy efficiency improvements – generation.

Energy efficiency improvements will be achieved due to the benefits of cogeneration technology, which lead to primary energy savings. The appropriate equivalent for 60 GWh (e) could be 180 GWh of fuel energy content. The project will generate 72.10 GWh of electricity and 125.65 GWh of heat energy consuming 27.4 million m^3 or approximately 255 GWh in fuel energy content of natural gas. To generate the same amount of electricity and heat energy under the baseline scenario about 353 GWh of fuel energy content is needed. Thus, the project reduces energy consumption on the supply side by about 98 GWh per annum, which is significantly less than 180 GWh.

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the small-scale project:

Gas turbine cogeneration technology is employed in the project. Gas turbine cogeneration systems operate on the thermodynamic cycle known as the Brayton cycle.

The air is delivered through a diffuser to a constant-pressure combustion chamber, where fuel is injected and burned. The diffuser reduces the air velocity to values acceptable in the combustor. Combustion takes place with high excess air. The exhaust gases exit the combustor at high temperature and with oxygen concentrations of up to 15-16%. The highest temperature of the cycle appears at this point; the higher this temperature is, the higher the cycle efficiency is. The upper limit is placed by the temperature the materials of the gas turbine can withstand, as well as by the efficiency of the cooling blades. The high pressure and temperature exhaust gases enter the gas turbine producing mechanical work to drive compressor and electric generator. Energy of exhaust gases, which have high temperatures, is used for heat energy generation by exhaust boilers.

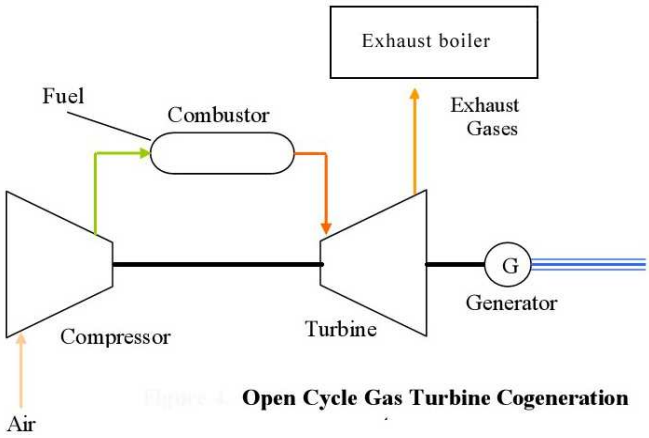

Fig. A 4-3. Gas turbine cogeneration cycle scheme

Equipment to be employed during the implementation of joint implementation project activity is described in detail for each project stage below.

Implementation schedule of project activity is the following:

Stage 1 – year 2010. Construction of CHP station TEK-3 with the electric capacity of 2.5 MW and heat capacity 5.6 Gkal/hour;

Stage 2 – year 2011. Construction of CHP station TEK-6 with the electric capacity of 6 MW and heat capacity 10 Gkal/hour.

Stage 1. Construction of CHP station TEK -3 with the electric capacity of 2.5 MW

CHP unit TEK-3 with the electric capacity of 2.5 MW consists with two main components:

- gas turbine unit PAEC-2500 with electric capacity of 2.5 MW and
- steam exhaust boiler KU-8/1,4-55-450GT.

Technical characteristics of CHP unit with the electric capacity of 2.5 MW are presented in the table below.

Table A-4.1 Technical characteristics of TEK-3.

Description	Unit	Value
Installed electric capacity	MW	2.5
Installed heat capacity	Gkal/hour	5.6
Annual electricity generation	MWh	20 000
Annual electricity consumption for own needs of CHP unit	MWh	3 500
Annual net electricity generation	MWh	16 500
Annual heat production	Gkal	36 643
Annual use of installed electric capacity	hours	8 000
Annual use of installed heat capacity	hours	6543
Annual natural gas consumption	m^3	9 614 000
NCV of natural gas	ccal/m^3	8 000
Thermal efficiency of CHP unit	%	81.39
Electric efficiency of CHP unit	%	44,57
Total CHP unit efficiency	%	66,14
Frequency	Hz	50
Voltage	V	6 300, 10 500
Weight	kg	28 500

Source of data: Business plan of investment project of innovative product introduction , which foresees construction of energy-saving cogeneration unit 'Heat and Power complex – 3' (TEK-3).

In CHP station with the electric capacity of 2.5 MW (TEK-3) a gas turbine engine GTE-MC-2.5 is used. CHP station is supplied with the efficient electric starting system, complex system of air cleaning, noise control system and modern automatic control system and safety system.

Fig. A 4-4. Gas turbine energy generation unit PAES 2500

Heat energy generated by TEK-3 will partly substitute heat energy that would be otherwise generated by the boilers of boiler room №2. The boiler room #2 has 4 Babcock and Wilcox steam boilers and 3 PTVM-50 water heating boilers installed. All boilers are used for providing heat energy to ensure heating and hot water supply of the Enterprise and residential sector.

Technical characteristics of Babcock and Wilcox steam boilers are presented below. Two of them have steam production capacity of 40 tonnes per hour and 2 – 10 tonnes per hour. The main fuel source for steam boilers is natural gas, but they can also operate using residual fuel oil.

Table. Technical characteristics of steam boilers Babcock and Wilcox

Data	Babcock and Wilcox №7	Babcock and Wilcox №8	Babcock and Wilcox №9	Babcock and Wilcox №10
Installed steam capacity, tonnes/hour	40,00	40,00	10,00	10,00
Actual steam production, tonnes/hour	29,16	27,54	9,20	9,30
Heat energy generation capacity, Gkal/hour	17,06	16,04	5,28	5,29
Steam pressure, MPa	0,64	0,63	0,66	0,61
Steam temperature, C	215	210	178	175
Natural gas NCV, kcal/m3	8056	8056	8056	8056
Feeding water temperature, C	103	102	102	102
Boiler efficiency, %	92,49	92,46	90,03	89,37
Natural gas consumption, m3/hour	2020	1920	700	710
Residual fuel oil consumption, kg/hour	496	476	-	-

Specific fuel consumption, kg of coal equivalent / Gcal	155,94	156,07	158,68	159,84

Source of data: parameter charts of the boilers.

Each of 3 PTVM-50 water heating boilers has 7 burners and could work under different operating modes having from 3 to 7 burners in operation. Technical characteristics of water heating boilers assuming operation of all 7 burners presented in the table below.

Table. Technical characteristics of water heating boilers PTVM-50

Data	PTVM-50 №11	PTVM-50 №12	PTVM-50 №13
Heat energy generation capacity, Gkal/hour	25,50	31,70	35,60
Water pressure at the exit of the boiler, MPa	0,67	0,67	0,65
Water temperature at the exit of the boiler, C	109	113	131
Water consumption, tonnes/hour	580,6	620,64	583,6
Natural gas NCV, kcal/m3	8116	8102	8117
Boiler efficiency, %	92,04	92,43	92,03
Natural gas consumption, m3/hour	3544	4195	4741
Specific fuel consumption, kg of coal equivalent / Gcal	155,21	154,56	155,22

Source of data: parameter charts of the boilers.

All technical characteristics are provided from the approved parameter charts of the boilers. The average efficiency of all boilers installed in boiler room #2 and for all operation modes is 92% according to the approved parameter charts.

Taking into account recommended in approved baseline methodology AM0014 “Natural gas-based package cogeneration” default natural gas fired boilers efficiency value of 90% the value presented in PDD and used further for baseline emission calculations could be treated as conservative.

Electricity generated by TEK-3 would be used for partial covering of electricity demand of the Enterprise and would be substitute electricity that in the absence of project activity would have been purchased from the national grid. The project owner could also analyse and consider the option of exporting generated electricity to the national grid in the future.

Stage 2. Construction of CHP station TEK-6 with the electric capacity of 6 MW

CHP unit with the electric capacity of 6 MW will be used for covering heat demand of two residential districts in Zaporizhzhya, substituting heat energy produced by natural gas fired boilers.

CHP unit with the electric capacity of 6 MW consists with three main components:
- gas turbine unit TTI -6,
- steam exhaust boiler KUP-15 and
- and steam turbine TG-0,75 A/0.4 P13/2.

Technical characteristics of CHP unit with the electric capacity of 6 MW are presented in the table below.

Description	Unit	Value
Installed electric capacity	MW	6.0
Installed heat capacity	Gkal/hour	10
Annual electricity generation	MWh	58 520
Annual electricity consumption for own needs of CHP unit	MWh	2 920
Annual net electricity generation	MWh	55 600
Annual heat production	Gkal	71 400
Annual use of installed electric capacity	hours	8 000
Annual use of installed heat capacity	hours	6543
Annual natural gas consumption	m^3	17 790 000
NCV of natural gas	ccal/m^3	8 000
Electric efficiency of CHP unit	%	Not less than 31
Frequency	Hz	50 (60)
Voltage	V	6 300, 10 500 (13 800)
Weight	kg	42 000

Source of data: Executive summary of feasibility study 'Heat and Power complex TEK-6).

Fig. A 4-5. Gas turbine energy generation unit EG 6000

Heat energy generated by TEK-6 will be used for heating purposes and in the absence of project activity similarly to stage 1 heat energy would have been generated using natural gas fired boilers.

Electricity generated by TEK-6 would be used for partial covering of electricity demand of the Enterprise and would substitute electricity that in the absence of project activity would have been purchased from the national grid. The project owner could also analyse and consider the option of exporting generated electricity to the national grid in the future.

The project uses the state-of-the-art technology, which will result in a significantly better performance than commonly used technologies in the Host country (natural gas fired boilers for heat generation and generation of electricity by power stations of national grid). Besides, the technology was specially developed for the implementation of the project and thus is not likely to be substituted by other or more efficient technologies within the project period. All the technological parameters of the project equipment meet environment protection normative requirements.
Due to the use of modern technology project requires initial training of the personal. All responsible workers have successfully passed the training course on general principles of functioning and the rules of

operation of exhaust boiler automatic and control system as well as were acquainted with the relevant operation and safety regulation manuals. Additional provisions for meeting training and maintenance needs envisaged due to training of the personal during the setup mode operation period and enforced requirements for educational and professional background of the working personal.

A.4.4. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed small-scale project, including why the emission reductions would not occur in the absence of the proposed small-scale project, taking into account national and/or sectoral policies and circumstances:

Anthropogenic emissions of greenhouse gases will be reduced due to more efficient utilisation of energy resources (natural gas in particular) in combined cycle of heat and power generation. Implementation of the project activity will reduce anthropogenic emissions of greenhouse gases due to substitution of electricity from the national grid, which has high carbon intensity factor, with on site generated natural gas based electricity; and also due to more efficient heat energy generation using natural gas as a fuel source.

Only CO_2 emissions concerned with fossil fuel combustions and electricity generation included in the project boundary and addressed in PDD. CH_4 emissions and NO_x emissions were considered negligibly low and were not taken into consideration. Detailed description of project boundaries is presented in Section B.

Mentioned above emission reductions would not occur in the absence of the proposed joint implementation activity due to a number of financial barriers described in details in Section B and also due to the fact that using of gas turbine based cogeneration units to generate electricity and heat energy is not a common practice in Ukraine.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

The length of the crediting period is 3 years. The amount of total reductions of greenhouse gases emission within the defined project boundaries during the first crediting period 2010-2012 is 86 401 tonnes of CO_2 equivalent.

Estimates of total as well as annual emission reductions for the crediting period 2010-2012 are provided in the table below.

	Years
Length of the crediting period	4
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2010	5 059
2011	40 671
2012	40 671
Subtotal estimated emission reductions over the crediting period 2010-2012 (tonnes of CO_2 equivalent)	86 401
Annual average of estimated emission reductions over the crediting period of 2010-2012 (tonnes of CO_2 equivalent)	28 800

	Years
Length of the crediting period	8
2013	40 671
2014	40 671
2015	40 671
2016	40 671
2017	40 671
2018	40 671
2019	40 671
2020	40 671
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	40 671
Subtotal estimated emission reductions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	325 368
Total estimated emission reductions over the period of 2010-2020 (tonnes of CO_2 equivalent)	411 769

A.4.5. Confirmation that the proposed small-scale project is not a debundled component of a larger project:

The proposed project is not a debundled component of a larger project. JSC Motor Sich is not a project participant to any other joint implementation or small-scale joint implementation project with a publicly available determination in accordance with paragraph 34 of the JI guidelines.

A.5. Project approval by the Parties involved:

The Project Idea Note had been submitted for review of the Ministry of Environmental Protection of Ukraine. Ministry of Environmental Protection of Ukraine issued a Letter of Endorsement for this project providing its support for further development of proposed joint implementation project.

In accordance with the "Requirements for the Joint Implementation Projects preparation" approved by National Agency of Ecological Investments of Ukraine (Order #33 from 25th of June, 2008) to receive a Letter of Approval for the JI project the project proponent should provide to the National Agency of Ecological Investments of Ukraine the final determination report of the proposed project along with project design documentation and the copy of Letter of Endorsement. After the consideration, which usually takes up to 30 days, the National Agency of Ecological Investments of Ukraine makes a decision regarding issuing Letter of Approval.

SECTION B. Baseline

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

The baseline scenario has been established in accordance with Appendix B of the JI Guidelines and in accordance with the Guidance on Criteria for Baseline Setting and Monitoring by the JISC.

The Guidance on Criteria for Baseline Setting and Monitoring established by the JISC states: '*The baseline for a JI project is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of GHGs that would occur in the absence of the proposed project.'*

Taking into account guidelines mentioned above project participants established the baseline using JI specific approach by identifying and listing possible alternatives on the basis of conservative assumptions and identifying the most plausible one.

JI specific approach foresees use of project specific baseline and monitoring methodology based partly on CDM approved methodology AM0014 "Natural gas-based packaged cogeneration". Namely the approaches for estimation of energy (fuel) consumptions for heat energy generation under the baseline scenario and associated baseline emissions as well as the approach for estimation of baseline emissions from electricity supply to the plant that is offset by the electricity supplied from the cogeneration units have been used. The mentioned CDM methodology is not applicable to this JI project to be used as a whole, because the project does not meet in full the applicability criteria of the methodology, namely the criterion that no excess heat from the cogeneration system is provided to another user and no excess of electricity is supplied to the power grid. In fact, heat energy generated within the project is partly supplied for ensuring heating and hot water supply of the residential buildings and electricity could be supplied to the national grid in the future.

Analysis of alternatives for the project activity

Plausible alternatives for the heat and power generation within the proposed project boundaries were examined based on the existing practice analysis, national and sectoral policies and project specific circumstances.

The main activities of JSC 'Motor Sich' are aviation engine production including design, production, testing and maintenance phases. In 2008, 86.5% of production volumes corresponded to production of aviation equipment. Consequently, the main focus of investments as well as research and development activities, new technology and equipment introduction is also in the area of aviation products production. Besides, JSC 'Motor Sich' supplies engines for gas piping units and energy production units with the electric capacity of 1 MW, 2.5 MW, 6 MW and 8 MW. Among already realised projects, where such equipment was used, there are the following: gas turbine cogeneration station with 4 EG-6000 units at JSC 'Tomskneft' (Russian Federation) working on oil well gas (2004), power station EG-6000 at JSC 'Rosneft-Krasnodarneftegas' (Russian Federation) working on oil well gas, cogeneration station EG-6000 at 'Grodnoenergo' (Byelorussia) (2006) and others. Production of all main products is export oriented and revenues from foreign contracts had a share of 93% in total revenues in 2008.

Therefore, energy generation does not belong to main scope of activities of the Enterprise and the construction of own energy generation stations has been not feasible without applying flexible mechanisms of Kyoto Protocol because of focus of the Enterprise on described activities and also due to economic and financial barriers described in detail in Section B.2.

However, execution of the project activity not being registered as joint implementation project has been considered as a plausible alternative.

The only other plausible and realistic alternative for the project activity is continuation of existing practice using natural gas fired boilers for heat energy generation and purchasing power from the national grid.

Ukraine has a surplus of electricity generation capacities due to significant decrease of economic activities after 1992 and even taking into consideration the growth of electricity demand since 2000 the surplus of electricity generation capacities is still significant (peak level of electricity demand reaches only 74% of existing installed capacity). Besides, Ukraine has relatively low electricity price even comparing to other CIS and Eastern European countries[1]. Thus, covering electricity demand purchasing power from the national grid is the most common for industrial enterprises and it is also the most plausible and realistic baseline, which does not lead to any additional investments and does not face any technological or other kinds of barriers.

As for heat energy generation, using natural gas fired boilers is one of the most common heat energy generation technologies in Ukraine. Heat is produced in Ukraine by thermal power plants, combined heat and power plants, nuclear power stations and boiler plants. In 2005 thermal power stations and CHPs accounted together for 22% of heat produced, boilers for 62%, and individual generators for 10% and nuclear power stations for 0.01%. Secondary heat energy sources accounted for about 5%. Thermal power stations use mainly coal (57.8%) and natural gas (47.4%), CHP units are operated mainly on natural gas (76-80%) and residual fuel oil (15-18%), and boilers are operated on natural gas (52-58%), coal (27-36%) and residual fuel oil (12-15%).[2] There are also single cases of heat energy generation using biomass or biomethane. Heat energy generation using geothermal energy and solar energy could be considered negligible.

Taking into account described sectoral circumstances and conservative assumptions, natural gas as the least carbon intensive fuel not including biomass, has been chosen as a baseline fuel. Moreover, due to the fact that heat energy for residual households, that will be substituted by project activity, is provided by boiler workshops, but not by thermal power station or other sources, this technology has been chosen as the most realistic and plausible one to be used under the baseline scenario. Thus, the most realistic and plausible baseline scenario for heat generation is continuation of current practice using natural gas fired boilers. The efficiency factor for natural gas fired boilers has also been chosen based on conservative assumptions and the circumstances of the project activities. 92% efficiency corresponds to average efficiency of boilers installed at JSC ‘Motor Sich’ boiler room and is higher than conservative value of 90% proposed by Approved baseline methodology AM0014 “Natural gas-based package cogeneration”.

Therefore, based on the existing practice analysis, existing technologies, national and sectoral policies and project specific circumstances the following plausible alternative future scenarios for the proposed project activity were defined:

- Development of the project activity not being registered as a joint implementation project. In section B.2 it is demonstrated that the proposed project without JI revenue is financially not attractive and faces barriers.

- Continuation of existing practice. Covering electricity demand purchasing power from the national grid and covering heat energy demand using natural gas fired boilers.

[1] Ukraine. Energy Policy Overview. Report published by International Energy Agency in 2006

[2] Anna Tsarenko. Overview of Heating Sector in Ukraine // Center for Social and Economic Research, Kyiv, 2007.

Baseline scenario has been established on a project specific basis and using multi-project emission factor for electricity purchased from national grid. The project specific approach was used to estimate baseline emissions from heat energy generation as described above.

Emission reductions will be defined based on monitoring data regarding actual electricity generation and heat energy generation volumes, and thus cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

The basic assumptions of the baseline methodology in the context of the project activity could be summarized as following:

- emission reductions occur due to displacing of electricity consumption from the grid and avoiding consumption of fossil fuel for heat generation;
- electricity consumption from the grid under the baseline is considered equal to the electricity generation during the project and heat energy generation is considered equal both in the baseline and project scenarios; electricity and heat generation under the project scenario was estimated based on technical characteristics of the project equipment and the number of operating hours during the year;
- actual baseline emissions will be determined based on the monitoring data.

Detailed information about the parameters used to estimate baseline scenario greenhouse gases emissions within the project boundaries as well as key factors and data sources are clearly described in the tables below.

Data / Parameter	$\mathbf{EG}_{TEK3, net}$
Data unit	MWh
Description	Electricity generation by TEK 3
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of electricity generated was estimated based on electricity capacity of steam turbine and annual operation of 8000 hours. See Section E for details.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	

Data / Parameter	$\mathbf{EG}_{TEK6, net}$
Data unit	MWh
Description	Electricity generation by TEK 6
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of electricity generated was estimated based on electricity capacity of steam turbine and annual operation of 8000 hours. See Section E for details.
Justification of the choice of data or description of measurement methods and	Conservative

procedures (to be) applied	
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	

Data / Parameter	**$EF_{co2, national grid, red.}$**
Data unit	tonnes CO_{2e}/MWh
Description	Emission factor for electricity of Ukrainian grid
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	"Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007). See Annex 2 for details.
Value of data applied (for ex ante calculations / determinations)	*0.896*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	The value of the parameter could be changed in case of new emission factors for electricity of Ukrainian grid are properly approved.

Data / Parameter	**HG_{TEK3}**
Data unit	GJ
Description	Heat energy generation by TEK 3
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation of TEK 3 was assumed.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	

Data / Parameter	**HG_{TEK6}**
Data unit	GJ
Description	Heat energy generation by TEK 6
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation of TEK 3 was assumed.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	

Data / Parameter	**$EF_{co2, NG}$**
Data unit	*kg CO_2/GJ*
Description	CO_2 emission factor for natural gas combustion
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions.
Value of data applied (for ex ante calculations / determinations)	*56.1*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	**$\dot{\eta}$**
Data unit	%
Description	Efficiency of natural gas fired boilers
Time of determination / monitoring	Parameter is determined during PDD development based on conservative assumptions (see Section B above).
Source of data (to be) used	Parameter charts of the boilers
Value of data applied (for ex ante calculations / determinations)	Average natural gas boilers efficiency determined based on the latest approved data of parameter charts of the boilers installed at boiler room #2 of JSC 'Motor Sich' - $\dot{\eta}$=92%.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	

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 small-scale project:

In accordance with Article 6 of the Kyoto Protocol a joint implementation project has to provide a reduction in emissions by sources, or an enhancement of net removals by sinks, which is additional to any that would otherwise occur. This supposes that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources of GHGs.

JI specific approach has been used to demonstrate that anthropogenic emissions of greenhouse gases will be reduced below those that would have occurred in the absence of project activity. Financial analysis and common practice analysis were used to demonstrate project additionality.

Realistic and credible alternatives available to the project participants (see Section B.1), that provide outputs comparable with the proposed joint implementation project activity are the following:

- Development of the project activity not being registered as a joint implementation project. Below it is demonstrated that the proposed project without JI revenue is financially not attractive and faces barriers.

- Continuation of existing practice. Covering electricity demand purchasing power from the national grid and covering heat energy demand using natural gas fired boilers.

All alternatives are compliant with national law and regulations.

Financial Analysis

Financial analysis was used to demonstrate that proposed project activity is not the most financially attractive. Net present value indicator (NPV) was used to perform the analysis.

Financial analysis was performed assuming data available for the project owners at the time of making a decision about project realization, which is the beginning of 2007, and also taking into consideration conservative assumptions about natural gas, electricity and heat, which is being sold for heating of residential area, price increase rates.

Information about the price of natural gas, electricity and heat energy for the Enterprise as for the January 2007 as well as information about other key data, which were used in the financial analysis, is presented in Table B 2-1 below. All prices are indicated with VAT excluded.

Table B 2-1. Data used for financial analysis

Data	Value	Source of data
Natural gas price (UAH/1000 m^3)	722.16	Information from the Enterprise about the price of natural gas as for January 2007
Electricity price (UAH /MWh)	241.9	Information from the Enterprise about the price of electricity as for January 2007
Heat energy price (UAH /Gkal)	128.33	Information from the Enterprise about the price of heat energy as for January 2007
Discount rate (%)	10	Discount rate of National Bank of Ukraine (01.01.08)
ERU price (UAH)	100	Market data

The following conservative assumptions were applied for natural gas, electricity and heat energy price data:

- natural gas price will increase 38% (average natural gas price increase rate for industrial users in Ukraine during 2005-2007) annually during first three years (2008-2010), and further increase rate will be 18.4% (based on average natural gas price increase rate for industrial users in European Union during 1997-2006 of 8.4% and adjusted for higher inflation rates in Ukraine); the assumption corresponds to tendencies of natural gas price increase in Ukraine during the period 2006-2007 and also to the projections of its further gradual but rapid increase to reach the level of natural gas price for European countries (market price);
- electricity price will increase 19% (average electricity price increase rate for industrial users in Ukraine during 2005-2007) annually during first three years (2008-2010), and further increase rate will be 12.4% (based on average electricity price increase rate for industrial users in European Union during 1997-2006 of 2.4% and adjusted for higher inflation rates in Ukraine) annually; there are surplus of electricity generation capacities in Ukraine and no reasons for rapid electricity price increase;
- heat energy price will increase 10% annually during first three years (2008-2010), and further increase rate will be 18.4% as for natural gas; price of heat energy is not likely to increase at rapid levels as the price of natural gas in 2008-2010 because the process of heat price setting is highly regulated and politically bound; due to the high social impact the price of heat energy is used to be low and more o less stable even if the heat tariffs did not cover the heat production costs[3].

[3] Historical data on electricity and natural gas price increase rates are taken from the statistical data of Eurostat, Naftogas of Ukraine and NERC.

Detailed information about capital expenditures is presented in the table below. Data presented with VAT excluded.

Table B 2-2. Project cost information

Expenditures	Value, UAH
Equipment cost for ТЕК-3	8 151 137
Design works for ТЕК-3	749 663
Construction and assembling works cost for ТЕК-3	10 724 270
Other expenditures for ТЕК-3	375 759
Equipment cost for ТЕК-6	28 804 759
Other expenditures for ТЕК-6	15 068 309
Total amount of capital expenditures	63 873 896

Total capital expenditures for the project scenario will be about 63.87 million UAH.

Results of NPV calculation are presented in table B 2-3.

Table B.2-3. Net present value of the Project and Baseline Scenario

	NPV (UAH) till 2020, discount rate is 10%
Baseline scenario	-464 452 142
Project scenario	- 445 250 641

Project scenario without additional revenues from emission reduction units sale is not the most attractive from the financial point of view. Overall, financing due to project ERU sale will ensure additional incentive to implement the project activity for the Enterprise. Revenues from the sale of emission reduction units generated as a result of first project stage implementation will be used to finance second stage of the project.

Sensitivity analysis has been executed to demonstrate the robustness of conclusion that the project scenario is not the most financially attractive. The +10% and -10% fluctuations of natural gas price, electricity price and heat energy price have been used in the analysis.

Table B.2-4. Sensitivity analysis results

Input data	Fluctuations					
	- 10%		0		+10%	
	Project	Baseline	Project	Baseline	Project	Baseline
Natural gas price	-408970079	-431379767	-464452142	-445250641	-519934205	-459121515
Electricity price	-464452142	-414596451	-464452142	-445250641	-464452142	-475904831
Heat energy price	-477218461	-445250641	-464452142	-445250641	-451685822	-445250641

Thus, sensitivity analysis concludes that the proposed joint implementation project activity is unlikely to be the most financially attractive in most cases except the case of natural gas price decrease by 10% (which is very unlikely under existed economic and political conditions) and electricity price increase by 10% (which is considered as not very realistic and plausible scenario). Baseline scenario is more financially favorable in most cases.

Common practice analysis

Overall, there are about 250 CHPs in Ukraine. More than 200 of them are small CHP plants incorporated in the property of industrial enterprises. Industrial enterprises produce heat for their own needs, and sell the rest of heat to households. About 30 CHPs are separate legal entities. They are large heat producers that supply heat to households and industry. Half of them are state owned and incorporated in NAC ECU structure. About 10 CHPs are owned by local communities and 5 of them are privately owned[4]. Most of existing cogeneration units employ steam turbine based cogeneration technology.

Even though in 2005 the Cogeneration Act was adopted by Ukrainian Parliament it was not effective enough to create enabling environment for cogeneration projects in Ukraine. Experts point out the contradictions of this law with existing legislation, including tax laws, as reasons for its poor effect[5]. As a result the share of combined heat and power generation in district heating systems is insignificant[6].

Several cogeneration units employing reciprocating gas engine technology are supposed to be installed within district heating rehabilitation joint implementation projects throughout Ukraine: 6 gas engines (3 MWe total capacity) in Crimea[7], 5 gas engines (4 MWe total capacity) in Kharkiv city[8] and 18 gas engines (10 MWe total capacity) in Donetsk region[9]. This cogeneration equipment in district heating sector has minor share in overall heat energy production capacity consisted mainly of natural gas fired boilers. Besides, there are also a number of joint implementation projects foreseeing installation of steam turbine based and reciprocating gas engine based cogeneration systems using biogas, biomass and coal mine methane as a fuel source. All mentioned projects could not be treated as common practice due to the fact that they are being realised as joint implementation projects.

Overall, it could be concluded that gas turbine cogeneration technology is not a common practice in Ukraine.

Thus, based on financial analysis and common practice analysis it could be concluded that the project is additional and greenhouse emission reductions would not have been occurred in the absence of joint implementation activity.

Project scenario foresees installation of two combined heat and power stations (heat and power complexes) based on gas turbine units PAES 2500 and EG 6000 with the electric installed capacity of 2.5 MW and 6 MW respectively and two exhaust boilers. Generated electricity will displace electricity from the national grid and heat energy will substitute heat energy generation by natural gas fired boilers.

Baseline scenario foresees continuation of existing practice: covering electricity demand by purchasing power from the national grid and covering heat energy demand using natural gas fired boilers.

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[4] Anna Tsarenko. Overview of Heating Sector in Ukraine // Center for Social and Economic Research, Kyiv, 2007.

[5] Volodymyr Smelik, Vladyslav Smelik and Dmytro Sakharuk. Investing in cogeneration fpr Ukraine – how to develop projects successfully. Cogeneration and On-Site Power Production. http://www.cospp.com/display_article/346780/122/CRTIS/none/none/1/Investing-in-cogeneration-for-Ukraine-%E2%80%94-how-to-develop-projects-successfully/

[6] Ukraine. Energy Policy Overview. Report published by International Energy Agency in 2006

[7] PDD is available at JISC web site

[8] PDD is available at JISC web site

[9] PDD is available at JISC web site

Due to introduction of efficient state-of-the-art cogeneration technology within the project the emissions of the baseline scenario from fossil fuel combustion for separate generation of heat energy and electricity will exceed the emissions from natural gas combustion in the project scenario. Total greenhouse gases emission reductions as a result of joint implementation project realization within the defined project boundaries during the first crediting period 2010-2012 will be 86 401 tonnes CO_{2e}. See Section E for details.

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

Project boundary includes emission sources attributable to the project which are under the control of project participants.

Greenhouse gases emissions due to natural gas combustions at cogeneration units are included in project boundaries under the projects scenario. Greenhouse gases emissions due to natural gas combustions by natural gas fired boilers and greenhouse gases emissions due to electricity generation are included in project boundaries under the baseline scenario.

Table B 3-1. Sources of emissions included in consideration or excluded of it

	Source	Gas	Incl./Excl.	Justification/Explanation
Baseline	Emissions due to natural gas combustion for heat energy generation	CO2	Incl	**Main source of emissions**
		CH4	Excl	Considered negligible. Conservative
		N2O	Excl	Considered negligible. Conservative
	Emissions due to electricity consumption from the national grid, which will be substituted by on site generated electricity under the project scenario	CO2	Incl	**Main source of emissions**
		CH4	Excl	Considered negligible. Conservative
		N2O	Excl	Considered negligible. Conservative
Project	Emissions due to natural gas combustion by cogeneration units	CO2	Incl	**Main source of emissions**
		CH4	Excl	Considered negligible. Conservative
		N2O	Excl	Considered negligible. Conservative

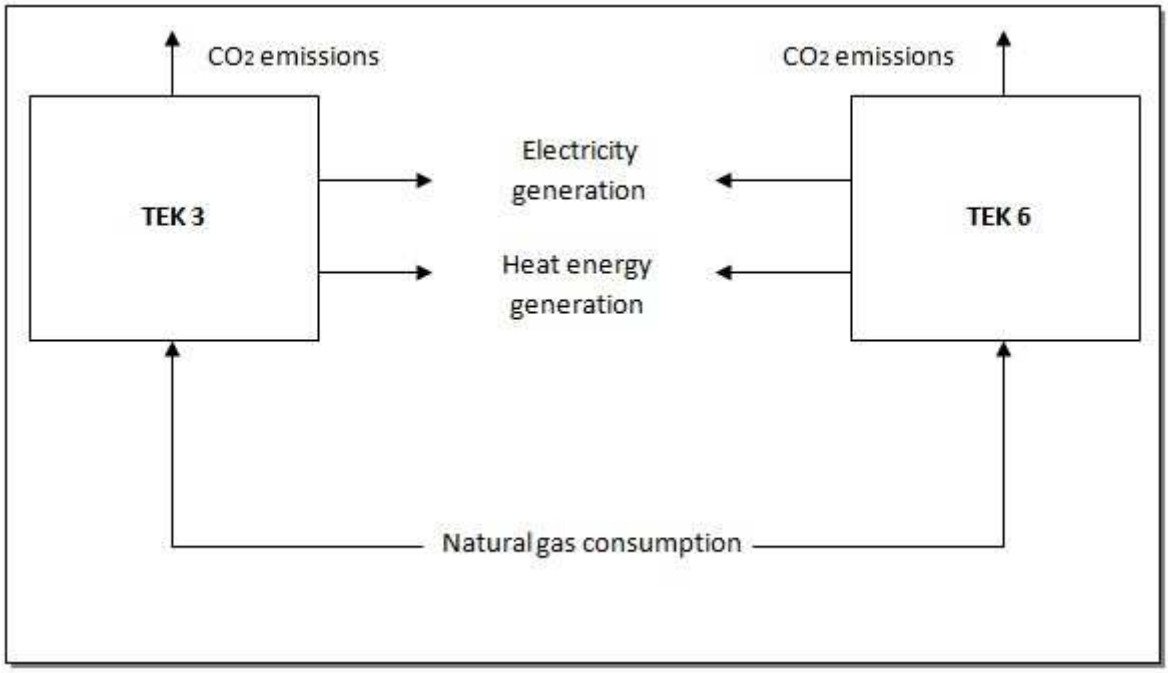


Fig. B-3.1 Boundaries scheme for the project scenario.

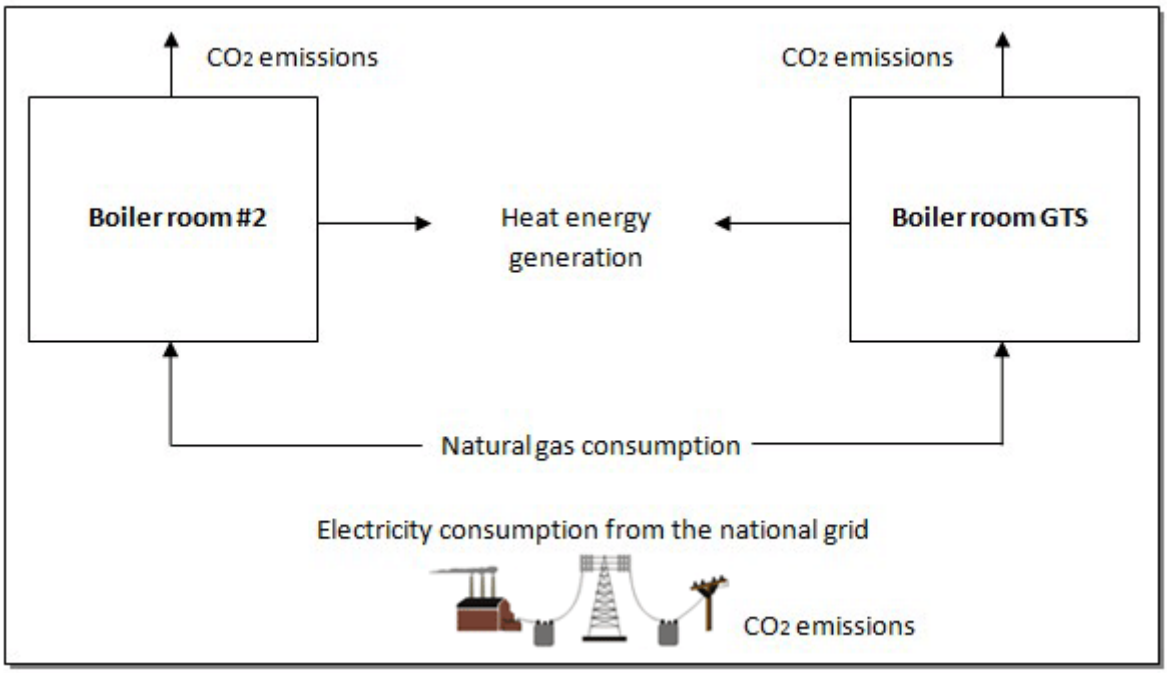


Fig. B-3.2 Boundaries scheme for the baseline scenario

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 the baseline setting: 21/09/2010
Mykola Shlapak, LLC 'Joint Implementation Team'
15 B/22 Biloruska st.,
Kiev, 04119, Ukraine
Tel/Fax. +380 44 493 83 32
mshlapak@ji.com.ua
LLC 'Joint Implementation Team' is not a participant of this Project.

SECTION C. Duration of the small-scale project / crediting period

C.1. Starting date of the small-scale project:

The starting date of the small-scale JI project is 17.02.2007.

C.2. Expected operational lifetime of the small-scale project:

Expected operational lifetime of both CHP units is 100 000 hours, which corresponds to 12.5 years (assuming annual operation of 8 000 hours) or 150 months. Thus, expected operational lifetime of the project is 12.5 years or 150 months for each stage.

C.3. Length of the crediting period:

According to Glossary of Joint Implementation Terms ('Glossary of Joint Implementation Terms', Version 2), approved at eighteen meeting of Joint Implementation Supervisory Committee (see Eighteen Meeting Report. Annex 10. 'Glossary of Joint Implementation Terms', Version 2), crediting period is the period for which reductions in anthropogenic emissions by sources or enhancements of anthropogenic removals by sinks may be determined by an Accredited independent entity. Projects starting as of 2000 may be eligible as JI projects if they meet the requirements of the JI guidelines, but ERUs shall only be issued for a crediting period starting after the beginning of 2008. The project participants shall choose the starting date of the crediting period to be on or after the date the first emission reductions are generated by the JI project and the crediting period shall not extend beyond the operational lifetime of the project.

Therefore, start of the crediting period for proposed project activity is August 4th, 2010, which corresponds to the start of operational phase of the project activity.

End of the first crediting period is December 31st, 2012.

The length of the crediting period is 2 years and 5 months or 29 months.

The start date of the second crediting period is expected to be January 1st, 2013 and the end date of the second crediting period is expected to be December 31st, 2020. The length of the second crediting period is expected to be 8 years or 96 months.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

JI specific approach was chosen for monitoring of greenhouse emission reductions in accordance with paragraph 9 (a) of the 'Guidance on criteria for baseline setting and monitoring'. Detailed theoretical description, assumptions, formulae, data sources and key factors used in the monitoring plan is described below.

Monitoring plan ensures the collection and archiving of all relevant data necessary for measuring anthropogenic emissions and calculation of GHGs emission reductions occurring within the project boundary during the crediting period. Monitoring plan provides also quality assurance and control procedures for the monitoring process and procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed JI project.

Monitoring plan is established in accordance with Host Party regulations, namely in accordance with Decree of Cabinet of Ministers of Ukraine #206 dated 22.02.2006 'On Approval of the Procedure of Drafting, Review, Approval and Implementation of Projects Aimed at Reduction of Anthropogenic Emissions of Greenhouse Gases' and "Requirements for the Joint Implementation Projects preparation" approved by National Agency of Ecological Investments of Ukraine (Order #33 from 25th of June, 2008).

The monitoring plan will serve to trace Project Emissions, Baseline Emissions and to calculate Emission Reductions in accordance with the gathered data fixed by direct measurement of specific related parameters through the application of technical devices and calculations.

Project owner has developed and enforced the system of monitoring of GHG emission reductions at the Enterprise, which defines the procedure of gathering and storing of necessary data and responsibility.
Responsible persons of workshop #14 will manage natural gas consumption and heat energy production log books and will provide reports on natural gas consumption and heat energy generation to Energy Department on a monthly basis. Natural gas consumption and heat energy production log books will be stored during 10 years. Responsible persons of workshop #15 will manage electricity generation and electricity consumption log books, electricity metering equipment and will provide reports on net electricity generation to Energy Department on a monthly basis. Electricity generation and consumption log books will be stored during 10 years.

Energy Department will be responsible for collecting all data needed for monitoring of GHG emission reductions and preparing reports on a monthly basis. Monthly reports will be provided to Department of Corporate Rights Management and Investment Projects.

Monitoring data will be archived in paper and electronic form.

Based on the collected data the annual monitoring reports on actual GHG emission reductions due to implementation of JI project will be prepared. The monitoring reports must be delivered by the contractual party to an accrediting independent entity (AIE) at regular intervals. This entity examines the reports. Monitoring data must be kept for at least 2 years after the end of the crediting period or the last transfer of ERUs.

Detailed information relating to the collection and archiving of all relevant data necessary for estimating or measuring project emissions, determining baseline emissions, and assessing leakage effects provided below.

Formulae used to calculate project emissions

Greenhouse gases emissions in the project scenario are calculated using formula presented below:

$$PE = PE_{NG,TEK-3} + PE_{NG,TEK-6} \quad (D.1)$$

where,
$PE_{NG,TEK-3}$ – project emissions due to natural gas consumption by TEK – 3,
$PE_{NG,TEK-6}$ – project emissions due to natural gas consumption by TEK – 6.

$$PE_{NG,TEK-3} = NG_{TEK-3} \cdot NCV_{NG} \cdot EF_{CO2,\ NG} \cdot 10^{-6} \quad (D.2)$$

NG_{TEK-3} is the quantity of natural gas used for combined heat and power generation by TEK-3 during the year y, m^3. Parameter is monitored throughout the crediting period.

NCV_{NG} is the net calorific value of natural gas, GJ/thousand m^3. Parameter is monitored throughout the crediting period.

$EF_{CO2,\ NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

$$PE_{NG,TEK-6} = NG_{TEK-6} \cdot NCV_{NG} \cdot EF_{CO2,\ NG} \cdot 10^{-6} \quad (D.3)$$

NG_{TEK-6} is the quantity of natural gas used for combined heat and power generation by TEK-6 during the year y, m^3. Parameter is monitored throughout the crediting period.

NCV_{NG} is the net calorific value of natural gas, GJ/thousand m^3. Parameter is monitored throughout the crediting period.

$EF_{CO2,\ NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

Formulae used to calculate baseline emissions

Greenhouse gases emissions sources in baseline scenario include the following:

- greenhouse gases emissions due to natural gas consumption for heat energy generation in the amounts that would be generated by TEK-3 and TEK-6;
- greenhouse gases emissions due to electricity generation by power plants of the national grid in the amounts that would be generated by TEK-3 and TEK-6.

$$BE = BE_{heat,\ TEK-3} + BE_{el.,\ TEK-3} + BE_{heat,\ TEK-6} + BE_{el.,\ TEK-6} \quad (D.4)$$

where:

$BE_{heat,\ TEK-3}$ – baseline emissions due to heat energy generation using natural gas fired boilers under the baseline scenario in the amount which will be substituted with heat energy generated by TEK-3 under the project scenario

$BE_{el., TEK-3}$ – baseline emissions due to electricity generation by power plants of the national grid under the baseline scenario in the amount which will be substituted with electricity generated by TEK-3 under the project scenario.

$BE_{heat, TEK-6}$ – baseline emissions due to heat energy generation using natural gas fired boilers under the baseline scenario in the amount which will be substituted with heat energy generated by TEK-6 under the project scenario.

$BE_{el., TEK-6}$ – baseline emissions due to electricity generation by power plants of the national grid under the baseline scenario in the amount which will be substituted with electricity generated by TEK-6 under the project scenario.

$$BE_{heat, TEK-3} = (HG_{TEK-3} \cdot EF_{CO2, NG} \cdot 10^{-3}) / \acute{\eta} \quad (D.5)$$

HG_{TEK-3} - amount of heat energy generated by TEK-3 during the year y, GJ. Parameter is monitored throughout the crediting period.

$EF_{CO2, NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.
$\acute{\eta}$ – *average* efficiency of natural gas fired boilers under the baseline scenario estimated according to operational tests of the boilers indicated in parameter charts of the boiler installed at boiler room #2 of JSC 'Motor Sich'. Parameter is not monitored throughout the crediting period. According to parameter charts of the boilers the average efficiency of installed boilers $\acute{\eta}_{boilers}$ = *92%.*

$$BE_{el., TEK-3} = (EG_{TEK-3, own\ needs} \cdot EF_{CO2, national\ grid\ red.}) + (EG_{TEK-3, grid} \cdot EF_{CO2, national\ grid\ prod.}) \quad (D.6)$$

$EG_{TEK-3, own\ needs} = EG_{TEK-3, net} - EG_{TEK-3, grid}$, if $EG_{TEK-3, grid} = 0$, than $EG_{TEK-3, own\ needs} = EG_{TEK-3, net}$, and

$$BE_{el., TEK-3} = (EG_{TEK-3, net} \cdot EF_{CO2, national\ grid\ red.}) \quad (D.7)$$

$EG_{TEK-3, own\ needs}$ - amount of electricity generated by TEK-3 and used for own needs of the Enterprise during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK-3, grid}$ - amount of electricity generated by TEK-3 and exported to the national grid during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK-3, net}$ – amount of electricity generated by TEK-3 during the year y, MWh (net quantity – total electricity generation minus electricity consumption for own needs of TEK-3). Parameter is monitored throughout the crediting period.

$EF_{CO2, national\ grid\ red.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects reducing power consumption from power grid is the following $EF_{CO2, national\ grid\ prod.}$ = 0.896 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$EF_{CO2, national\ grid, prod.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007)

emission factor for Ukrainian electricity grid for joint implementation projects producing electricity to the power grid is the following $EF_{CO2,\ national\ grid,\ prod.}$ = 0.807 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$$BE_{heat,\ TEK\text{-}6} = (HG_{TEK\text{-}6} \cdot EF_{CO2,\ NG} \cdot 10^{-3}) / \acute{\eta}\ (D.8)$$

$HG_{TEK\text{-}6}$ - amount of heat energy generated by TEK-6 during the year y, GJ. Parameter is monitored throughout the crediting period.

$EF_{CO2,\ NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

$\acute{\eta}$ – average efficiency of natural gas fired boilers under the baseline scenario estimated according to operational tests of the boilers indicated in parameter charts of the boiler installed at boiler room #2 of JSC 'Motor Sich'. Parameter is not monitored throughout the crediting period. According to parameter charts of the boilers the average efficiency of installed boilers $\acute{\eta}_{boilers}$ = *92%.*

$$BE_{el.,\ TEK\text{-}6} = (EG_{TEK\text{-}6,\ own\ needs} \cdot EF_{CO2,\ national\ grid\ red.}) + (EG_{TEK\text{-}6,\ grid} \cdot EF_{CO2,\ national\ grid\ prod.})\ (D.9)$$

$EG_{TEK\text{-}6,\ own\ needs} = EG_{TEK\text{-}6,\ net} - EG_{TEK\text{-}6,\ grid}$, if $EG_{TEK\text{-}6,\ grid} = 0$, than $EG_{TEK\text{-}6,\ own\ needs} = EG_{TEK\text{-}6,\ net}$, and

$$BE_{el.,\ TEK\text{-}6} = (EG_{TEK\text{-}6,\ net} \cdot EF_{CO2,\ national\ grid\ red.})\ (D.10)$$

$EG_{TEK\text{-}6,\ own\ needs}$ - amount of electricity generated by TEK-6 and used for own needs of the Enterprise during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK\text{-}6,\ grid}$ - amount of electricity generated by TEK-6 and exported to the national grid during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK\text{-}6,\ net}$ – amount of electricity generated by TEK-6 during the year y, MWh (net quantity – total electricity generation minus electricity consumption for own needs of TEK-6). Parameter is monitored throughout the crediting period.

$EF_{CO2,\ national\ grid\ red.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects reducing power consumption from power grid is the following $EF_{CO2,\ national\ grid\ prod.}$ = 0.896 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$EF_{CO2,\ national\ grid,\ prod.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects producing electricity to the power grid is the following $EF_{CO2,\ national\ grid,\ prod.}$ = 0.807 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

GHG emission reductions from the project are estimated by means of the following formula:

$$E_r = \sum(BE_y - PE_y),\ (D.11)$$

where E_r – GHG emission reduction units delivered by project activity, tonnes CO_{2e};

BE_y – greenhouse gases emissions in baseline scenario for the year y, tonnes CO_{2e};

PE_y – greenhouse gases emissions in project scenario for the year, tonnes CO_{2e};

D.2. Data to be monitored:

Data to be monitored and parameters used in the calculations are described in the single tables below.

Data / Parameter	$\mathbf{NG_{TEK-3}}$
Data unit	m^3
Description	Amount of natural gas consumed by TEK-3
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from natural gas meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of natural gas consumed was estimated based on technical data of the equipment.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Natural gas meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{NG_{TEK-6}}$
Data unit	m^3
Description	Amount of natural gas consumed by TEK-6
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from natural gas meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of natural gas consumed was estimated based on technical data of the equipment.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Natural gas meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{NCV_{NG}}$
Data unit	GJ/1000 m^3
Description	Net calorific value of natural gas
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Suppliers data
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations the conservative value of 33.5 GJ/1000 m^3 has been used.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative

QA / QC procedures (to be) applied	
Any comment	Data will be recorded on a monthly basis.

Data / Parameter	$\mathbf{EF}_{co2, NG}$
Data unit	*kg CO_2/GJ*
Description	CO_2 emission factor for natural gas combustion
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions
Value of data applied (for ex ante calculations / determinations)	*56.1*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$\mathbf{EG}_{TEK3, net}$
Data unit	MWh
Description	Electricity generation by TEK-3 (net quantity – total electricity generation minus electricity consumption for own needs of TEK-3)
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of electricity generated was estimated based on electricity capacity of steam turbine and annual operation of 8000 hours. See Section E for details.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EG}_{TEK3, own needs}$
Data unit	MWh
Description	Amount of electricity generated by TEK-3 and used for own needs of the Enterprise
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations was assumed to be equal $\mathbf{EG}_{TEK3, net}$
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer

	norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EG}_{TEK3, grid}$
Data unit	MWh
Description	Amount of electricity generated by TEK-3 and exported to the national grid
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations was assumed to be equal zero.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EG}_{TEK6, net}$
Data unit	MWh
Description	Electricity generation by TEK-6 (net quantity – total electricity generation minus electricity consumption for own needs of TEK-6)
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations amount of electricity generated was estimated based on electricity capacity of steam turbine and annual operation of 8000 hours. See Section E for details.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EG}_{TEK6,\ own\ needs}$
Data unit	MWh
Description	Amount of electricity generated by TEK-6 and used for own needs of the Enterprise
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations was assumed to be equal $\mathbf{EG}_{TEK6,\ net}$
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EG}_{TEK6,\ grid}$
Data unit	MWh
Description	Amount of electricity generated by TEK-6 and exported to the national grid
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Operation report with data from power meter (on site measurements)
Value of data applied (for ex ante calculations / determinations)	For ax ante calculations was assumed to be equal zero.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Power meter will be calibrated according to manufacturer norms and existing regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{EF}_{co2,\ national\ grid,\ red.}$
Data unit	tonnes CO_{2e}/MWh
Description	Emission factor for electricity of Ukrainian grid for JI project reducing electricity consumption from the grid
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	"Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007). See Annex 2 for details.
Value of data applied (for ex ante calculations / determinations)	*0.896*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	The value of the parameter could be changed in case of new emission factors for electricity of Ukrainian grid are properly approved.

Data / Parameter	$\mathbf{EF_{co2,\ national\ grid,\ prod.}}$
Data unit	tonnes CO_{2e}/MWh
Description	Emission factor for electricity of Ukrainian grid for JI project supplying electricity to the grid
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	"Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007). See Annex 2 for details.
Value of data applied (for ex ante calculations / determinations)	*0.807*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	The value of the parameter could be changed in case of new emission factors for electricity of Ukrainian grid are properly approved.

Data / Parameter	$\mathbf{HG}_{TEK3}$
Data unit	GJ
Description	Heat energy generation by TEK 3
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation of TEK 3 was assumed.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\mathbf{HG}_{TEK6}$
Data unit	GJ
Description	Heat energy generation by TEK 6
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation of TEK 6 was assumed.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	Data will be recorded daily. Reports will be submitted on a monthly basis.

Data / Parameter	$\dot{\eta}$
Data unit	%
Description	Efficiency of natural gas fired boilers
Time of determination / monitoring	Parameter is determined during PDD development based on conservative assumptions (see Section B above).
Source of data (to be) used	Parameter charts of the boilers
Value of data applied (for ex ante calculations / determinations)	Average natural gas boilers efficiency determined based on the latest approved data of parameter charts of the boilers installed at boiler room #2 of JSC 'Motor Sich' - $\dot{\eta}$=92%.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative
QA / QC procedures (to be) applied	
Any comment	

There are also established procedures of monitoring, collecting, and archiving of data on the environmental impacts of the project, namely emissions of pollutants into the atmospheric air. The emissions of carbon oxide and nitrogen oxides are monitored once per year according to 'Set of methodologies for defining concentrations of polluting substances in industrial emissions'. The emissions should not exceed 250 mg/m^3 for carbon oxide and 500 mg/m^3 for nitrogen oxides. In case of emergency situations, which lead to emissions of polluting substances in larger quantities than allowed by relevant emission allowance, as well as in the case of failure of monitoring equipment, which could lead to lose of control on pollution prevention system, the Enterprise should inform the regional State authority on environmental protection as soon as possible. Any emergency situations should be documented.

Besides, the enterprise also files reports by the following official annual statistical forms:

- 2-tp (air) *Data on protection of atmospheric air*, which contains information on amounts of trapped and neutralized atmospheric pollutants, itemized emissions of specific pollutants, number of emission sources, measures on reduction of emissions into the atmosphere, emissions from particular groups of pollution sources;

- 2-tp (water resources) *Data on water use*, which presents information on consumption of water from natural sources, discharge of waste water, and content of pollutants in it, capacity of treatment facilities, etc.;

- 2-tp (waste) *Data on formation, use, neutralization, transportation and placement of industrial and household waste*, which presents the annual balance of waste flow, by waste types and hazard classes.

Data are monitored with compliance to Law of Ukraine "On metrology and metrological activities'.

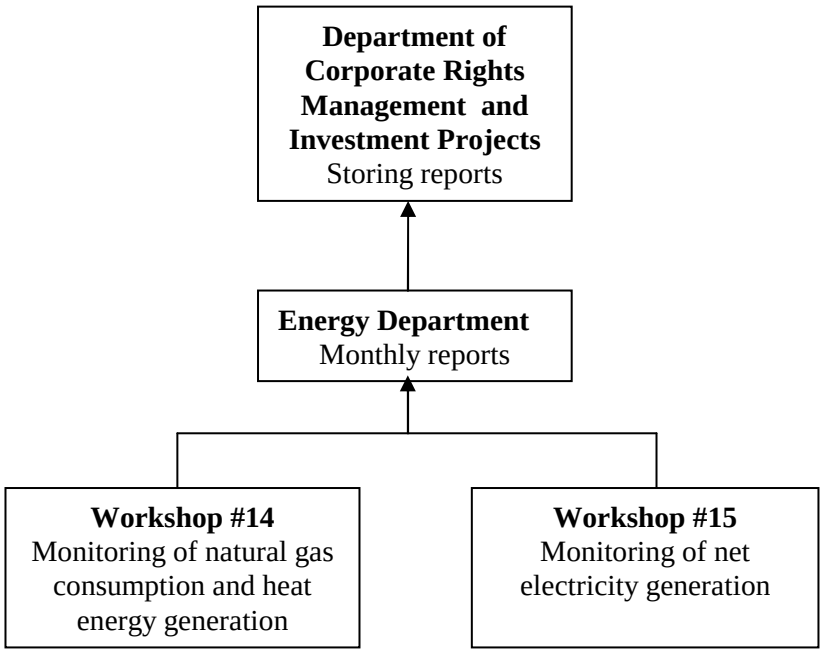
D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Amount of natural gas consumed by TEK-3	*low*	*Devices used: gas meter G1000-LG-K-200-1/20-1.6-1-Ex, which is installed at gas compressor unit of TEK-3. Accuracy 2%, calibrated once per two years, reports are submitted monthly.*
Amount of natural gas consumed by TEK-6	*low*	*Devices used: gas meter, which would be installed at gas compressor unit of TEK-6. Accuracy 2%, calibrated once per two years, reports are submitted monthly.*
Net calorific value of natural gas	*low*	*Suppliers data*
Heat energy generation by TEK 3	*low*	*Devices used: heat meter DKS 10-150-a/b-1. Crosschecking using data on natural gas consumptions and technical characteristics of cogeneration equipment.*
Electricity generation by TEK-3	*low*	*Devices used: power meter Alpha A 1800 installed at TP-12. Accuracy 0.5%, calibrated once per six years, reports are submitted monthly.*
Heat energy generation by TEK 6	*low*	*Devices used: heat meter. Reports are submitted monthly. Crosschecking using data on natural gas consumptions and technical characteristics of cogeneration equipment.*
Electricity generation by TEK-6	*low*	*Devices used: power meter. Accuracy 0.5%, calibrated once per six years, reports are submitted monthly.*

All measurement equipment is calibrated according to national regulations.

D.4. Brief description of the operational and management structure that will be applied in implementing the monitoring plan:

The general scheme of operational and management structure of implementation the monitoring plan is presented below.



All necessary data will be collected by existing departments of JSC 'Motor Sich' and the reports will be prepared by Energy Department and provided to Department of Corporate Rights Management and Investment Projects according to the monitoring system described in Section D.1. Collection of information required for calculations of reductions of greenhouse gases emissions as a result of project implementation will be performed in accordance with procedures established at the enterprise. Data will be stored in operational journals of workshop, and in the relevant electronic databases. Calculations of greenhouse emission reductions will be prepared by LLC 'Joint Implementation Team', Kyiv.

D.5. Name of person(s)/entity(ies) establishing the monitoring plan:

Date: 21/09/2010
Mykola Shlapak, LLC 'Joint Implementation Team'
15 B/22 Biloruska st., Kiev, 04119, Ukraine
Tel/Fax. +(38 044) 493 83 32
mshlapak@ji.com.ua
LLC 'Joint Implementation Team' is not a participant of this Project.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions and formulae used in the estimation:

The following data were used in calculation of project emissions for the proposed joint implementation project.

Data	2010	2011	2012	Total
Stage 1 - TEK 3				
Annual operation for electricity generation, hours	6668	8000	8000	22668
Electricity generation by TEK-3, MWh	16670	20000	20000	56670
Electricity consumption for own needs of TEK-3, MWh	2917	3500	3500	9917
Net electricity generation by TEK-3, MWh	13753	16500	16500	46753
Annual operation fro heat energy generation, hours	5454	6543	6543	18540
Heat energy generation by TEK-3, Gkal	30542	36641	36641	103824
Natural gas consumption, 1000 m3	8012	9614	9614	27240
Stage 2 - TEK 6				
Net electricity generation by TEK-6, MWh		55600	55600	111200
Heat energy generation by TEK-6, Gkal		71400	71400	142800
Natural gas consumption, 1000 m3		17790	17790	35580
Total				
Net electricity generation, MWh	13753	72100	72100	157953
Heat energy generation, Gkal	30542	108041	108041	246624
Natural gas consumption, 1000 m3	8012	27404	27404	62820

Estimated project emissions within the project boundary for the period 2010-2012 are presented in table below.

Year	2010	2011	2012	2010-2012
GHG emissions due to natural gas consumption, tonnes CO_{2e}	15057	51502	51502	118061
Total project emissions, tonnes CO_{2e}	**15057**	**51502**	**51502**	**118061**

Thus, total amount of project emissions for the first crediting period 2010-2012 within the project boundaries is 118 061 tonnes CO_{2e}.

Total amount of estimated GHG emission reductions due to the project activity during the first crediting period 2010-2012 is 86401 tonnes CO_{2e}.

Greenhouse gases emissions sources in project scenario within the defined project boundaries include emissions due to natural gas consumption by both cogeneration units (TEK-3 and TEK-6).

Greenhouse gases emissions in the project scenario are calculated using formula presented below:

$$PE = PE_{NG,TEK-3} + PE_{NG,TEK-6}$$

where,

$PE_{NG,TEK-3}$ – project emissions due to natural gas consumption by TEK – 3,

$PE_{NG,TEK-6}$ – project emissions due to natural gas consumption by TEK – 6.

$$PE_{NG,TEK-3} = NG_{TEK-3} \cdot NCV_{NG} \cdot EF_{CO2,\,NG} \cdot 10^{-6}$$

NG_{TEK-3} is the quantity of natural gas used for combined heat and power generation by TEK-3 during the year y, m^3. Parameter is monitored throughout the crediting period.

NCV_{NG} is the net calorific value of natural gas, GJ/thousand m^3. Parameter is monitored throughout the crediting period. For ex ante calculations conservative value of 33.5 GJ/thousand m^3 has been used.

$EF_{CO2,\,NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

$$PE_{NG,TEK-6} = NG_{TEK-6} \cdot NCV_{NG} \cdot EF_{CO2,\,NG} \cdot 10^{-6}$$

NG_{TEK-6} is the quantity of natural gas used for combined heat and power generation by TEK-6 during the year y, m^3. Parameter is monitored throughout the crediting period.

NCV_{NG} is the net calorific value of natural gas, GJ/thousand m^3. Parameter is monitored throughout the crediting period. For ex ante calculations conservative value of 33.5 GJ/thousand m^3 has been used.

$EF_{CO2,\,NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

E.2. Estimated leakage and formulae used in the estimation, if applicable:

Leakage is the net change of anthropogenic emissions by sources and/or removals by sinks of GHGs which occurs outside the project boundary, and that can be measured and is directly attributable to the JI project.

Leakages in the project activity are associated with additional fugitive emissions of CH4 during transportation due to increased natural gas consumption by cogeneration units in comparison of gas consumption by natural gas fired boilers under the baseline scenario to produce the same amount of heat energy. At the same time, leakages will be decreased as a result of project activity due to substitution of electricity consumption from the national grid with on site electricity generation by CHP units and consequent decrease of organic fuel consumption by power stations connected to the national grid and associated fugitive emissions of CH4 during production and transportation of organic fuel, which is used by power stations. Thus, leakages were not taken into account within the calculation of greenhouse gases emission reductions and assumed to be zero. This is conservative.

E.3. Sum of E.1. and E.2.:

Due to the fact that no leakage is expected during the project activity the sum of E.1 and E.2 equals E.1

E.4. Estimated baseline emissions and formulae used in the estimation:

The following conservative assumptions were taken into account while estimation baseline emissions:

- The amount of electricity generated during the project activity would have been consumed from national electricity grid under the baseline scenario;
- The amount of heat energy generated during the project activity would have been produced using natural gas fired boilers with the efficiency of 92% under the baseline scenario.

Estimated baseline emissions within the project boundary using formulae described in section D for the period 2010-2012 are presented in table below.

Year	2010	2011	2012	2010-2012
GHG emissions due to electricity consumption from the grid, tonnes CO_{2e}	12322	64602	64602	141526
GHG emissions due to heat energy production by natural gas fired boilers, tonnes CO_{2e}	7794	27571	27571	62936
Total baseline emissions, tonnes CO_{2e}	20116	92173	92173	204462

Thus, total amount of baseline emissions for the first crediting period 2010-2012 within the project boundaries is 204 462 tonnes CO_{2e}.

Greenhouse gases emissions sources in baseline scenario include the following:

- greenhouse gases emissions due to natural gas consumption for heat energy generation in the amounts that would be generated by TEK-3 and TEK-6;
- greenhouse gases emissions due to electricity generation by power plants of the national grid in the amounts that would be generated by TEK-3 and TEK-6.

$$BE = BE_{heat,\ TEK\text{-}3} + BE_{el.,\ TEK\text{-}3} + BE_{heat,\ TEK\text{-}6} + BE_{el.,\ TEK\text{-}6}$$

where:

$BE_{heat,\ TEK\text{-}3}$ – baseline emissions due to heat energy generation using natural gas fired boilers under the baseline scenario in the amount which will be substituted with heat energy generated by TEK-3 under the project scenario.

$BE_{el.,\ TEK\text{-}3}$ – baseline emissions due to electricity generation by power plants of the national grid under the baseline scenario in the amount which will be substituted with electricity generated by TEK-3 under the project scenario.

$BE_{heat,\ TEK\text{-}6}$ – baseline emissions due to heat energy generation using natural gas fired boilers under the baseline scenario in the amount which will be substituted with heat energy generated by TEK-6 under the project scenario.

$BE_{el.,\ TEK\text{-}6}$ – emissions due to electricity generation by power plants of the national grid under the baseline scenario in the amount which will be substituted with electricity generated by TEK-6 under the project scenario.

$$BE_{heat,\ TEK\text{-}3} = (HG_{TEK\text{-}3} \cdot EF_{CO2,\ NG} \cdot 10^{-3}) / \eta$$

$HG_{TEK\text{-}3}$ - amount of heat energy generated by TEK-3 during the year y, GJ. Parameter is monitored throughout the crediting period.

$EF_{CO2, NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng\ combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

$\acute{\eta}$ – *average* efficiency of natural gas fired boilers under the baseline scenario estimated according to operational tests of the boilers indicated in parameter charts of the boiler installed at boiler room #2 of JSC 'Motor Sich'. Parameter is not monitored throughout the crediting period. According to parameter charts of the boilers the average efficiency of installed boilers $\acute{\eta}_{boilers}$ = *92%.*

$$BE_{el., TEK-3} = (EG_{TEK-3, own\ needs} \cdot EF_{CO2, national\ grid\ red.}) + (EG_{TEK-3, grid} \cdot EF_{CO2, national\ grid\ prod.})$$

$EG_{TEK-3, own\ needs} = EG_{TEK-3, net} - EG_{TEK-3, grid}$. Electricity export to the national grid is assumed to be equal zero. The project owner could analyse and consider the option of exporting generated electricity to the national grid in the future, but currently generated electricity is planned to be used for covering power demand of the Enterprise substituting electricity from national grid. Thus, baseline emissions due to electricity generation by power plants of the national grid are calculated using the following formula:

$$BE_{el., TEK-3} = (EG_{TEK-3, net} \cdot EF_{CO2, national\ grid\ red.})$$

$EG_{TEK-3, own\ needs}$ - amount of electricity generated by TEK-3 and used for own needs of the Enterprise during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK-3, grid}$ - amount of electricity generated by TEK-3 and exported to the national grid during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK-3, net}$ – amount of electricity generated by TEK-3 during the year y, MWh (net quantity – total electricity generation minus electricity consumption for own needs of TEK-3). Parameter is monitored throughout the crediting period.

$EF_{CO2, national\ grid\ red.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects reducing power consumption from power grid is the following $EF_{CO2, national\ grid\ prod.}$ = 0.896 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$EF_{CO2, national\ grid, prod.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects producing electricity to the power grid is the following $EF_{CO2, national\ grid, prod.}$ = 0.807 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$$BE_{heat, TEK-6} = (HG_{TEK-6} \cdot EF_{CO2, NG} \cdot 10^{-3}) / \acute{\eta}$$

HG_{TEK-6} - amount of heat energy generated by TEK-6 during the year y, GJ. Parameter is monitored throughout the crediting period.

$EF_{CO2, NG}$ is the emission factor for natural gas, kg CO_2/GJ. According to the data of IPCC, and with allowance for full oxidation of carbon fraction this factor is assumed constant and equal to $EF_{CO2\ ng}$

$_{combustion}$ = *56.1 kg CO_2/GJ* (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions). Parameter is not monitored throughout the crediting period.

$\acute{\eta}$ – average efficiency of natural gas fired boilers under the baseline scenario estimated according to operational tests of the boilers indicated in parameter charts of the boiler installed at boiler room #2 of JSC 'Motor Sich'. Parameter is not monitored throughout the crediting period. According to parameter charts of the boilers the average efficiency of installed boilers $\acute{\eta}_{boilers}$ = *92%.*

$$BE_{el.,\ TEK\text{-}6} = (EG_{TEK\text{-}6,\ own\ needs} \cdot EF_{CO2,\ national\ grid\ red.}) + (EG_{TEK\text{-}6,\ grid} \cdot EF_{CO2,\ national\ grid\ prod.})$$

$EG_{TEK\text{-}6,\ own\ needs} = EG_{TEK\text{-}6,\ net} - EG_{TEK\text{-}6,\ grid}$. Electricity export to the national grid is assumed to be equal to zero. The project owner could analyse and consider the option of exporting generated electricity to the national grid in the future, but currently generated electricity is planned to be used for covering power demand of the Enterprise substituting electricity from national grid. Thus, baseline emissions due to electricity generation by power plants of the national grid are calculated using the following formula:

$$BE_{el.,\ TEK\text{-}6} = (EG_{TEK\text{-}6,\ net} \cdot EF_{CO2,\ national\ grid\ red.})$$

$EG_{TEK\text{-}6,\ own\ needs}$ - amount of electricity generated by TEK-6 and used for own needs of the Enterprise during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK\text{-}6,\ grid}$ - amount of electricity generated by TEK-6 and exported to the national grid during the year y, MWh. Parameter is monitored throughout the crediting period.

$EG_{TEK\text{-}6,\ net}$ – amount of electricity generated by TEK-6 during the year y, MWh (net quantity – total electricity generation minus electricity consumption for own needs of TEK-6). Parameter is monitored throughout the crediting period.

$EF_{CO2,\ national\ grid\ red.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects reducing power consumption from power grid is the following $EF_{CO2,\ national\ grid\ prod.}$ = 0.896 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

$EF_{CO2,\ national\ grid,\ prod.}$ – Emission factor for electricity of Ukrainian grid, tonnes CO_{2e}/MWh; According to "Ukraine - Assessment of new calculation of CEF" by TUV SUD Industrie Service GmbH (17.08.2007) emission factor for Ukrainian electricity grid for joint implementation projects producing electricity to the power grid is the following $EF_{CO2,\ national\ grid,\ prod.}$ = 0.807 tonnes CO_{2e}/MWh (See Annex 2). Parameter is not monitored throughout the crediting period and is assumed constant for the period 2010-2012.

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

Reductions of anthropogenic emissions by sources of greenhouse gases (GHGs) generated by joint implementation (JI) projects are estimated/calculated by comparing the quantified anthropogenic emissions by sources within the project boundary in the baseline scenario with those in the project scenario and adjusting for leakage.

GHG emission reductions are estimated as a difference between emission amounts in baseline and project scenarios by means of the following formula:

$$E_r = \sum(BE_y - PE_y)$$

where E_r – GHG emission reduction units delivered by project activity, tonnes CO_{2e};

BE_y – greenhouse gases emissions in baseline scenario for the year y, tonnes CO_{2e};

PE_y – greenhouse gases emissions in project scenario for the year, tonnes CO_{2e};

Year	2010	2011	2012	2010-2012
Total GHG emissions reductions, tonnes $CO_{2\,e}$	5059	40671	40671	86401

Thus, total greenhouse gases emission reductions as a result of joint implementation project realization within the defined project boundaries during the first crediting period 2010-2012 will be 86 401 tonnes CO_{2e}.

Total greenhouse gases emission reductions as a result of joint implementation project realization within the defined project boundaries during the period 2013-2020 will be 325 368 tonnes CO_{2e}.

Year	GHG emissions reductions, tonnes $CO_{2\,e}$
2013	40671
2014	40671
2015	40671
2016	40671
2017	40671
2018	40671
2019	40671
2020	40671
Total expected GHG emissions reductions for the period 2013-2020, tonnes $CO_{2\,e}$	325 368

Total greenhouse gases emission reductions as a result of joint implementation project realization within the defined project boundaries during the period 2010-2020 will be 411 769 tonnes CO_{2e}.

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

GHG emissions reduction for each year of first crediting period (2010-2012) and for the expected second crediting period (2013-2020) as well as total amount for the period 2010-2020 presented in the table:

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)
2010	15057	-	20116	5059
2011	51502	-	92173	40671
2012	51502	-	92173	40671
Subtotal over the period 2010-2012	118061	-	204462	86401
2013	51502	-	92173	40671
2014	51502	-	92173	40671
2015	51502	-	92173	40671

2016	51502	-	92173	40671
2017	51502	-	92173	40671
2018	51502	-	92173	40671
2019	51502	-	92173	40671
2020	51502	-	92173	40671
Subtotal over the period 2013-2020	412 016	-	737 384	325 368
Total over the period 2009-2020	530 077	-	941 846	411 769

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:

Power production has local impact on environment. In accordance to Ukrainian legislation, an Environmental Impact Assessment (EIA), as a part of the project design documents, has been completed for the proposed project and approved by local authority. The Ministry of Environmental protection of Ukraine has also issued a positive conclusion of state environmental impact audit

The requirements of the following regulations were met during the project design development:

- Law of Ukraine 'On atmospheric air protection',
- State construction norms A.2.2-3-97 'The scope, the order of development, endorsement and approval of project documentation for construction',
- State construction norms A.2.2-1-95 'Designing. The structure and content of environmental impact assessment (EIA) materials for designing and construction of plants, buildings, houses and structures. Basic concepts of designing'.
- State sanitary rules on planning and development of residential places, approved by Ministry of Health Protection of Ukraine by Order #173 from 19.06.96,
- Sanitary Regulations and Norms 4946-89 Sanitary regulations on atmospheric air protection.

The Ministry of Environmental protection of Ukraine has issued an Allowance for emissions of polluting substances into the atmospheric air by stationary sources at 26.12.2007, which will remain valid till 25.12.2012.

Implementation of the project will have straight positive environmental effects in local and global scopes due to more efficient fossil fuel consumption and greenhouse gases emission reductions. Modern natural gas fired cogeneration technology will be employed within the project and the produced power will substitute electricity from national grid (which have high carbon emission factor) and, in addition, produced heat will particular substitute heat energy currently being produced by natural gas-fired boilers.

Local air pollution could be slightly increased within project boundary due to larger natural gas consumption by cogeneration equipment in comparison with the amount of natural gas needed for production of the same amount of heat energy by boilers, but assuming the effect of air emission reductions due to substitution of electricity from national grid, we can conclude positive trend. Expected concentrations of pollutants will be in compliance with the requirements of the plant's operational license and local environmental regulations. Additionally to greenhouse gases emissions, the substitution of electricity from national grid will lead to nitrous and sulphur oxide emission reductions.

The waste heat produced during electricity generation process will be utilised by exhaust boilers to produce heat power. All equipment has appropriate isolation in accordance to the technical requirements and state standards, which helps avoiding other harmful impacts like noise and vibration. The level of noise at the distance of about 2 meters from the cogeneration unit will not exceed regulated value for industrial facilities.

The project does not have transboundary environmental impact.

The social impact of the project is positive. The new cogeneration facility will contribute to improvement of heat energy reliability for the residential sector, which is an issue of current importance in Ukraine. Also we should admit that implementation of the project will bring new working places at the Enterprise.

The construction of the cogeneration units will not have negative impact on the living conditions of nearby residential sectors.

Assuming reasons described above, we can determine influence of implementation of project activity as positive and in accordance to current legislation.

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

Total environmental impacts of project scenario in comparison with baseline scenario will be positive.

SECTION G. Stakeholders' comments

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

Ukrainian legislation on conducting the environmental impact assessment stipulates that for every EIA, a public stakeholder consultation process, during which the affected public is informed of the proposed and invited to provide comments.

No negative comments were received.

The realisation of the project has been supported by local authorities and Zaporizhzhya regional state administration issued to JSC 'Motor Sich' a Letter of award for the best energy saving project in Zaporizhzhya region in 2009.

No stakeholder consultation process for the JI projects is required by the Host Party. Stakeholder comments will be collected during the time of this PDD publication during the determination procedure.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Motor Sich JSC
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State/Region:	Zaporizhzhya
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URL:	http://www.motorsich.com/
Represented by:	
Title:	
Salutation:	Mr.
Last name:	Semenov
Middle name:	
First name:	Volodymyr
Department:	
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Annex 2

Carbon emission factor for Ukrainian national electricity grid

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Choose certainty.
Add value.

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

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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

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ANNEX 1 – Calculated emission factors

Weigthed average Simple OM 2003 - 2005

	El. Production MWh	CO2 emissions tCO2	Technical Losses %	Producing tCO2/MWh	Reducing tCO2/MWh
2003	98.214.112	80.846	14,2		
2004	94.330.765	74.518	13,4		
2005	96.526.887	78.203	13,1		
Total	**289.071.764**	**233.567**	**10%**	**0,807**	**0,896**
			Other baselines		
			ERUPT 2006	0,725	0,876
			ERUPT 2012	0,636	0,756
			UA Hydro project	0,915	