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

CONTENTS

SECTION A. General description of the project

A.1. Title of the project:

Title of the project:
Reconstruction of the electrical and heating systems in Kyiv

Version of the document: 02

Date of the document: 13/11/2012

Sectoral scope(s):

Codes	Sectors
2	Energy distribution
3	Energy demand
10	Fugitive emissions from fuels (solid, oil and gas)

A.2. Description of the project:

The main objective of the project "Reconstruction of electrical and heating systems in Kyiv", which is implemented by PJSC "KYIVENERGO is to reduce greenhouse gas emissions by reducing fossil fuel and electricity consumption and reduction of heat and electric energy looses, increasing of equipment and systems efficiency in general.

Sub-project 1. Reconstruction and modernization HPP-5 and HPP-6
The project main goal is to improve the reliability and efficiency of installed equipment. Increasing efficiency will reduce the specific fuel consumption, which in turn lead to reduce greenhouse gas emissions per unit of output.
The current situation prior to the project
Described as baseline scenario.
Baseline scenario
The common practice for heating and electricity supply companies in Ukraine, including heat and heat and power plant that implementing the project is fulfils annual minimal repairing of boilers and to keep it working. Continuation of this situation is the baseline. Tariffs for heat and electricity do not include the resources for prospective rehabilitation of the supply system, only the resources for probable necessary repairing after possible accidents. Minimal annual repairing doesn't lead to drooping of baseline emissions because of degradation of the whole system with efficiency droop at other objects, the overall actual emissions of Supplier would stay on the same level.
Project scenario
Implementation of the proposed project activity will allow generate electricity and heat more efficiently, thereby significantly reducing the amount of fossil fuel combustion in comparison with the absence of the project.
The proposed project is intended to modernise of all for units at the HPP in order to:

- Improve energy efficiency and reduce auxiliary equipment consumption;
- improve stability and reliability of generation and transmission of electricity and heat power;

- Improve efficiency;
- Introduce modern control systems.

Sub-project 2. Rehabilitation of the District Heating System

Project objective is to reduce greenhouse gas emissions due to fuel, in particular natural gas (which is imported to Ukraine) consumption reduction, as well as power consumption reduction, by means of rehabilitation of the district heating system in Kyiv City, including boiler-houses and distribution network equipment replacement and rehabilitation.

Situation existing prior to the starting date of the project

Described as baseline scenario.

Baseline scenario

The base scenario supposes to fulfill annual minimal repairing of the DH system to keep it working. Particularly it executes repairing of network's parts and boilers that might cause accidents. Minimal annual repairing doesn't lead to drooping of baseline emissions because of degradation of the whole system with efficiency droop at other objects, the overall actual emissions of Supplier would stay on the same level. This base scenario is the same scenario which was before project implementation, with minimal volume of system repairing just to maintain its working.

Project scenario

The project employs the reconstruction of central heating supply system which includes replacement and reconstruction of old boilers and distribution networks, frequency controllers, replacement of heat exchanger, implementation of frequency controllers, transition from the existing CHSS to IHSS.

Project provides increase of fuel and electricity consumption efficiency to reduce greenhouse gas emissions relative to current practice.

The following activities will ensure fuel saving:

1. Replacement of old boilers by the new highly efficient boilers;
2. Rehabilitation of boilers with increasing of their efficiency;
3. Switching of load from boiler-houses with obsolete equipment to modern equipped boiler houses;
4. Burners replacement;
5. Installation of heat utilizers;
6. Application of the pre-insulated pipes;
7. Etc.

Sub-project 3. Reduction of Electricity Technical Losses in the KYIVENERGO PJSC grid

The Project main goal is reduction of greenhouse emissions due to the realization of the programme of technical reconstruction of electrical network and equipment, introduction of the progressive technologies, organization structure improvement, and transition to the higher organizational level of electricity grid transmission and distribution.

The current situation prior to the project

Described as baseline scenario.

Baseline scenario.

By the beginning of the Project KYIVENERGO PJSC had only carried out measures aimed at maintaining electrical grids in operational state. In most cases, these measures included repairs intended to correct defects arising during the operation of the electrical grids. The baseline scenario assumes the continued use of existing equipment with doing routine repair work without significant investment. Loss of electricity in networks would remain constant, leading to emission of greenhouse gases from burning fossil fuels for electricity generation plants at a basic level.

Project Scenario

The basis of the Project is the introduction of new energy-efficient equipment and activities:

- organizational and technical measures;
- technical measures that aim to eliminate energy losses when transporting electricity via distribution grids.

Measures to be implemented under the project, as well as application and implementation of ongoing monitoring of possible sources of loss and preventing from their occurrence would significantly reduce energy losses in the electrical grids of KYIVENERGO PJSC.

Historical details of the development of the JI project

The project "Reconstruction of electrical and heating systems in Kyiv" was initiated in 2003.
03/01/2004 – date when KYIVENERGO PJSC started implementation of project measures in introducing of modernization of technological equipment and improvement of its efficiency, reliability and safety rates in accordance with own energy saving program.
26/06/2012 – Project design document development for the project activities.
20/09/2012 – The State Environmental Investment Agency of Ukraine issued a Letter of Endorsement # 2682/23/7.
Implementation of the project will provide substantial economic, environmental, and social benefits to the plant. Social impact of the project is positive since after project implementation the heat and hot water supply service will be improved.

Environmental impact of the project is expected to be very positive as emission of the exhaust gases such as CO_2, NO_x, and CO will be reduced. Also due to better after-implementation service, some part of population will cease to use electric heaters thus reducing electricity consumption, which is related to heat and power plants emissions of CO_2, SO_x, NO_x, CO and particulate matter.

KYIVENERGO purchases all the necessary inputs, including fuel, electricity, water, etc, it has the primary interest in the reduction of specific fuel consumption that can be achieved by the implementation of the project.

A.3. Project participants:

PARTY involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	KYIVENERGO PJSC	No
Netherlands	OHANA LLP	No

KYIVENERGO PUBLIC JOINT STOCK COMPANY (KYIVENERGO PJSC), EDRPOU code 00131305, certificate about state registration A01 №769840 issued by Pechersk state district administration in Kyiv 12/04/2003, is an integral part of a unified energy system of Ukraine and provides uninterrupted and reliable supply of electricity to consumers in Kyiv.

KVED types of economic activities:

40.11.0 Electricity production
40.30.0 Supply steam and hot water
40.13.0 Distribution and supply of electricity

The Company is a legal entity with a new name, as a result of the state registration of amendments to the Charter relating to entry into force of the Law of Ukraine "About Joint-Stock Companies» № 514-VI dated September 17, 2008 and change of the name from STOCK POWER SUPPLY COMPANY "KYIVENERGO" to KYIVENERGO PUBLIC JOINT STOCK COMPANY.

KYIVENERGO STOCK Power Supply Company was created by virtue of Order of the Ministry of Energy of Ukraine No. 177 dated August 31, 1995 (legal successor of the Ministry of Energy and Coal Industry of Ukraine) through the transformation energy production association "KYIVENERGO" into a stock company under the Decree of President of Ukraine dated April 4, 1995 № 282/95 "About the restructuring in the electricity sector of Ukraine."

Stock power supply company “KYIVENERGO” is the legal successor of State Joint Stock power supply company “KYIVENERGO” and energy production association “KYIVENERGO” concerning property, rights and liabilities of separate units and management associations, which are located in Kiev City and on which it founded under delivery and acceptance certificates approved by the Ministry of Power of Ukraine June 26, 1995.

1. Full name of the company:

- In Ukrainian - ПУБЛІЧНЕ АКЦІОНЕРНЕ ТОВАРИСТВО «КИЇВЕНЕРГО»;
- In Russian - ПУБЛИЧНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО «КИЕВЭНЕРГО».
- In English - PUBLIC JOINT-STOCK COMPANY «KYIVENERGO»;

2. The short name of the Company

- In Ukrainian language - ПАТ «КИЇВЕНЕРГО»;
- In Russian - ПАО «КИЕВЭНЕРГО»;
- In English - PJSC «KYIVENERGO».

PJSC "KYIVENERGO" - a company which implements this project (Project owner, supplier). It operates equipment for the production and distribution of heat and electricity in Kiev. Since it PJSC "KYIVENERGO" pays for the necessary energy and raw materials (fuel, electricity, water, etc.), it is most interested party in reducing the specific fuel consumption as a result of project implementation.
PJSC "KYIVENERGO" - a unique company that provides capital of Ukraine with electric and heat energy, combining the processes of production, transport and distribution of energy resources. For specifics and scope of activity of PJSC "KYIVENERGO" unparalleled in Eastern Europe.
Today KYIVENERGO - is 13 branches that provide Kiev with light, hot water and heat, and the single in Kiev Energia combustion plant. The number of employees of the Company is more than 13,500 people. Energy sources and an extensive network of pipelines, cables, aerial lines allows this energy company fully meet the needs of Kyiv in the electrical and 85% in heat energy.

Branch "Heat and Power Plant #5 KYIVENERGO" KYIVENERGO Public Joint Stock Company - the largest to date power plants of Ukraine, designed for centralized heat supply of industrial, residential and administrative buildings in Kyiv while supplying electricity to the grid.

Branch "Heat and Power Plant #6 KYIVENERGO" KYIVENERGO Public Joint Stock Company - the youngest power plant in Ukraine. The company produces heat and electricity for consumers mainly for Obolonsky, Desnyanskiy, Dniprovsky, Podol, Shevchenko districts of Kyiv.

Branch "Cable Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company. The main focus of the branch is to provide ever-increasing needs of the capital of Ukraine in quality and reliable electricity supply.

Branch "Heat Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company. Area of Responsibility of Branch - production and distribution of heat energy by pipelines from heat sources (heating plants and district boilers) to the distribution networks.

Branch "Heat Distribution Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company (previously - "Teplovi Rozpodilchi Merezhi") provides transportation and distribution of theat energy from the heating units to consumers through heat networks, central heating (CH) and domestic hot water supply (DHW), provides increased pressure of cold water using pumping stations.

Branch "Zhytloteploenergo KYIVENERGO" KYIVENERGO Public Joint Stock Company produces and transport heat energy by pipelines from heat sources (boiler). From branch depends district heating of 2716 objects in Kyiv. Among them - 1674 residential houses, 65 schools, 88 kindergartens, 55 hospitals. PJSC "KYIVENERGO" is project host.

A.4. Technical description of the project:

A.4.1. Location of the project:

The Project is located in Kyiv City in the north central part of the of Ukraine.

A.4.1.1. Host Party(ies):

Ukraine

The project is located on the territory of Ukraine (see fig.1).

Ukraine is an Eastern European country that ratified the Kyoto Protocol to UN FCCC on February 4th, 2004, enters into the list of the countries of the Annex 1 and is eligible for the Joint Implementation projects.

Fig.1 The map of Ukraine with neighboring countries

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

Kyiv Region

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

The city is located in northern Ukraine, on the border Polissya and forest steppe on both coast of the Dnieper River in its middle reaches. The territory of Kyiv City is 836 km2. Length along the coast - more than 20 miles. As for 2012 is the largest city in Ukraine and the seventh largest population in Europe. As of January 1, 2012 in Kiev lived 2814258 persons. However, Kyiv suburbs form agglomeration with a combined population of about 4 million inhabitants.

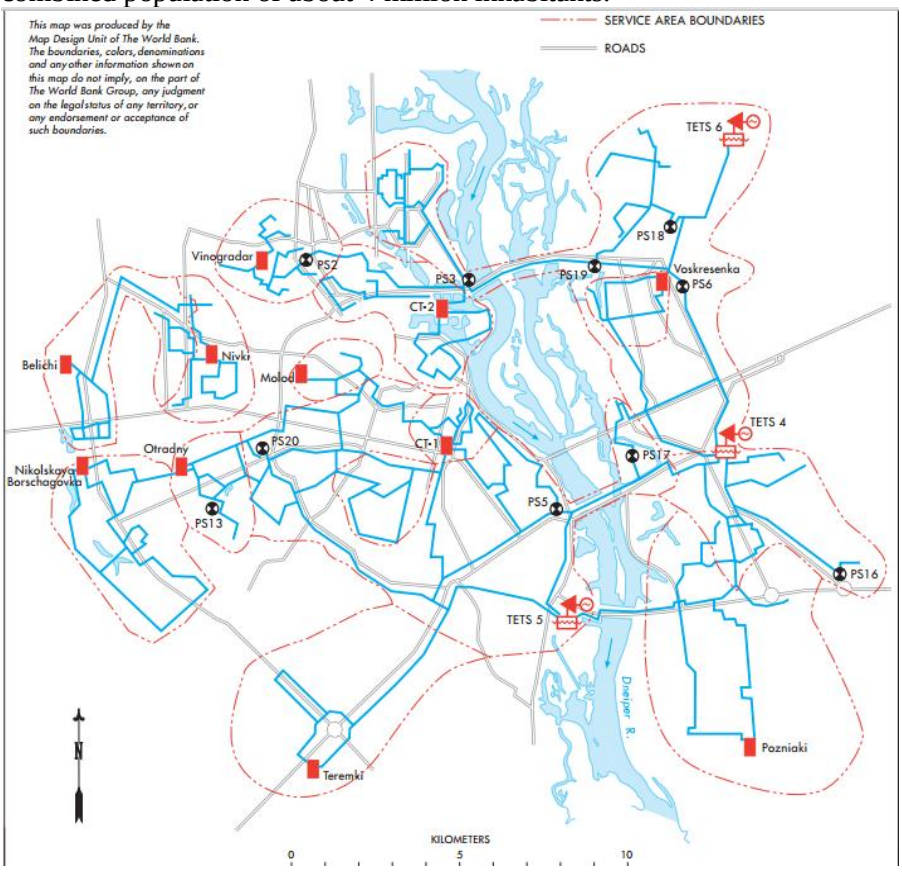

Fig.2 The map of the Kyiv city with main objects.

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

All project objects are located in the Kyiv city. It is located in the following geographical coordinates 50° 27′ 0″ N, 30° 31′ 25″ E[1].

Kiev has a humid continental climate with mild winter and warm summer[2]. The average temperatures is +7.7°C, the lowest in January – (-5.6°C), the heist in July – (+19.3°C).

The project boundaries include:

- Branch "Heat and Power Plant #5 KYIVENERGO" KYIVENERGO Public Joint Stock Company - heat and electricity production.

Location: Kyiv, Holosiivskyi district, 4 Promyslova st.;

[1] http://toolserver.org/~geohack/geohack.php?language=uk&pagename=%D0%9A%D0%B8%D1%97%D0%B2&params=50.45000001_N_30.523611121111_E_scale:100000

[2] http://www.meteoprog.ua/ua/climate/Kyiv/

- Branch "Heat and Power Plant #6 KYIVENERGO" KYIVENERGO Public Joint Stock Company - heat and electricity production.

Location: Kyiv, Desnyanskyi district, 1A Puhivska st.;

- Branch "Heat Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company - production, transportation and distribution of heat energy to the final consumer.

Location: Kyiv, Holosiivskyi district, 29 Gorkogo st.;

- Branch "Zhytloteploenergo KYIVENERGO" KYIVENERGO Public Joint Stock Company - production, transportation and distribution of heat energy to the final consumer.

Location: Kyiv, Shevchenkivskyi district, 2 Dovzhenko st.;

- Branch "Heat Distribution Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company - production, transportation and distribution of heat energy to the final consumer.

Location: Kyiv Holosiivskyi district 82H Volodymirska st.

- Branch "Cable Networks KYIVENERGO" KYIVENERGO Public Joint Stock Company - transportation and distribution of electricity to the final consumer.

Location: Kyiv, Obolonskyi district, 20 Novokonstantinovskaya st.;

Branches and separated structural units of the Company (KYIVENERGO PJSC) are not a separate legal entities and act on the basis of relevant provisions.

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

Sub-project 1

Technical Specifications of HPP-5

The installed electrical capacity of HPP-5 is 700 MW, installed heat capacity - 1874 Gcal / h. In HPP-5 are 4 power blocks, and 5 hot-water boilers.

Power blocks number 1 and number 2 are equipped with boilers TGM-96A, turbines T-100-130, turbine generators TVF-120-2, and blocking transformers. Power units № № 3,4 consist of boilers THMP-314 A, T-250/300-240 turbines, turbogenerators TIA-320-2, block transformers.

Water boilers stations like PTVM-180 c. Number 1, 2, 3, KVGM-180 c. Number 4, 5 with heat productivity 180 Gcal / h. for each.

Transmission of electricity from HPP-5 is carried air transmission lines. In particular, the tires 330 kV are connected line 2, to tires 110 kV - 8 lines and 35 kV - 10 lines, 10 kV - 27 lines.

Heat from HPP-5 released by six heat networks of diameter pipelines 900-1200 mm. Fuel system water in the heating period is about 31 000 cubic meters / h.

Fig.3 HPP-5

Technical Specifications of HPP-6

Installed power capacity HPP-6 is 500 MW, and installed heat capacity - 1740 Gcal / h. The structure of main energy equipment includes: - 2 direct-flow power blocks for supercritical steam parameters of 250 MW capacity (2 Boilers type TGMP-344A 1000 t / h steam output, 2 steam turbines type T 250/300-240 and 2 generators type TVV -320-2) - 6 peak boilers type KVGM-180 180 Gcal / h heat capacity. Supply electricity from HPP is carried out by air electrical lines: voltage 330 kV - 1 line - voltage 110 kV - 6 lines (including 4 transit lines) .Heat energy is carry out 4 pipelines with diameters of 1000 mm.

Fig.4 HPP-6

All equipment installed and used in the project activity for heat and electricity generation and transportation them to the consumer:

№	HPPs equipment	Installed capacity, MW (Gcal/h)
HPP-5		
1	TGM-96A	284
2	TGM-96A	284
3	TGMP-314A	624
4	TGMP-314A	624
5	T-100-130	100 (160)
6	T-100-130	100 (160)
7	T-250/300-240	250 (324)
8	T-250/300-240	250 (330)
9	TVF-120-2	120
10	TVF-120-2	120
11	TVV-320-2	320
12	TVV-320-2	320
13	PTVM-180	180
14	PTVM-180	180

15	PTVM-180	180
16	KVGM-180	180
17	KVGM-180	180
HPP-6		
1	TGMP-344A	635
2	TGMP-344A	635
3	T-250/300-240	250 (330)
4	T-250/300-240	250 (330)
5	TVV-320-2	320
6	TVV-320-2	320
7	KVGM-180	180
8	KVGM-180	180
9	KVGM-180	180
10	KVGM-180	180
11	KVGM-180	180
12	Firm Alstom	180
13	DE-25-14	12,5
14	DE-25-14	12,5
15	GM-50-14	25
16	GM-50-14	25

Table.1 HPPs equipment

Key measures under the project activities aimed at reducing GHG emissions into the atmosphere by the Sub-project 1 are:

1. the preparations for the rehabilitation, including repairs, servicing, optimisation of the regimes and the fuel preparation;
2. the rehabilitation of the turbine equipment to restore its initial efficiency and modernize its command & control system;
3. the improvement of the designed parameters of the turbine equipment;
4. the rehabilitation (reconstruction) of the boiler;
5. the reconstruction (change) of the control system of the of the Unit;
6. the reconstruction of the generator and it's cooling system;
7. the rehabilitation (reconstruction) of the electric filters with the change of the electric and control systems;
8. the rehabilitation of the feed-pump;
9. the rehabilitation (reconstruction) of the electric equipment of the Unit (including unit transformer).
10. the Project consists not only of the reconstruction and the rehabilitation measures. The unscheduled maintenance within the current, medium or a major repairs is also should be taken into account. The mandatory list of the measures within the repairs is given in the GKD 34.20.661-2003 "The Rules for the Organization of the Power Plants and the Networks Equipment, Buildings and Constructions Servicing and Repairs" approved by the Ministry of the Fuel and Energy of Ukraine in 2004. The measures outside the list should be taken into account when calculating the Project, Baseline Emission and the Emission Reductions.

Sub-project 2

Technical Specifications of district heating system

District Heating System PJSC "KYIVENERGO" is formed by the three branches: Branch "Heat Networks KYIVENERGO", Branch "Heat Distribution Networks KYIVENERGO" and Branch "Zhytloteploenergo KYIVENERGO".

	Length of heating lines by 2-pine system for heating	Length of heating lines by 2-pine system for hot water supply	Number of heat sources (boiler house)	Number of boilers in operation	Heat supply systems		Boiler points
					CHSS	IHSS	
"Heat Networks KYIVENERGO"	928.4 km		12	58			
"Heat Distribution Networks KYIVENERGO"	577 km	385 km			1069	1032	
"Zhytloteploenergo KYIVENERGO"	315 km	77,3 km	173	631			250
Total	1820.4 km	462,3 km	185	689	1069	1032	250

Table.2 District heating system equipment

Key measures under the project activities aimed at reducing GHG emissions into the atmosphere by the Sub-project 2 are:

- Old operating boilers with low efficiency will be replaced by the new highly efficient ones that will result in efficiency increase from 56-82% up to 90-93%. Technical characteristic of new boilers scheduled to be installed are presented at the producer's websites that are listed in table below.

Type of boiler	**Website of boiler producer**
TVG	www.tekom.com.ua/kotel/tva.html
KVG	www.mktes.ru/cataloaue/Droduct 220
KVGM	www.pskovkotel.ru/catalog.html
Viessmann	viessmann-ua.com
LOOS	www.loos-int.com/loos/default.asp
Riello	www.riello.su
KSVa	www.tekom.com.ua/kotel/vk.html
KOLVI	www.kolvi.com/index.DhD?oDtion=com content&task=bloacateaory&id=
	11&Itemid=105
KVT	www.ukrbbs.com/kotly niistu 5 i kvt 581355469.html
REX	www.termosystems.ru/catalos/boilers/ici caldaie/rex/
Super Rac	www.ookk.ru/cataloe/detail.php?ID=1578
BGV	www.termo.ua/index.php?option=com content&view=article&id=80&I
	temid=170
Bernar module	www.ukrinterm.com.ua/goods/price.html
Sunier duval	www.saunierduval.ua

VPR	www.teplotrade.com.ua/catalog/397.html
E-1	www.tekom.com.ua/kotel/e-details
Protherm	www.protherm.com.ua/?a=cataloa&item=73&cataloa id=9
Steam generator	www.certuss.de/index.php?id=19&L=1

Table.3 Boilers producer's web sites

Fig.5 Boiler VK-21 with efficiency 92%.

- Rehabilitation of obsolete but able to work boilers with using various technologies, including rehabilitation of screen tubes, burners and control automatic equipment replacement, etc., will lead to 6-9% increase in efficiency.
- Heat-recovery apparatuses (utilizers)will be installed in order to utilize and recover the exhaust gases heat. The implementation of this technology will result in increasing the fuel consumption efficiency by 6-10%.
- Switching load from the boiler houses with obsolete equipment to the boiler houses with highly effective equipment.
- The efficiency of distribution networks system will be considerably increased by:
  - decreasing pipelines length (moving heat generating source closer to consumer, etc.);
  - improving of network organization (replacing 4-pipe lines by 2-pine ones with simultaneous installation of heat exchangers directly at the consumers);
  - replacing of the main network pipes with diameter 57 mm and more by the pre-insulated ones, including produced by "Transprogres" Ltd. (http://www.transprogress.com.ua/products.htm) and "Polimerteplo-Ukraine" Ltd. (http://polymerteplo.com.ua/).
  - decreasing of losses in pipelines (renovation of thermal insulation, packing of controlling, locking and fitting elements, etc.).

Fig.6 Pipes produced by JSC "Transprogress".

- Transition from the existing central heat supply stations (CHSS) to individual heat supply stations (IHSS) with installation of heat exchangers directly at the consumers' houses makes it possible improving service of district heating enterprise, reducing heat losses in network and power consumption for power supply of circulation pumps.
- Replacement of outdated heat exchangers to highly effective lamellar. Due to this reconstruction, it will enable to reduce heat losses and to reduce power consumption. Technical characteristic of new heat exchangers are presented on the producer's website http://teploenergo.com.ua.

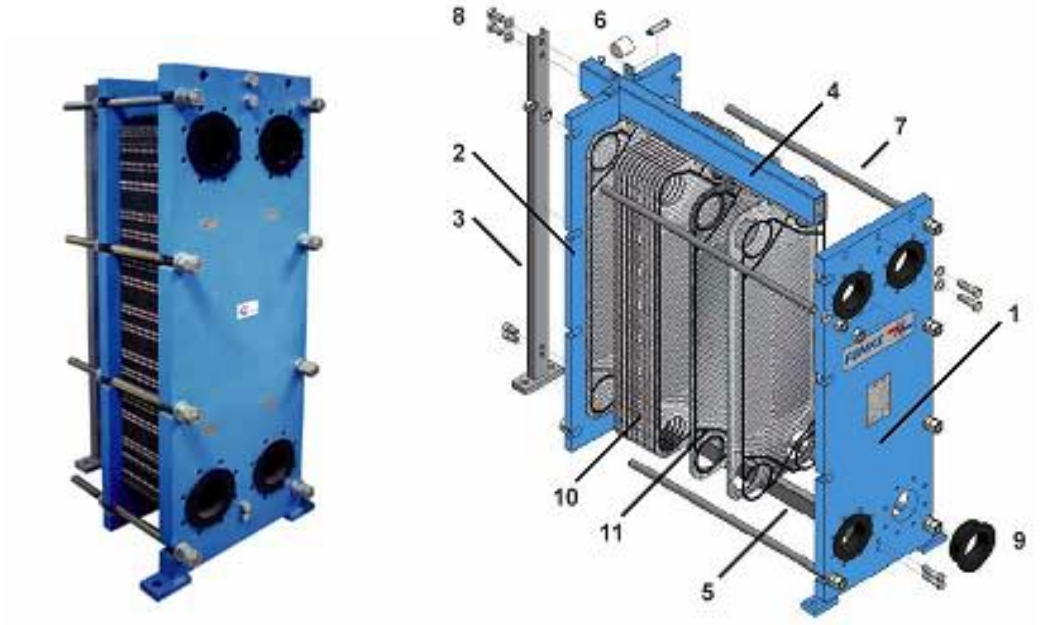

Fig.7 Heat exchangers produced by "Ukrteploenergo" corporation.

- Replacement of old pumps on modern that will significantly reduce electricity consumption for pumping coolant.

Sub-project 3

Technical Specifications of electricity supply system

Total length of cable transmission lines is 10.17 thousand km, air lines - 1.568 thousand km. The bulk of cable transmission lines are lines of distribution network of 10 kV and 0.4 kV. Among air electricity lines a significant part is high-voltage lines of 110 kV and low voltage of 0.4 kV. Transformation and control the transmission of electricity is carried out by 60 substations of 35/110 kV with total capacity of 3709 MVA and 3352 transformer substations 6/10 kV with total capacity of 2770 MVA. In the cable network installed 5561 power transformers voltage 10/110 kV and 4898 switches. The number of employees is

1433 persons. Dispatching management regime of the electricity network resources is central and five regional dispatching centers equipped with modern communications, telemechanics and computer technology.

All equipment installed and used in the project activity for electricity transportation to the consumer:

Designation	Unit	Quantity
Power grid total length, incl.:	km	11741.88
air:	km	1568.43
110 kV	km	380.14
35 kV	km	85.73
10 kV	km	63.13
500 V and less	km	1039.43
cable:	km	10173.45
110 kV	km	68.5
35 kV	km	277.85
10 kV	km	5478.52
6 kV	km	4.49
500 V and less	km	4344.09
Own transformer total capacity:	MVA	6479.09
110 kV	MVA	3062
35 kV	MVA	646.9
10 kV	MVA	2768.24
6 kV	MVA	1.95
Substation total number:	pcs	60
110 kV	pcs	39
35 kV	pcs	21
Own generating capacity	MW	1200
Total number of conventional units	pcs	93620

Table.4 The electricity supply system equipment

Key measures under the project activities aimed at reducing GHG emissions into the atmosphere by the Sub-project 3 are:

- realization of scientific and technical support, extension of the exploitation term of the functioning equipment, realization of the equipment diagnostics system and prognostication of its residual operating time;
- introduction of organizational and technical measures for technological power consumption reduction;
- reconstructions and renovations of the electric networks, and substitution of outdated equipment;
- attraction of investments for the development and achievement of high technical and economical level of the Company;

- increase of power supply reliability level for the region consumers;
- implementation of the Automatized system of commercial accounting of power consumption of the energy-supplying company perimeter, ASCAPC of consumers and substations;
- introduction of complex technical power consumption reduction Program;
- modernization of the equipment in the framework of the electric power development investment programs.

Implementation of the program is continuous process that will conduct over the operational period of the project.

The Project implementation provided the following measures:

1. Organizational and technical measures

1.1. Turning off transformers with seasonal load;
1.2. Regular monitoring and adjustment of phase loads in electrical grids;
1.3. Modernization of the program and technical measures on automatization of operational and dispatch management of operational and information complex (OIC), system of remote metering, telesignaling to the dispatch centers of the Company;
1.4. Optimization of schemes of normal mode of electrical grids operation;
1.5. Reduction of time of sub-optimal schemes operation of electricity distribution and supply by reducing the duration of repairing and restoration works;
1.6. Reduction of power consumption for subdivision's needs of the company;
1.7. Reduction of power consumption for the company's own needs;
1.8. Cleanout of lanes from underbrush and shrubs;
1.9. Other measures of reducing PLE for electricity transmission processes;

2. Technical measures:

2.1. Measurement of short circuit currents and changing inconsistent with standards switching devices and safety devices;
2.2. Bringing to standards of: contact connections, remote contact connections temperature control and insulation using thermal visions and pyrometers.
2.3. Instalation of longitudinal cross-reactive power compensation in electrical grids and reducing the higher harmonics level;
2.4. Introduction of automated systems of electricity consumption commercial records (ASECCR) in boundaries of energy supply company, ASECCR of customers and subplants;
2.5. Implementation of new energy efficiency technical equipment, a description of the main measures is provided below:

2.5.1. Installation of circuit breakers that are able to conduct, switch on and switch off the current, switchers designed for occasional switches, and also to protect cables and end-users from overloading and short circuits. Brief description of equipment is listed below, and on equipment seller's site[3].

[3] http://www.abb.ua/

Fig.8 Circuit breaker

Switchers consist of arc chutes, which are concluded in aluminum and / or steel containers. Switchers poles consist of sequentially connected compression arc chutes, spring-hydraulic drive, current transformers, constructed in factory and installed under the switcher hood and power supply terminals of the transformer control cabinet.

2.5.2. Installation of transformers, that have much lower power losses and increased efficiency as well as increased number of adjustment taps levels and control range . Specifications of transformers are listed below, and on the equipment seller's site[4].

Fig.9 Transformers

Index	*Measurement unit*	*Values*					
		3-winding			*1-winding*		
Maximum rated load current	*A*	*200*	*400*	*630*	*800*	*1200*	*1600*
Maximum rated step voltage	*V*	*4000*	*3500*	*3000*	*3000*	*2500*	*2000*
Resistance to short-circuit - *Thermal (3 sec)* - *Dynamic (peak value)*	 *kA* *kA*	 *4* *10*	 *8* *20*	 *12,6* *31,5*	 *16* *40*	 *24* *60*	 *24* *60*
Nominal switching capacity	*kV*A*	*800*	*1400*	*1890*	*2000*	*3000*	*3200*
Mechanical endurance / number of switching		*10^6*					
Nominal frequency	*c^{-1}*	*50/60*					

[4] http://www.uer.com.ua/Default.aspx

Table.5 Technical characteristics of transformers

Transformers are designed for electricity transformation in power networks and for supplying electricity to different consumers in AC networks.

The transformers are able to regulate voltage with a control range of 5% of nominal load. Switching the transformer to another regulation level happens in non-operating condition.
Transformers consist of active parts, coatings and a weld rectangular tank. On the cover there are inputs for high and low voltage.

2.5.3. Replacing of wires of overhead transmission lines from aluminum to steel-aluminum , steel-aluminum enforced. Specifications of overhead listed in Table 2 and on equipment seller's site[5].

Fig.10 Self-supporting insulated wire.

Nominal cross section, mm^2	Diameter mm	DC at 20oC, Ohm / km	Efforts to rupture, H, not less	Weight, kg
10	4,5	2,76630	3790	43
16	5,6	1,800934	6220	65
25	6,9	1,1759	9300	100
35	8,4	0,7897	13500	148
50	9,6	0,60298	17110	195
70	11,4	0,42859	24130	276
95	13,5	0,30599	33370	385
120	15,2	0,24917	41520	471
150	16,8	0,19919	46310	554
150	17,1	0,19798	52280	599
185	18,8	0,15701	58080	705
185	18,9	0,16218	62060	728
240	21,6	0,12060	75050	921
240	21,6	0,12428	80900	952
240	22,4	0,12182	98250	1106
300	24,0	0,09747	90570	1132

[5] tehtorg-sm.ru

300	24,1	0,09983	100620	1186
300	24,5	0,10226	126300	1313
500	29,4	0,06129	112550	1537
500	30,6	0,06040	148260	1852
600	33,2	0,05091	183840	2170
800	39,7	0,03586	260070	3092
1000	42,4	0,02936	224050	3210

Table.6 Technical characteristics of wires of overhead lines

2.5.4. Installation of glass and polymer insulators. Specifications of insulators are listed below, and on the equipment seller's site.

Fig.11 Glass insulator [6]

Fig.12 Polymer insulator [7]

The main specifications of polymer insulators:
Rated voltage of contact system, 27.5 kV
The test voltage of industrial frequency, not less, kV
- in the dry state 200

[6] http://elfarfor.com.ua/

[7] http://izoplast.biz/izolator2.html

- in the rain 160

The level of interference at the test voltage of 30kV, max, 15 dB

Weight, not more than 2.7 kg

Materials

Insulating component is glass and plastic with ribbed protective shell of organic silicon rubber. Tops - steel, hot galvanized coating method.

2.5.5. Installing and modernization of towers of overhead power lines. Towers specifications are below, as well as on equipment seller's site[8]

Fig.13 Towers of overhead power lines

Type	Height to the bottom of crossarm, m	Weight without zinc coating, kg	Weight with zinc coating, kg
OL of 110 kV			
US110-7	10,5	7438	7729
US 110-7+5	15,5	9450	9819
US 110-7+9	19,5	11115	11550
US 110-7+14	24,5	14368	14930
US 110-8	10,5	12068	12540

Table.7 Technical characteristics of towers of overhead power lines

2.5.6. Replacement of meters with meters with a higher accuracy (meters of accuracy classes 0,2, 0,5, 1,0) the characteristics thereof is given in Table 3, the exterior appearance is shown in the Figure 9 and also on equipment seller's site[9]

[8] http://www.enzp.ru/

[9] http://www.energysave.com.ua/

Fig.14 Three-phase multi-tariff, multi-function energy meter

Accuracy class	1,0; 0,5S; 0,2S
Rated current H5 (H6)	10A (40A)
Maximum current H5 (H6)	40A (100A)
Temperature range	from -40°C to +55°C
Thresholds of sensitivity	6,25 mA
System of self-diagnostics	availabe
Integration period, min	0.25, 0.5, 1, 3, 5, 10, 30, 60
Inspection interval	6 years

Table.8 Technical characteristics of three-phase multi-tariff, multi-function energy meters

Measures	Volume
Implementation of new or reconstruction of existing air wires of electricity transmission lines, km	340
Implementation of insulators of electricity transmission lines, units	11052
Implementation of new or reconstruction of existing wires of electricity transmission cables, km	190
Introduction of new or reconstruction of existing transformers of substation, units	55
Implementation of new or reconstruction of existing switches of substation, units	301
Implementation of new or reconstruction of existing insulators of substation, units	447

Introduction of new or reconstruction of existing measurement transformers of substation, units	142
Replacement of electricity meters, units	568681

Table.9 The volume of the sub-project 3 implementation

All these measures, implementation and continuous monitoring of possible sources of energy losses and prevent possible occurrence of KYIVENERGO PJSC reduce technical electricity losses in their electrical systems.

Reduction of technological electricity consumption in the Company networks allowed reducing CO2 emissions, caused by generation of electricity that was lost.

Duration of the project is unlimited, since the measures taken to detect and remove TPC (TVE) in separate power network units and feeders, power network areas, as well as to reduce general technological power consumption in the KYIVENERGO PJSC, are a constant and continual process.

Purchase of equipment and supplies as well as carrying out of project assembly and commissioning operations are accomplished by contract organizations by tender in the order, established in Ukraine. Besides the equipment and work cost, the main criteria of equipment selection is its quality and reliability, as well as professionatism and responsiveness to ISO–9000 of executors. The equipment suppliers are national and foreign producers which have proved themselves in the power.

These technologies are already approved but some of them are not widespread. Therefore, there might be some bottlenecks, which are typical when implementing the new technologies and equipment.

Taking into account the overall economic situation, it is not likely that the project technology will be substituted with any more efficient technology in the next 20 years very low.

As to the first commitment period from 2008 to 2012, it is ensured that there is absolutely no risk that this technology will be substituted by any other technology during this time.

The program of training

As far as the main activity of KYIVENERGO PJSC will not change in course of the JI project implementation, the special technical trainings for personnel are not necessary. The technical personnel of the enterprise has sufficient knowledge and experience for implementation of the project activity and maintenance of the usual equipment.

In cases of the new (never used at this enterprise before), equipment installation, the company - producer of this equipment should provide trainings for personnel.

KYIVENERGO PJSC provides personnel retraining according to the labour protection norms. The enterprise has the Labour protection department, which is responsible for raising the level of personnel skills and trainings. KYIVENERGO PJSC has its own Training Centre. Branch "Training Center" KYIVENERGO PJSC provides training, retraining and advanced training of employees of the Company and other companies in Kyiv and energy industry.

During the development of the JI Project Developer specialists carried out a comprehensive consultation and training for involved representatives of KYIVENERGO PJSC about collecting the necessary data in accordance with the monitoring plan.

The program of maintenance service

Maintenance and operation of equipment provided by the project staff KYIVENERGO PJSC.

Name	Date of implementation									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sub-project 1										
Sub-project 2										
Sub-project 3										

Table.10 The implementation schedule

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

Sub-project 1

The proposed measures within the JI project include replacement and rehabilitation of heat and electricity producing equipment; this will increase overall energy efficiency and reduce fuel consumption for heat and electricity producing. Natural gas savings for heat and electricity producing and reduction of power consumption for the own needs after HPPs reconstraction will lead to CO_2 emissions reduction. Part of the emission reductions of the proposed JI project are based on rehabilitation of district heating system, i.e. heat supply network and its substations. In the absence of the proposed project, all equipment would operate in usual regime and emission reductions would not occur.

In March 2006 the government of Ukraine approved "The Energy strategy of Ukraine until 2030". The strategy foresees gradual increase of electricity consumption following the stable economic growth during next years. Increasing of energy efficiency from both supply and demand sides is one of the main strategy priorities. The proposed JI project corresponds with the priorities of the state energy strategy as it is expected to increase specific efficiency of heat and electric power generation at HPP.

"The Energy strategy of Ukraine until 2030" does not enforce the owners of HPPs to implement the project. This project implementation requires substantial investment that cannot be attracted by the host company. The availability of long-term project financing in Ukraine is strictly limited, loans are given by banks for a very short term and at high interest rates.

Sub-project 2

The project activities including rehabilitation of boilers, heat distribution networks will increase energy efficiency of Kyiv City DH system, thus enabling it to produce the same amount of heat energy with less fuel consumption. Reduced fuel consumption will lead to reduction of CO_2 emissions.

Ukraine has claimed district heating and municipal energy sector as a priority of the national energy-saving development. This is pointed out in the State Program for Reformation and Development of municipal economy for 2004-2010 (Law of Ukraine from 24.06.2004 № 1869-IV), The Law of Ukraine from 01.07. 1994 № 74/94-VR "On energy saving" and The Law of Ukraine from 22.12.2005 №3260-IV "On changes in The Law of Ukraine "On energy saving". The law of Ukraine "On heat energy supply" (№ 2633-IV from 02.06.2005) regulates all relations in the heat supply market. It does not considerably change the previously existing practices in the market, but stimulates the more rigid energy saving and implementation of energy-efficient technologies.

Sub-project 3

Introduction of the project will secure the reduction of greenhouse gasses emissions, due to the power production cut down in the national grid.

The list of measures aimed at reducing electricity losses in networks of KYIVENERGO PJSC given in Section A.4.2 above.

The state of the energy sector of Ukraine.

The state and tendencies of development of the energy sector of Ukraine were quite unsatisfactory. This was due to unsound principle of pricing for services ("Retail electricity tariffs for consumers"[10]) that does not ensure the development of business in power sector and inflow of investments into the sector (lack of cost-effective modernization)[11]. To improve this situation the National security and defense council of Ukraine analyzed the situation and issued the decision of June 5, 2009 "On the energy resources market development within the Energy Strategy of Ukraine till 2030"[12], in this decision it described in detail the status of the State support of the development of the electricity sector.

The introduction of a new model of the competitive electricity market in Ukraine is slower than it was provided for by the Concept of functioning and development of the wholesale electricity market of Ukraine, approved by the Cabinet of Ministers of Ukraine of November 16, 2002 # 1789, because the main efforts of the executive authorities and market players during 2003-2006, were aimed at creating certain pre-conditions stipulated by the Concept for transition to market of bilateral electricity sales contracts – ensuring of settlement payments for the consumed electricity in full, partial solution to the problem of debt, implementing appropriate information systems, accounting systems and so on.

Under the existing model the electricity market could not fully ensure effective competition among manufacturers and suppliers of electricity and formation of prices for electricity that would encourage energy companies to increase efficiency and increase investment in the energy sector. Neither existing market mechanisms, nor direct administrative measures would ensure the necessary modernization and upgrading of existing production facilities and power supply companies. A limited number of projects on upgrading and reconstruction of power plants and power grids was taken for execution. The situation is especially critical given the growth in the near future of the need for shunting facilities, lack of which threatens the safe operation of the power system of Ukraine. In recent years, the practice to solve the current economic problems by supporting certain categories of consumers and certain segments by means of the electricity industry through the mechanisms of cross-subsidies and benefits became popular. Unreasonable restraint of low tariffs for certain consumer groups, including the population, resulted in increased cross-subsidization of some consumers by consumers in other regions. In particular, the share of grant certificates in the wholesale price for electricity today is more than 25 percent and it continues to grow, that becomes an obstacle for introduction of economic instruments that would regulate power market. Introduced in connection with the Order of the Cabinet of Ministers of Ukraine of August 15, 2005 № 745 "On the transition to unified tariffs on electricity sold to consumers" and deepen cross-subsidization with subsidy certificates are the economic impediments to implementation of the new model of the electricity market. Imperfect tariff policy also leads to increases in accounts payable of power generating companies, causing their bankruptcy or non-transparent privatization. State investment programs in most cases are directed at the administrative and organizational implementations[13].

[10] http://www.nerc.gov.ua/control/uk/publish/article/main?art_id=33153&cat_id=32004

[11] http://www.er.energy.gov.ua/doc.php?p=1041

[12] http://www.rainbow.gov.ua/documents/243.html?PrintVersion

[13] http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/archive?&cat_id=33495&stind=1

As described in National Electricity Regulation Commission of Ukraine (hereinafter - NERC) Order of 03.25.2002, № 289 "On approval of the report on the activities of NERC in 2001", the main causes of increased energy losses during its transportation to consumers are: low technical condition of grids; inconformity of electrical grids with existing levels of load, inconformity of a number of parameters of electricity with applicable standards of quality, shortcomings in the existing metering of electricity supplied to the electric grid and electricity consumed. Addressing the negative effects that cause energy losses in electric grids, requires considerable investments to modernize electrical systems and change existing metering systems of electricity consumed, practical implementation of which will help reduce both process and above standard losses of electricity. Debt issues of the wholesale electricity market (WEM) subjects and issues of their imbalance arise when implementing measures on reduction of process losses of electricity.[14] There is a lack of conditions for the inflow of investments from both domestic and foreign investors.

In the absence of the proposed project, the losses in the gridss would remain constant. When satisfying the needs of consumers for electricity fossil fuels would be burned, which in turn would lead to emissions of carbon dioxide into the atmosphere. Emissions reductions would not occur.

There are several main reasons which make the implementation of the project without the mechanism of joint implementation unlikely to happen:

- No significant changes in the legislation of Ukraine in the energy sphere, which could force the company to give up the existing practices of operation, modernization and reconstruction of distribution electrical grids, are expected;
- There are no restrictions for Ukrainian enterprises regarding GHG emissions, and they are unlikely to be imposed by 2012;
- In the absence of the project additional, very risky, investments and financial risks associated with the operation of new equipment might have been avoided;
- According to Ukrainian legislation the company will not receive any financial benefits from reduced electricity losses during its transportation (more details are given in Section B2).

In the absence of the proposed project, all equipment, including old with low efficiency, but still workable for a long time will work as usual and reductions would not occur.

This project requires a substandard approach in the implementation and facing obstacles relative economic attractiveness of the project. Section B of this PDD shown that reduction will not occur if the project will be introduced.

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

	Years
Length of the crediting period	4
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2004	138196
2005	218951
2006	1163407
2007	1415939
Total estimated emission reductions for 2004-2007 period	**2936493**

[14] http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/archive?cat_id=35046

(tonnes of CO_2 equivalent)	
Annual average of estimated emission reductions for 2004-2007 period (tonnes of CO_2 equivalent)	**734123**

Table.11 Estimated amount of CO_2e Emission Reductions for 2004-2007 period

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	1552983
2009	1763080
2010	1718599
2011	1510635
2012	1571981
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**8117278**
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**1623456**

Table.12 Estimated amount of CO_2e Emission Reductions over the crediting period

	Years
Length of the crediting period	10
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	1571981
2014	1571981
2015	1571981
2016	1571981
2017	1571981
2018	1571981
2019	1571981
2020	1571981
2021	1571981
2022	1571981
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**15719810**
Annual average of estimated emission reductions after the crediting period (tonnes of CO_2 equivalent)	**1571981**

Table.13 Estimated amount of CO_2e Emission Reductions after the crediting period

Thus the estimated amount of emission reductions over the commitment period (2008-2012) is **8117278** tons of CO_2e.

Description of formulae used to estimate emission reductions is represented in section B.

A.5. Project approval by the Parties involved:

State Environmental Investment Agency of Ukraine provided Letter of Endorsement № 2682/23/7 dated 20.09.2012.

According to the national Ukrainian procedure, the LoA by Ukraine is expected after the project determination.

SECTION B. Baseline

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

In accordance with appendix B to decision 9/CMP.1 of the JI guidelines and following the guidance on criteria for baseline setting and monitoring[15] version 3. Baseline will be described in the PDD, using the step-wise approach.

Sub-project 1

Baseline emissions coming from one main source:

- Emissions from the combustion of fossil fuels for heat and electricity producing.

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

Project participants may select either:

(a) An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach); or

(b) A methodology for baseline setting and monitoring approved by the Executive Board of the clean development mechanism (CDM), including methodologies for small-scale project activities, as appropriate, in accordance with paragraph 4(a) of decision 10/CMP.1, as well as methodologies for afforestation/reforestation project activities.

For the calculation a JI specific approach (a) is applied.

JI specific approach

According to the JI guidelines:

(a) 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. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol, and anthropogenic removals by sinks, within the project boundary;

(b) A baseline shall be established:

- (i) on a project-specific basis and/or using a multi-project emission factor;
- (ii) in a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors;
- (iii) taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector;
- (iv) in such a way that emission reduction units (ERUs) cannot be earned for decreases in activity levels outside the project activity or due to force majeure;
- (v) taking account of uncertainties and using conservative assumptions;

(c) Project participants shall justify their choice of baseline.

In the proposed project CO_2 emissions to the atmosphere will be reduced through the efficiency increase of the power generation at the HPP after the optimisation of the regimes, servicing, fuel preparations,

[15] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

reconstruction of the boiler, the turbine equipment, the control and regulation system, the electro-generation and the cooling system.

The calculation of the Baseline Emissions

The proposed Approach for the emission reductions calculation uses the specific fuel rate (*SFRy*) parameter. This parameter shows the efficiency level of the fuel combustion at the HPP and, consequently, the emissions from the fuel combustion. This parameter is being calculated in the energy units and allows seeing the actual picture of the energy efficiency measures provided on the HPP. The use of the *SFR* parameter shows the real fuel efficiency of the HPP including the net caloric value of used fuel.

$SFRy = \sum(Fiy) / (4.187 * AHSy)$ **(1.1)**

where

SFRy – specific fuel rate of the HPP in period *y*, tef/GJ;
Fiy – amout of fuel *i* consumed in period *y*, tef.;
AHSy – amount of the heat output in period *y*, Gkal;
4.187 - conversion factor, GJ/Gkal.

$BEy = 29{,}3 * \Sigma (SFR_b * SFiy * OXIDi * EFi) * 4{,}187 * AHSy$ **(1.2)**

where:

BEy – Baseline emission in period *y*, tons of CO2;
SFR_b – specific fuel rate of the heat and heat and power plant in the Baseline Scenario, tef/GJ;
SFiy - share of fuel *i* (coal, natural gas or a heavy fuel oil), consumed in period *y*, ratio;
OXIDiy – oxidation factor of the fuel *i*,ratio;
EFiy - emission factor of the fuel *i* consumed, tons of CO2/GJ;
AHSy – amount of the heat output in period *y*, Gkal;
4.187 - conversion factor, GJ/Gkal.
29.3 - conversion factor, GJ/tef

The fixed value of the SFR parameter in the Baseline scenario allows taking into account the effect of the planned repairs at the HPP where the project is implemented. In the other case, the parameter would have been lowering every year due to due to physical wear of equipment.

This parameter measured in the tons of the equivalent fuel per GJ of the heat supplied. One ton of the equivalent fuel (tef) is 29.3 GJ or 7 Gkal. The calculation of the SFR shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up. The use of the SFR parameter shows the fuel efficiency of the HPP independent of the fuel quality and the net caloric value and allows comparing the fuel efficiency data of the different time periods.

The energy efficiency of the HPP has to be determined prior to the implementation of the project activity. For this purpose, the value of the SFR parameter in the baseline scenario should be calculated taking into account the value of the parameter in at least 3 (three) years prior to the project implementation.

$SFRb = \sum((Fib) / (4.187 * AHSb))$ **(1.3)**

Where:

SFRb - specific fuel rate of the heat and heat and power plant in the Baseline Scenario, tef/GJ;
Fib – amout of fuel *i* consumed in the Baseline Scenario, tef.;

AHSb– amount of the heat output of the HPP in the Baseline Scenario, Gkal;
4.187 - conversion factor, GJ/Gkal.

Step 1: Identify technically feasible baseline scenario alternatives to the project activity
Alternatives to the baseline scenario should include all technically feasible options which are realistic and credible. These options should include the JI project activity not implemented as a JI project.

Step 2: Eliminate baseline options that do not comply with legal or regulatory requirements
On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Step 3: Eliminate baseline alternatives that face barriers
If there are several potential baseline scenario candidates that do not face barriers: (1) either choose the most conservative (results in least emissions) alternative as the baseline scenario; or (2) choose the economically most attractive alternative (using Step 4).

Step 4: Identify the most economically attractive baseline scenario alternative (optional)
Determine which of the remaining project alternatives that are not prevented by any barrier is the most economically or financially attractive, and thus is the most plausible baseline scenario.

Step 2 Application of the approach chosen

Step 1: Identify technically feasible baseline scenario alternatives to the project activity
The baseline scenario alternatives should include all technically feasible options which are realistic and credible. These options should include the JI project activity not implemented as a JI project. The options are:

- Status quo

The first version of Baseline scenario is a business-as-usual scenario with minimum reconstruction works balanced by overall degradation of DH system. For this Baseline scenario there are no barriers (no investment barrier since this scenario doesn't require the attraction of additional investments, and no technological barrier since the equipment is operated by existing skilled personnel, and additional re-training is not required), and represent the common practice in Ukraine.

- Reconstruction without Joint Implementation mechanism

The second version of Baseline scenario is construction of a modern module boiler house without JI mechanism. In this case there exist both investment barrier since this scenario requires the attraction of large additional investments, and due to very large payback time and high risks it is not attractive for investments, and as well the technological barrier since operation of the new modern equipment will require additional re-training of personnel.

- Exclusion from the project any non-key type of measures:

The third version of Baseline scenario is the shortened project activity, without any of the non-key type of activity, for example, the exclusion of the modernization of existing units and the construction of an entirely new heat power plant. But it was concluded that this alternative is too costly.

Each of the above alternatives has examples that why are technically feasible.

Step 2: Exclude the basic options are not relevant legislate and regulatory requirements

According to The Laws of Ukraine "On licensing of the separate types of activity" (№ 1775-III, from June 01, 2000) and "On heat energy supply" (№ 2633-IV from 02.06.2005); Ukrainian Government Regulation "On introduction of changes to the Government Regulations №1698 from 14.11.2000 and №756 from 04.07.2001" №549 from 19.04.2006 and "On approval of the list of licensing bodies" №1698 from 14.11.2000, execution of economic activity in fields of heat energy production, distribution and supply require a license that is issued by Ministry of Housing and Municipal Economy of Ukraine.

KYIVENERGO PJSC has such licenses.

The alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to implement shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.

It should be noted that there is no local legislation regarding the time of boilers replacement and maximum lifetime permitted for boilers. It is common practice to exploit boilers which was installed in 70 th. and even 50-60th and earlier in Ukraine, if they pass the technical examination pass by the authorized body ("Derzhnagliadohoronpratsi") While specific permissions and licenses may be required, each of the options above can comply with legal and regulatory requirements. Therefore, each of these options is technically feasible and can comply with legal or regulatory requirements.

Step 3: Eliminate baseline alternatives that face prohibitive barriers

Step 3a: On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. For each of the alternatives to the situation existing prior to the implementation of the project, the barriers are listed below.

Investment barriers

Total capital investments that are required for this project is about 121.851 million euro (Operating costs are not included in the project because it is believed that they remain at the same level or even decrease due to lower costs for new equipment).

The cost of the new power generating plant with the same approximate capacity would cost around 1 000-2000 USD/kW[16] installed capacity. It means that the construction of the new HPP with the same loading capacity as HPP-5 will cost around 1-1.5 Billion USD. Even the JI registration does not allow accumulating the amount of money to build a new generation capacity.

Technological barriers

1. Not all proposed technologies are widely approved already. Qualification of operational personal for implementation of the new technologies may be not sufficient to provide proper activity implementation in time.

Most of enterprisers in Ukraine fulfill annual minimal repairing of the heating system to keep it working. Particularly they execute repairing of network's parts and boilers that might cause accidents. The most economically feasible and realistic scenario without carbon credits sales is a very slow reconstruction activity, instead of making a modernization of HPPs with reconstruction of the heating system.

[16] http://www.ecu.gov.ua/ua/press/vistup.html?_m=publications&_t=rec&id=520

Most of proposed technologies are widely used in Ukraine for the similar JI projects or regular activity. For example boilers replacement, network replacement with pre-insulated pipes, installation of frequency controllers, reconstruction of turbine and electrical equipment.

2. Risk of technological fault: the risk of fault of process / technology to local conditions is much higher than for other technologies that provide services or final products in comparison to those proposed by project activities .Efficiency of installed equipment could be lower than was claimed by producers or equipment may have substantial defects.

3. Available amount of natural gas. Last years Ukraine faced with incomplete delivery of natural gas from Russian Federation. Ukrainian Government realized attempts to decrease dependence from Russian natural gas delivery.

Organizational barriers
The management experience in implementation of JI projects is absent, including international collaboration, determination, verification, registration, monitoring of similar projects and so on.

Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity.

Step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Since the barriers identified above, directly related to investment in modernization of HPPs , in KYIVENERGO PJSC there are no barriers to the further operation of HPPs on the same level. The status quo does not face any barriers. All alternatives to the status quo face realistic and credible barriers that would prevent their implementation without registration as a JI project activity.

Therefore the continuation of the status quo is the only remaining alternative and is selected as baseline scenario. As there is only one alternative to the project scenario, step 4 is not necessary.

Step 4: Identify the most economically attractive baseline scenario alternative (optional)
Not necessary, as there is only one alternative to the project scenario after step 3.

Conclusion

In conclusion, the baseline scenario is the continuation of the status quo, which is the continuation of the situation before the project was installed, without a full-scale renovation / modernization of HHP.

The key information and data used to establish the baseline (variables, parameters, data sources etc.) are presented below.

Data/Parameter	*SFRy*
Data unit	tef/GJ
Description	Specific Fuel Rate
Time of determination/monitoring	Minimum once per year
Source of data (to be) used	Calculated by the equation 1.1
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC

Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per unit of the output heat energy including net caloric value. The calculation of the *SFR* shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up and the sum is divided by the amount of output heat energy. SFR indicator shows fuel consumption not in natural value, but in energy units, that makes it possible to move away from the specifics of a particular type of fuel and compare the efficiency of equipment in different time intervals.
QA/QC procedures (to be) applied	During the calculations take into account uncertainties and errors of measuring instruments. All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be excluding from calculation emission reductions.
Any comment	

Data/Parameter	***SFiy***
Data unit	ratio
Description	The share of fuel *i* combusted by the heat and power plant for the energy production in period *y*, taken in the energy units.
Time of determination/monitoring	Minimum once per year
Source of data (to be) used	Calculated on the basis of data from statistical reports 17-energy.
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	n/a
QA/QC procedures (to be) applied	n/a
Any comment	

Data/Parameter	*OXIDi*			
Data unit	ratio			
Description	Oxidation factor of the fuel *i* in period *y*			
Time of determination/monitoring	Ones per year			
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010[17]			
Value of data applied (for ex ante	*OXIDi* for			
		2008	2009	2010

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http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

calculations/determinations)	Heavy fuel oil	0.99	0.99	0.99
	Natural gas	0.995	0.995	0.995
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The *OXIDiy* parameter shows the share of the fossil fuel fully oxidised during the combustion			
QA/QC procedures (to be) applied				
Any comment				

Data/Parameter	*EFi*									
Data unit	tons of CO2/TJ									
Description	Emission factor of the fuel *i* in year *y*									
Time of determination/monitoring	Ones per year									
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010[18]									
Value of data applied (for ex ante calculations/determinations)			2005	2006	2007	2008	2009	2010	2011	2012
	Carbon content of natural gas, tC/TJ	*Cnatural gas,y*	15.19	15.22	15.16	15.17	15.20	15.17	15.17	15.17
	Carbon content of fuel oil, tC/TJ	*Cfuel oil,y*	21.10	21.10	21.10	21.10	21.10	21.10	21.10	21.10
	transfer coefficient		44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000
		EFnatural gas,y	0.0557	0.0558	0.0556	0.0556	0.0557	0.0556	0.0556	0.0556
		EFfuel oil,y	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The *EFiy* parameter shows the CO2 emission from the combustion of the fossil fuel of different types.									
QA/QC procedures (to be) applied	n/a									
Any comment										

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http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

Data/Parameter	***AHSy***
Data unit	Gkal
Description	The amount of the output heat supplied in the period y
Time of determination/monitoring	Calculated at least once a year. Monitoring during the crediting period
Source of data (to be) used	Statistic data of KYIVENERGO PJSC. Form statistical reports 6-tp (es)
Value of data applied (for ex ante calculations/determinations)	Provided by KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	n/a
QA/QC procedures (to be) applied	All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions.
Any comment	

Data/Parameter	*SFRb*
Data unit	tef/GJ
Description	Specific Fuel Rate
Time of determination/monitoring	Determined in the PDD
Source of data (to be) used	Historic day for the last at least three years prior to project implementation. Data is collected by the company and is calculated by the developer of the project using equation 1.3.
Value of data applied (for ex ante calculations/determinations)	**HPP-5 0.092 tef/GJ** **HPP-6 0.077 tef/GJ**
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per unit of the output heat energy including net caloric value. The calculation of the *SFR* shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up and the sum is divided by the amount of output heat energy. SFR indicator shows fuel consumption not in natural value, but in energy units, that makes it possible to move away from the specifics of a particular type of fuel and compare the efficiency of equipment in different time intervals.
QA/QC procedures (to be) applied	During the calculations take into account uncertainties and errors of measuring instruments. All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement

	accuracies or other uncertainties in all of the variables need to be excluding from calculation emission reductions.
Any comment	

Sub-project 2
Baseline emissions come from two main sources:
- Emissions from the combustion of fossil fuels to produce heat.
- Emissions from consumption of electricity from the national grid.

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

Project participants may select either:
(a) An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach); or
(b) A methodology for baseline setting and monitoring approved by the Executive Board of the clean development mechanism (CDM), including methodologies for small-scale project activities, as appropriate, in accordance with paragraph 4(a) of decision 10/CMP.1, as well as methodologies for afforestation/reforestation project activities.
(c)
There is no approved CDM baseline and monitoring methodology which is applicable – without revisions – to outdated district heating systems. Therefore, a JI specific approach (a) is applied. The most appropriate methodology AM0044 can be used for the project because the project has some differences and inconsistencies with the conditions of the applicability of this methodology.

JI specific approach

According to the JI guidelines:
(c) 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. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol, and anthropogenic removals by sinks, within the project boundary;
(d) A baseline shall be established:
- (vi) on a project-specific basis and/or using a multi-project emission factor;
- (vii) in a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors;
- (viii) taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector;
- (ix) in such a way that emission reduction units (ERUs) cannot be earned for decreases in activity levels outside the project activity or due to force majeure;
- (x) taking account of uncertainties and using conservative assumptions;

(c) Project participants shall justify their choice of baseline.

The main cause of impossibility of methodology AM0044 using for baseline calculation is no data for thermal energy output, because of thermal energy meters absence on the majority of boiler houses included in the project. The main complication for implementation of the JI projects on district heating in Ukraine is the practical absence of monitoring devices for heat and heat-carrier expenditure in the municipal boiler-houses. Only the fuel consumption is registered on a regular basis. It makes practically impossible the application of AM0044 (version 01) methodology which basic moment is monitoring of the value $EG_{PJ,\,i,\,y}$ (thermal energy output of project boiler i in year y) - page 9 of Methodology AM0044 (version 01), which should be measured every month by flow-meters (the expenditure of heat-carrier) and thermal sensors (temperatures at the input and output of the boiler, etc.). This also concerns the definition

of the average historical value of heat power generation per year $EG_{BL, his, i}$ (average historic thermal energy output from the baseline boiler "i").

To calculate the project will be used "Methodological tool" developed by the Institute of Engineering Ecology Ltd which is based on the basis of permanent monitoring of fuel consumption and of the account of various other factors, such as connection or disconnection of the consumers, change of fuel heating value, weather change, ratio of the heat consumption for heating, etc.

The "Methodological tool" has two important advantages in comparison with the methodology AM0044 (at least for Ukrainian conditions):

- It takes into account the quality of heat supply (heating and hot water supply). Almost annually for the various reasons (receiving of less amount and high price of the fuel, in particular natural gas which is nearly 95 % of fuel type used in Ukraine for the needs of the municipal heat supply), the consumers receive less than necessary amount of heat, in the result of which the temperature inside the buildings is much lower than normative one, and hot water supply is insufficient or absent. As the purpose of JI projects, including the current project, is the GHG (CO_2) emission reduction under the conditions of not worsening in any circumstances of the social conditions of population, the issue of approaching of the heat supply quality to the normative one is extremely important. Therefore, the amount of the fuel consumption for the after project implementation period is calculated for the conditions of providing the normative parameters of heat supply and at least partially of hot water supply, and in accordance with the monitoring plan, the implementation of continuous control (monitoring) of its quality (measurement of internal temperature in the specific buildings as well as registration of residents' complaints for the poor-quality heat supply) is foreseen. This increases the control for the qualitative heat supply for the consumers and excludes deliberate reduction of heat consumption, and, in such a way, of fuel consumption with the purpose of increasing of generation of GHG emissions reduction units (ERUs) at the project verification.
- Definition of the fuel consumption in base year (baseline) in view of the fact that in Ukraine at the majority of the heat supply enterprises the natural gas is used as a fuel, which consumption is measured constantly by the counters with the high measurement accuracy, seems to be more exact, than definition of the fuel consumption with use of heat power, boiler efficiency and heat value of the fuel. This especially concerns the efficiency, which changes greatly depending on load of boilers, which also changes essentially, and often not automatically but manually, in the heat supply systems within a day and within a year. Averaging of such values without having of the heat account system is fraught with serious discrepancies. Definition of the fuel consumption in the presence of counters requires only data collection and implementation of arithmetic actions.

However, as it was mentioned before in this PDD, the majority of boiler houses in Ukraine are not equipped with devices for heat-carrier expenditure definition or heat meters. There is only one parameter that is regularly and with high precision defined in the boiler houses – fuel consumption.

The Methodological tool is based on the permanent measuring of the fuel consumption and amendments for possible parameters changes in baseline in comparison with reporting year. The variable parameters may be the changes in lower heating value of fuels, quality of heating service, weather changes, changes in customers' number, etc. Taking into account only equipment efficiency does not eliminate the possibilities of undersupply of heat to customers (deterioration of heat supply service), and possible weather warming in reported year, change in fuel quality, disconnection of some consumers, and other factors, and could lead to artificial overestimation of ERUs amount.

The Methodological tool is designed for DH projects with in conditions of Ukraine, already approved by the accredited independent entities in the process of determination similar projects, such as

"Rehabilitation of the District Heating System in Donetsk Region" [19], "District Heating System Rehabilitation of Chernigiv Region" [20], "Rehabilitation of the district heating system of Crimea" [21], "Rehabilitation of the District Heating System in Kharkiv City"[22], "Rehabilitation of the District Heating System in Donetsk City" [23] and many others is most acceptable, accurate and in accordance with the principle of conservatism, and most fully consistent with the goals, objectives and mind of the Kyoto protocol.

The baseline study will be fulfilled every year of the emission reduction purchasing, to correct adjustment factors which have an influence at the baseline. For more detailed information see **section D.1.**

Step 1: Identify technically feasible baseline scenario alternatives to the project activity

Alternatives to the baseline scenario should include all technically feasible options which are realistic and credible. These options should include the JI project activity not implemented as a JI project.

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

On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Step 3: Eliminate baseline alternatives that face prohibitive barriers

If there are several potential baseline scenario candidates that do not face barriers: (1) either choose the most conservative (results in least emissions) alternative as the baseline scenario; or (2) choose the economically most attractive alternative (using Step 4).

Step 4: Identify the most economically attractive baseline scenario alternative (optional)

Determine which of the remaining project alternatives that are not prevented by any barrier is the most economically or financially attractive, and thus is the most plausible baseline scenario.

Step 2 Application of the approach chosen

Plausible future scenarios will be identified in order to establish a baseline.

Step 1. Identify technically feasible baseline scenario alternatives to the project activity
The baseline scenario alternatives should include all technically feasible options which are realistic and credible. These options should include the JI project activity not implemented as a JI project. The options are:

- Status quo

The first version of Baseline scenario is a business-as-usual scenario with minimum reconstruction works balanced by overall degradation of DH system. For this Baseline scenario there are no barriers (no investment barrier since this scenario doesn't require the attraction of additional investments, and no

[19] http://ji.unfccc.int/JIITLProject/DB/I71KB95JEW3XSFWSOSHFZG2TA5VUSF/details

[20] http://ji.unfccc.int/JIITLProject/DB/PWS73YAWOKYQ100MP5TH5U7SN06DYO/details

[21] http://ji.unfccc.int/JIITLProject/DB/KWHXFPDA7LXPLNZ8XUI7GVPWNUTFTO/details

[22] http://ji.unfccc.int/JIITLProject/DB/D2ZYZ533L116F3KQUPMM1N5HR3FT7S/details

[23] http://ji.unfccc.int/JIITLProject/DB/GGJ0ASSCFDDL304D4MCZL09L4ZW9PO/details

technological barrier since the equipment is operated by existing skilled personnel, and additional re-training is not required), and represent the common practice in Ukraine.

- Reconstruction without Joint Implementation mechanism

The second version of Baseline scenario is construction of a modern module boiler house without JI mechanism. In this case there exist both investment barrier since this scenario requires the attraction of large additional investments, and due to very large payback time and high risks it is not attractive for investments, and as well the technological barrier since operation of the new modern equipment will require additional re-training of personnel. Rehabilitation of heat supply equipment in order to improve its efficiency is not a common practice in Ukraine.

- exclusion from the project any non-key type of measures:

The third version of Baseline scenario is the shortened project activity, without any of the non-key type of activity, for example excluded frequency controllers, etc., from the project. This makes project economically less attractive, with the longer pay back period.

Each of the above options has examples so there is technically feasible.

Step 2: Exclude the basic options are not relevant legislate and regulatory requirements

According to The Laws of Ukraine "On licensing of the separate types of activity" (№ 1775-III, from June 01, 2000) and "On heat energy supply" (№ 2633-IV from 02.06.2005); Ukrainian Government Regulation "On introduction of changes to the Government Regulations №1698 from 14.11.2000 and №756 from 04.07.2001" №549 from 19.04.2006 and "On approval of the list of licensing bodies" №1698 from 14.11.2000, execution of economic activity in fields of heat energy production, distribution and supply require a license that is issued by Ministry of Housing and Municipal Economy of Ukraine.

The alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to implement shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.

It should be noted that there is no local legislation regarding the time of boilers replacement and maximum lifetime permitted for boilers. It is common practice to exploit boilers which was installed in 70 th. and even 50-60th and earlier in Ukraine, if they pass the technical examination pass by the authorized body ("Derzhnagliadohoronpratsi") While specific permissions and licenses may be required, each of the options above can comply with legal and regulatory requirements. Therefore, each of these options is technically feasible and can comply with legal or regulatory requirements.

Step 3: Eliminate baseline alternatives that face prohibitive barriers

Step 3a: On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. For each of the alternatives to the situation existing prior to the implementation of the project, the barriers are listed below.

Investment barriers

Total capital investments that are required for this project is about 121 million euro (Operating costs are not included in the project because it is believed that they remain at the same level or even decrease due to lower costs for new equipment).

Technological barriers

1. Not all proposed technologies are widely approved already. Qualification of operational personal for implementation of the new technologies may be not sufficient to provide proper activity implementation in time.

Most of enterprisers in Ukraine fulfill annual minimal repairing of the DH system to keep it working. Particularly they execute repairing of network's parts and boilers that might cause accidents. The most economically feasible and realistic scenario without carbon credits sales is a very slow reconstruction activity, instead of making a major overhaul of the heating system.

Most of proposed technologies are widely used in Ukraine for the similar JI projects. For example boilers replacement, network replacement with pre-insulated pipes, installation of frequency controllers/

2. Risk of technological fault: the risk of fault of process / technology to local conditions is much higher than for other technologies that provide services or final products in comparison to those proposed by project activities. Efficiency of installed equipment could be lower than was claimed by producers or equipment may have substantial defects.

3. Available amount of natural gas. Last years Ukraine faced with incomplete delivery of natural gas from Russian Federation. Ukrainian Government realized attempts to decrease dependence from Russian natural gas delivery.

Organizational barriers

The management experience in implementation of JI projects is absent, including international collaboration, determination, verification, registration, monitoring of similar projects and so on.

Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity.

Step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Since the barriers identified above, directly related to investment in modernization of district heating there are no barriers to the further operation of district heating the same level.The status quo does not face any barriers. All alternatives to the status quo face realistic and credible barriers that would prevent their implementation without registration as a JI project activity.

Therefore the continuation of the status quo is the only remaining alternative and is selected as baseline scenario. As there is only one alternative to the project scenario, step 4 is not necessary.

Step 4: Identify the most economically attractive baseline scenario alternative (optional)

Not necessary, as there is only one alternative to the project scenario after step 3.

Conclusion

In conclusion, the baseline scenario is the continuation of the status quo, which is the continuation of the situation before the project was installed, without full-scale modernization program of DH system.

Baseline Calculation

Calculation of baseline emissions is carried out for each baseline period based on the formula given below.

$$E_i^b = E_{1i}^b + E_{cons\ i}^b, \quad (2.\ 1)$$

where:
E_{1i}^b – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base period, t CO_2e;
$E_{cons\ i}^b$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the base period, t CO_2e.

For each i boiler-house:

$$E_1^b = HCV_b * Cef_b * B_b; \quad (2.\ 2)$$

$$E_{cons}^b = P_b * EFgrid, \quad (2.\ 3)$$

where:

HCV_b – lower heating value of fuel in the baseline scenario, MJ/m^3 (MJ/kg);
Cef_b – carbon dioxide emission factor of fuel combustion in the baseline scenario, kt CO_2/TJ;
B_b – fuel consumption by a boiler-house in the baseline scenario, ths m^3 or tons;
P_b – electric power consumption by a boiler-house where energy saving measures are scheduled to be implemented, MWh;
EFgrid – carbon dioxide emission factors for reducing electricity consumption in Ukraine[24], tCO_2e/MWh;

[$_b$] index – related to the base period;

If any boiler-house consumes more than one type of fuel, the calculations of E are to be made for each type of fuel separately, and results are to be summed.

According to the Dynamic Baseline assumption, the efficient value of E_1^b may be defined as follows:

$$E_{1i}^b = E_{hi}^b, + E_{wi}^b,, \quad (2.\ 4)$$

where the first term describes emissions from fuel consumption for heating, and the second one – from fuel consumption for hot water supply.

For the case when in the base period the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is:

$$E_1^b = HCV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_b * (1-a_b) * K_1 * K_w], \quad (2.\ 5)$$

where the first term in brackets describes fuel consumption for heating, and the second one – fuel consumption for hot water supply.

[24] *For the years 2008-2011 – NEIA Orders No.43 dated 28.03.2011, No.62 dated 15.04.2011, No.63 dated 15.04.2011,No.75 dated 12.05.2011*

http://neia.gov.ua/nature/control/uk/publish/category?cat_id=111922

For the case when in the base period the hot water supply service was absent at all ($(1-a_b) = 0$), and in the reporting period this service was provided (due to improvement of heat supply service quality for population), the formulae for E_1^b is:

$$E_1^b = HCV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_r * (1-a_r) * K_1 * K_{w0}], \quad (2.\ 6)$$

where:
HCV_b – lower heating value, MJ/m^3 (MJ/kg);
Cef_b – carbon dioxide emission factor, kt CO_2/TJ;
$B_{b,r}$ – amount of fuel consumed by a boiler-house, ths m^3 or tons per period;
K_1, K_h, K_w, K_{w0} – adjustment factors;
$a_{b,r}$ – portion of fuel (heat), consumed for heating purposes;
$(1-a_r)$ – portion of fuel (heat), consumed for hot water supply services;
$[_b]$ index – related to the base period;
$[_r]$ index – related to the reporting period.

$$a_b = L_h^b * g * N_h^b / (L_h^b * g * N_h^b + L_w^b * N_w^b); \quad (2.\ 7)$$
$$a_r = L_h^r * g * N_h^r / (L_h^r * g * N_h^r + L_w^r * N_w^r), \quad (2.\ 8)$$

where:
L_h, L_w – maximum connected load to the boiler-house, that is required for heating and for hot water supply service, MW;
g – recalculating factor for average load during heating period (is determined for each boiler-house on historical base, usually is in the range 0,4 – 0,8);
N_h, N_w – duration of heating period and period of hot water supply service per period, hours.

Adjustment factors:

1. K_1 (change in the lower heating value of fuel):

$$K_1 = HCV_b / HCV_r, \quad (2.\ 9)$$

2. Adjustment factors for heating should be used for creation the Dynamic Baseline which takes into account changes of the external factors such as weather conditions, heating area, etc.

Fuel consumption for heating is proportional to the required amount of heat during heating period, Q_h:

$$B_h = B_b * a_b = Q_h / HCV_b * \eta, \quad (2.\ 10)$$

where η is overall heating system efficiency.

According to the assumption of the Dynamic Baseline, the required amount of heat in the base period for correct comparison should be reduced to real conditions (external to the project) in the reporting period:

$$Q_{h\,br} = Q_{h\,b} * K_h = Q_{h\,r}, \quad (2.\ 11)$$

where:
$Q_{h\,br}$ – required heat for Dynamic Baseline, is assumed equal to Q_r – required heat in the reporting period,
$Q_{h\,b}$ – required heat in the base period,
K_h – averaged adjustment factor for heating.

From this 2. it is possible to determine the averaged adjustment factor:

$$K_h = Q_{h\,r} / Q_h, \quad (2.\ 12)$$

Required amount of heat for heating of buildings during a year, according to the "Codes and regulations on rationing of fuel and heat energy for heating of residential and public buildings, as well as for communal and domestic requirements in Ukraine. KTM 204 Ukraine 244-94"[25], is determined by [ibid, 2. 2.17]:

$$Q_h = F_h * k_h * (T_{in} - T_{out}) * N_h, \quad (2.\ 13)$$

where:
Q_h – required amount of heat for heating, kWh;
F_h – heating area of buildings, m^2;
k_h – average heat transfer factor of buildings, kW/m^2*K;
T_{in} – average inside temperature for the heating period, K (or ^0C);
T_{out} – average outside temperature for the heating period, K (or ^0C);
N_h – duration of the heating period per period, hours.

Then:

$$K_h = (F_{h\,r} * k_{h\,r}) * (T_{in\,r} - T_{out\,r}) * N_{h\,r} / F_{h\,b} * k_{h\,b} * (T_{in\,b} - T_{out\,b}) * N_{h\,b}, \quad (2.\ 14)$$

2.1. K_2 (temperature change factor):

$$K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b}), \quad (2.\ 15)$$

2.2. K_3 (heating area and building thermal insulation change factor):

$$K_3 = (F_{h\,r} * k_{h\,r}) / F_{h\,b} * k_{h\,b} = [(F_{h\,r} - F_{h\,t\,r} - F_{h\,n\,r}) * k_{h\,b} + (F_{h\,n\,r} + F_{h\,t\,r}) * k_{h\,n}] / F_{h\,b} * k_{h\,b}, \quad (2.\ 16)$$

where:
$F_{h\,b}$ – heating area of buildings in the base period, m^2;
$F_{h\,r}$ – heating area of buildings in the reporting period, m^2;
$F_{h\,n\,r}$ – heating area of new buildings connected to DH system (assumed with the new (improved) thermal insulation) in the reporting period, m^2;
$F_{h\,t\,r}$ – heating area of buildings (previously existed in the base period) in reporting period with the renewed (improved) thermal insulation, m^2;
$k_{h\,b}$ – average heat transfer factor of heated buildings in the base period, W/m^2*K;
$k_{h\,r}$ – average heat transfer factor of heated buildings in the reporting period, W/m^2*K;
$k_{h\,n}$ – heat transfer factor of heated buildings with the new thermal insulation (new buildings or old ones with improved thermal insulation), W/m^2*K.

2.3. K_4 (heating period duration change factor):

$$K_4 = N_{h\,r} / N_{h\,b} \quad (2.\ 17)$$

where:
$N_{h\,b}$ – duration of the heating period in the base period, hours;
$N_{h\,r}$ – duration of the heating period in the reporting period, hours.

Thus,

$$K_h = K_2 * K_3 * K_4, \quad (2.\ 18)$$

3. Adjustment factors for hot water supply service should be used for creation the Dynamic Baseline which takes into account changes of the external factors such as weather conditions, number of customers, etc.:

[25] Codes and regulations on rationing of fuel and heat energy for heating of residential and public buildings, as well as for communal and domestic requirements in Ukraine. KTM 204 Ukraine 244-94. Kyiv, 2001, 376 p.

Fuel consumption for hot water supply service is proportional to the required amount of heat during the service rendered period, Q_w:

$B_w = B_b*(1-a_b) = Q_w / HCV_b *\eta$, (2. 19)

where η is overall hot water supply system efficiency.

According to the assumption of the Dynamic Baseline, the required amount of heat for hot water supply service in the base period for correct comparison should be reduced to real conditions (external to the project) in the reporting period:

$Q_{w\,br} = Q_{w\,b}*K_w = Q_{w\,r}$, (2. 20)

where:
$Q_{w\,br}$ – required heat for hot water supply service for Dynamic Baseline, is assumed equal to $Q_{w\,r}$ – required heat for hot water supply service in the reporting period,
$Q_{w\,b}$ – required heat for hot water supply service in the base period,
K_w – averaged adjustment factor for hot water supply service.

From this 2. it is possible to determine the averaged adjustment factor:
$K_w = Q_{w\,r} / Q_{w\,b.}$ (2. 21)

The components of K_w may be illustrated by correlation of heat used for hot water supply service in the base and reporting periods:

$Q_w = n_w*v_w *N_w$, (2. 22)

where:
Q_w – required amount of heat for hot water supply service, kWh;
n_w – average number of service's customers, personal accounts;
v_w – standard specific discharge of hot water per personal account (in heat units, kWh/h);
N_w – duration of the service period per period, hours.

Then:
$K_w = n_{w\,r}*v_{w\,r}*N_{w\,r} / n_{w\,b}*v_{w\,b}*N_{w\,b}$, (2. 23)

3.1. K_5 (number of customers change factor):

$K_5 = n_{w\,r} / n_{w\,b}$, (2. 24)

3.2. K_6 (standard specific discharge of hot water per personal account change factor):
$K_6 = v_{w\,r} / v_{w\,b}$, (2. 25)

At present the standard specific discharge of hot water is valid in Ukraine that was established by the KTM 204 Ukraine 244-94[1] in 1993. and no information is available on any propositions to change it, thus $K_6 = 1$ and does not require special monitoring.

3.3. K_7 (hot water supply period duration change factor):

$K_7 = N_{w\,r} / N_{w\,b}$, (2. 26)

where:
$N_{w\,b}$ – duration of the hot water supply period in the base period, hours;
$N_{w\,r}$ – duration of the hot water supply period in the reporting period, hours.

Thus,

$K_w = K_5 * K_6 * K_7$. (2. 27)

Adjustment factors for hot water supply service in case when there was no hot water supply service in base period, and in the reporting period this service was provided:

Since in case when there was no hot water supply service in base period, number of customers, standard specific discharge of hot water per personal account and duration of hot water supply period in the base period are assumed to be equal to these values in the reporting period,

$K_5 = K_6 = K_7 = 1$. (2. 28)

Thus

$K_{w0} = 1$. (2. 29)

If data for the calculation of any of the coefficients K_1-K_7, K_w, K_h, a_r, a_b are unavailable conservative coefficient for which this assumption applies is taken equal to 1.

Building a Baseline scenario

Current heating system of the plant is expressed by long deterioration of the heat generating and distributing equipment with a continuous decline in its effectiveness. However, at the same time operative maintenance increases efficiency, which largely compensates for the deterioration and makes annual total emissions level (baseline) the same for years.

Calculation of Baseline Carbon dioxide emission factors

For the calculation the following values of the coefficients of CO_2 emissions (*EFi*), oxidation factor (*OXIDi*), defined in the National Inventory Report in Ukraine for 1990 – 2010[26], hereinafter Inventory, are used:

The CO2 emission factor (*EFi*) is used:

	2005	2006	2007	2008	2009	2010	2011	2012
Cnatural gas,y	15.19	15.22	15.16	15.17	15.20	15.17	15.17	15.17
Cfuel oil.y	21.10	21.10	21.10	21.10	21.10	21.10	21.10	21.10
Transfer coefficient	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000
EFnatural gas,y	0.0557	0.0558	0.0556	0.0556	0.0557	0.0556	0.0556	0.0556
EFfuel oil,y	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774

For the following years is used indicator for the latest reporting year of Inventory submission.
In monitoring reports will be used the coefficient for the latest approved periods.

The oxidation factor (*OXIDi*) of the fuel is used:

[26] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

	2005	2006	2007	2008	2009	2010	2011	2012
OXIDnatural gas,y	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
OXIDfuel oil,y	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995

Calculation of carbon dioxide emissions for the baseline

Specific indirect carbon dioxide emissions at electricity consumption of electric energy consumers who classified as a 1st class according to the Procedure for determining the classes of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 № 1052 is selected in accordance with methodology "Ukraine - Assessment of new calculation of CEF", authorized TUV SUD 17.08.2007 and Decree # 62 of the National Environmental Investment Agency of Ukraine" On approval of specific carbon dioxide emission factors in 2008" dated 15/04/2011, Decree # 63 of the National Environmental Investment Agency of Ukraine" On approval of specific carbon dioxide emission factors in 2009" dated 15/04/2011, Decree # 43 of the National Environmental Investment Agency of Ukraine" On approval of specific carbon dioxide emission factors in 2010" dated 28/03/2011 and Decree # 75 of the National Environmental Investment Agency of Ukraine" On approval of specific carbon dioxide emission factors in 2011"[27] dated 12/05/2011.

Year/Type	Parameter ($kgCO_2/kWh$ or tCO_2/MWh)	2006-2007	EF_ 2008	EF_ 2009	EF_ 2010	EF_ 2011
Consumption of 1 class of voltage electricity	**EFgrid**	0.896	1.082	1.096	1.093	1.090

Table.14 Specific indirect carbon dioxide emissions at electricity consumption

The key information and data used to establish the baseline (variables, parameters, data sources etc.) are presented below.

Data/Parameter	**B_b**
Data unit	$Ths.m^3$
Description	Fuel consumption at a boiler-house. Natural gas
Time of determination/monitoring	Once after the end of the baseline period
Source of data (to be) used	Gas flow meter
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Indication of meters is recorded in special paper journals in boiler house
QA/QC procedures (to be) applied	Meters pass periodic calibration and verification under national standards
Any comment	

[27] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

Data/Parameter	**HCV_b**
Data unit	TJ/mln.m^3 or TJ/ths.t
Description	Heat CaloricValue of fuel
Time of determination/monitoring	Once after the end of the baseline period
Source of data (to be) used	Supplier's Certificates
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	If the parameter change in the basis document that it will be changed according to new values

Data/Parameter	**$T_{out\ b}$** and **$T_{out\ r}$**
Data unit	^{0}C
Description	Average outside temperature during the heating period
Time of determination/monitoring	Once per heating period. Daily temperature is registered every day of heating period
Source of data (to be) used	Meteorological Centre sends the Report every decade or month for every day of heating season. Reports are filed in special journals
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average outside temperature during the heating season is calculated from the daily outside temperature values taken by dispatcher from Meteorological Centre every day of heating period
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	**$T_{in\ b}$**
Data unit	^{0}C
Description	Average inside temperature during the heating period
Time of determination/monitoring	Daily temperature is registered every day of heating period
Source of data (to be) used	Journal of records
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement of thermometer
QA/QC procedures (to be) applied	According to the national legislation
Any comment	

Data/Parameter	$\mathbf{T_{in\,r}}$
Data unit	^{0}C
Description	Average inside temperature during the heating period
Time of determination/monitoring	Once
Source of data (to be) used	KTM 204 Ukraine 244-94
Value of data applied (for ex ante calculations/determinations)	18
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{n_{wb}}$ and $\mathbf{n_{wr}}$
Data unit	
Description	Number of Customers for hot water supply service
Time of determination/monitoring	Once per year.
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data of the company
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{F_{hb}}$ **and** $\mathbf{F_{hr}}$
Data unit	M^2
Description	Heating area
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante	Provided by the KYIVENERGO PJSC

calculations/determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal
QA/QC procedures (to be) applied	The data is taken for January, 01 for every year
Any comment	

Data/Parameter	**k_{hb}**
Data unit	kW/m^2*K
Description	Average Heat transfer factor of buildings in baseline
Time of determination/monitoring	Heat transfer factor is recorded ones per period at recording of connection or disconnection of any heating area to boiler-houses included in project.
Source of data (to be) used	SNIP 2-3-79 (1998)
Value of data applied (for ex ante calculations/determinations)	0.63
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	For calculation of Heat transfer factor of buildings for every boiler-house, the method of Weighted average value was used, that depends on heating area of existing buildings and heating area of the new buildings. Values of the heat transfer factor for existing buildings were taken from SNiP 2-3-79 (1998) - not higher than 0.63. Values of the heat transfer factor of new buildings were taken according to State Buildings Norms (B.2.6-31:2006) - not higher than 0.36.
Any comment	

Data/Parameter	**F_{htr}**
Data unit	m^2
Description	Heating area of buildings (previously existed in the baseline period) with the renewed (improved) thermal insulation in the reporting period
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal
QA/QC procedures (to be) applied	The data is taken for January, 01 for every year

Any comment	

Data/Parameter	**$F_{h\,n\,r}$**
Data unit	m^2
Description	Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reporting period
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal
QA/QC procedures (to be) applied	The data is taken for January, 01 for every year
Any comment	

Data/Parameter	**$k_{h\,n}$**
Data unit	kW/m^2*K
Description	Heat transfer factor of new buildings and buildings with new thermal insulation
Time of determination/monitoring	Once per monitoring period
Source of data (to be) used	SBN (B.2.6-31:2006)
Value of data applied (for ex ante calculations/determinations)	0.36
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Value of the heat transfer factor of new buildings were taken from State Buildings Norms (B.2.6-31:2006)
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	**$N_{h\,b}$** and **$N_{h\,r}$**
Data unit	hour
Description	Heating period duration
Time of determination/monitoring	Each month of heating period
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC

Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	The duration of the Heating period is accepted in accordance with item 7.9.4 of "Rules of technical exploitation of heating equipment and networks. 2007". Beginning and ending of the heating period are determined in every town separately. The heating period begins if the average daily outside temperature is 8 ^{o}C or lower during 3 days, and finishes if average daily outside temperature is 8 ^{o}C or higher during 3 days.

Data/Parameter	$\mathbf{N_{w\,b}}$ and $\mathbf{N_{w\,r}}$
Data unit	hour
Description	Duration of the period of hot water supply service
Time of determination/monitoring	Once per month
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data of the company
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{L_h^b}$ and $\mathbf{L_h^r}$
Data unit	Gkal
Description	Maximum connected load to the boiler-house, that is required for heating
Time of determination/monitoring	Once per monitoring period.
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Maximum connected load to the boiler-house, that is required for heating, is calculated by KYIVENERGO PJSC for every heating season. It is calculated according to heat demand at outside temperature -25 ^{o}C.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{L_w^b}$ and $\mathbf{L_w^r}$
Data unit	Gkal

Description	Maximum connected load to the boiler-house, that is required for providing the hot water supply service
Time of determination/monitoring	Once per monitoring period.
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Maximum connected load to the boiler-house, that is required for hot water supply service, is calculated by the company in accordance with the needs of water supply and temperature conditions.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{v_{w\,r}}$ and $\mathbf{v_{w\,b}}$
Data unit	kWh/h
Description	Standard specific discharge of hot water per personal account
Time of determination/monitoring	Once per monitoring period
Source of data (to be) used	"KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it.
Value of data applied (for ex ante calculations/determinations)	$\mathbf{v_{w\,b}}$ /$\mathbf{v_{w\,r}}$=1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	At present the standard specific discharge of hot water is valid in Ukraine that was established by the "KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	Cef
Data unit	$KtCO_2/TJ$
Description	Carbon dioxide emission factor for different fuels
Time of determination/monitoring	Annualy
Source of data (to be) used	National Inventory Report of anthropogenic emissions of Ukraine [28]
Value of data applied (for ex ante calculations/determinations)	See section B.1.

28

http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	If the parameter changes in the reporting period must be corrected

Data/Parameter	g
Data unit	ratio
Description	Recalculating factor for average load during heating period
Time of determination/monitoring	Calculated one for monitoring period
Source of data (to be) used	N/A
Value of data applied (for ex ante calculations/determinations)	Recalculating factor for average load during heating period is determined for boiler-house on historical base, usually it is in the range (0,4 – 0,8)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	$g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$ where: g – recalculating factor for average load during heating period; F_h – heating area of buildings, m^2; k_h – average heat transfer factor of heated buildings,(W/m^2*K); T_{in} – average inside temperature for the heating period, K ; $T_{out\ av}$ – average outside temperature for the heating period, K (or ^0C); $T_{out\ min}$ – minimal outside temperature for the heating period, K (or ^0C).
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	P_b
Data unit	MWh
Description	Electric power consumption
Time of determination/monitoring	Once after the end of the baseline period
Source of data (to be) used	Electricity supply meters
Value of data applied (for ex ante calculations/determinations)	Provided by KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by Electricity supply meters
QA/QC procedures (to be) applied	n/a
Any comment	

Data/Parameter	**EFgrid**

Data unit	tCO_2/kWh or tCO_2/MWh
Description	Carbon dioxide emissions factor at electricity consumption
Time of determination/monitoring	Yearly
Source of data (to be) used	DFP Orders
Value of data applied (for ex ante calculations/determinations)	See section B.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	

Sub-project 3

Baseline emissions coming from one main source:
Emissions from combustion of fossil fuels to generate additional electricity to compensate losses in the grid.

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

Project participants may select either:
(a) An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach); or
(b) A methodology for baseline setting and monitoring approved by the Executive Board of the clean development mechanism (CDM), including methodologies for small-scale project activities, as appropriate, in accordance with paragraph 4(a) of decision 10/CMP.1, as well as methodologies for afforestation/reforestation project activities.

A JI specific approach (a) is applied.

JI specific approach

According to the JI guidelines:
(e) 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. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol, and anthropogenic removals by sinks, within the project boundary;
(f) A baseline shall be established:
- (xi) on a project-specific basis and/or using a multi-project emission factor;
- (xii) in a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors;
- (xiii) taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector;
- (xiv) in such a way that emission reduction units (ERUs) cannot be earned for decreases in activity levels outside the project activity or due to force majeure;
- (xv) taking account of uncertainties and using conservative assumptions;

(c) Project participants shall justify their choice of baseline.

To calculate the emission reduction will be used by the *JI specific approach*. Below mentioned *JI specific approach* has been used to calculate emission reductions in similar JI projects in the Ukraine such as "Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC " (ITL project ID: UA1000321[29]), and it is updated and verified by Accredited Independent Entity (Bureau Veritas Certification Holding SAS) and Join Implementation Supervisory Committee.

The baseline study will be fulfilled every year of the emission reduction purchasing, to correct adjustment factors which have an influence at the baseline.

Step 1: Identify technically feasible baseline scenario alternatives to the project activity

Project participants have chosen the following approach regarding baseline setting, defined in the Guidance (Paragraph 9):

• An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach).

The above indicated approach is mentioned in the Paragraph 12 of the Guidance. The detailed theoretical description of the baseline in a complete and transparent manner, as well as a justification in accordance with Paragraph 23 through 29 of the Guidance should be provided by the project participants.

The baseline for this project shall be established in accordance with appendix B of the JI guidelines. Furthermore, the baseline shall be identified by listing and describing plausible future scenarios on the basis of conservative assumptions and selecting the most plausible one.
The most plausible future scenario will be identified by performing a barrier analysis. Should only two alternatives remain, of which one alternative to represent the project scenario with the JI incentive, the CDM Tool "Tool for the demonstration and assessment of additionally" version 6.0.0. shall be used to prove that the project scenario cannot be regarded as the most plausible one. Key factors that affect the baseline such as sectoral reform policies and legislation, economic situation/growth and socio-demographic factors as well as decreasing and/or increasing demand to be met by the project, availability of capital, technologies/techniques, skills and know-how availability of best available technologies/techniques in the future, fluctuations in fuel prices, national and/or subnational expansion plans for the energy sector will be taken into account while formulating the plausible feature scenarios.

Step 2: Eliminate baseline options that do not comply with legal or regulatory requirements
On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Step 3: Eliminate baseline alternatives that face barriers
If there are several potential baseline scenario candidates that do not face barriers: (1) either choose the most conservative (results in least emissions) alternative as the baseline scenario; or (2) choose the economically most attractive alternative (using Step 4).

Step 4: Identify the most economically attractive baseline scenario alternative (optional)
Determine which of the remaining project alternatives that are not prevented by any barrier is the most economically or financially attractive, and thus is the most plausible baseline scenario.

Step 2 Application of the approach chosen

[29] http://ji.unfccc.int/JIITLProject/DB/KRS6S8H8G8UVWR4ESNMH3DUVFNTOM2/details

Step 1. Identify technically feasible baseline scenario alternatives to the project activity

Alternative 1: Continuation of the current situation, without JI project implementation.
Alternative 2: The proposed project activity without the use of Joint Implementation mechanism.
Alternative 3: Partial project activities (to implement not all project equipment) without the use of the Joint Implementation Mechanism.

Each of the above options has examples so there is technically feasible.

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

Alternative 1: Continuation of the current situation At the start of the project there existed a number of regulation acts (Law on energy saving) aiming at directing the producers and supplyers to the sphere of energy saving. However, these acts mostly had formal character and were ineffective. It is confirmed by the permenant increase of TPC (TVE) in the electrical network of KYIVENERGO PJSC before the start of the project.

Existing legal documents do not obligate KYIVENERGO PJSC to pursue the modernization of electricity distribution electrical grids. According to the Law of Ukraine "On Electric Energy Sector"[30] Article 5. State policy in the energy sector is based on following principles:

- State regulation of activities in the energy sector;
- Creating conditions for safe operation of power facilities;
- Ensurance of efficient consumption of fuel and energy;
- Adherance to uniform state regulations and standards by all subjects of relations connected with the production, transmission, supply and use of energy;
- Creating conditions for development and improvement of the technical level of energy sector;
- Improvement of the environmental safety of energy facilities;
- Protection of the rights and interests of consumers of energy;
- Maintaining of the integrity and ensurance of the safe and efficient operation of unified power system of Ukraine, unified dispatch control (operational and technological) thereof;
- Promotion of a competitive market for electricity;
- Providing training to prepare qualified specialists for energy sector;
- Creating conditions for prospective scientific research;
- Ensurance of a stable financial state of energy sector;
- Ensurance of accountability of energy suppliers and consumers.

The current practice of reducing electricity losses in the distribution electrical grid complies with all applicable laws and regulations of Ukraine. The legislation allowed for the losses in the electrical grids. Standards are set only for the frequency with which energy supplying organizations must carry out calculation of regulatory power losses in the electrical grid. Monitoring of compliance with regulations is made by the calculation of normative losses once a year.

Alternative 2: Reconstruction and modernization without the JI mechanism is consistent with mandatory laws and regulations, detailed analysis of consistency with the law was made for *Alternative 1,* which is similar to consistency with mandatory laws and regulations for *Alternative 2.*

Alternative 3: Reconstruction without the use of JI mechanism and with the exclusion of some key project activities is in line with mandatory laws and regulations, detailed analysis of consistency with the

[30] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0

law was made for *Alternative 1*, which is similar to consistency with mandatory laws and regulations for *Alternative 3.*

Step 3: Eliminate baseline alternatives that face barriers

Alternative 1: Continuation of the current situation or status quo

There are no barriers for this Alternative.

Alternative 2: Implementation of proposed project activity without JI mechanism

Investment barriers: The project activity within the framework of the suggested project is a perpetual process which requires considerable annual investments and manpower attraction.

This is connected with:

- Annual electrotechnical equipment renewal, which is represented in the Ukrainian market;
- Necessity of the perpetual monitoring of places where the electricity is lost, their removal and prevention of their appearing;
- Necessity of the perpetual stuff training to work with he new equipment.

Constant funding in Ukraine is possible only in case of financial attraction of the project. The current system of electric power tariff formation shifts the financial burden of technological power consumption on the final consumers and does not allow to receive the income from their reduction. According to the art. 191 of the Civil Code of Ukraine[31] state (communal) fixed prices (tariffs) shall be established for products (services) that are manufactured by business entities-monopolists and are of great social importance for population. By virtue of the authority granted by the Law of Ukraine "On Electric Energy Sector"[32] and the Order of the President of Ukraine as of 14.03.95 № 213/95 "On measures to support the activity of the National Commission for Electric energy Regulation of Ukraine "[33], National Electricity Regulation Commission of Ukraine forms and ensures the implementation of unified state policy for development and operation of the wholesale electricity market, carries out price and tariff policy in the electricity sector. According to the Resolution of the Cabinet of Ministers of Ukraine as of 15.08.2005 № 745 "On the transition to unified tariffs for electric energy that is released to consumers"[34], Resolution of the NERC of Ukraine of 10.03.1999 № 309 "On tariffs for electricity, which is released to population and settlements"[35] (Edition: № 343 of March 17, 2011.), Resolution of NERC of Ukraine of 22.01.2001 № 47 "On approval of the procedure for formation of retail tariff for electricity to consumers (except population and population settlements) by the licensees that supply electricity at a regulated tariff"[36] national tariffs for households and settlements, the tariffs that consider threshold levels for legal entities, limits of tariff zones are established. The components of the tariff are a wholesale price, average price for the purchase electricity, tariff for the supply of electricity, tariff for electricity transmission and standard process losses of electricity in grids. The main component is the rate of process losses. Rate setting of electricity process losses in the electricity transmission power grids (PLE) is based on the balance of power in the previous year according to the reporting forms and technical data base of electricity grids.

[31] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=436-15&p=1302268052983958

[32] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0

[33] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=213%2F95

[34] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=745-2005-%EF

[35] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0151-99

[36] http://www.nerc.gov.ua/control/uk/publish/article?showHidden=1&art_id=100901&cat_id=34446

The procedure for the approval of standardized process losses for the company provides for:

a) calculation of the standardized process losses of energy in electricity grids;
b) the approval of the prime data and the results of calculations of standardized process losses of electricity at regional power distribution companies with the Ministry of Energy;
c) approval of standardized process losses of electricity by NERC after following procedures "a", "b".

Rate setting of process losses of electricity should be implemented according to guidelines "Rate setting of process losses of electricity during transmission in electrical grids". Calculation of standardazed values of losses differs from the calculation of process losses because the standardized characteristics apply not factual but standardized values of regime parameters, including: medium operating voltage of electrical grids, the rate of uneven load distribution in phases, nominal frequency etc. When formating retail electricity prices the electricity losses, which are determined using the regime parameters outside the standardized values, are not used. According to NERC regulations of 25.05.2006 № 654 "On approval of the procedure for filing, determination and approval of economic factors of standardized process losses of electricity"[37] decisions on compensation or absence of compensation to a licensee for loss of electricity by distribution third-party organizations, is made by NERC following discussion with stakeholders and formalization of a protocol. Compensation of standardized electricity process losses is carried out by their consideration in the determining of the electricity supply to the grids of the licensee to transfer to other licensees.

Thus, KYIVENERGO PJSC has no right to set prices (tariffs) for services provided: transmission and supply of electricity and due to the existing Procedure for the tariffs for electricity transmission and supply formation, reducing energy losses will not bring any additional income to the enterprise as reducing electricity losses, according to this procedure leads to a reduction of the level of standardized losses and absence of compensation from the state.

Step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives to the proposed JI project activity.

Since the barriers identified above, directly related to investment in modernization of electricity system there are no barriers to the further operation of system at the same level.The status quo does not face any barriers. All alternatives to the status quo face realistic and credible barriers that would prevent their implementation without registration as a JI project activity.

Therefore the continuation of the status quo is the only remaining alternative and is selected as baseline scenario. As there is only one alternative to the project scenario, step 4 is not necessary.

Step 4: Identify the most economically attractive baseline scenario alternative (optional)

Not necessary, as there is only one alternative to the project scenario after step 3.

Conclusion

In conclusion, the baseline scenario is the continuation of the status quo, which is the continuation of the situation before the project was installed, without full-scale modernization program of electrical system.

Baseline Calculation

[37] http://www.nerc.gov.ua/control/uk/publish/article/main?art_id=45694&cat_id=34446&

Therefore, the baseline emissions are:

$$BE_y = V_y \cdot EF_{grid,y} \quad (3.1)$$

where

BE_y - baseline emissions (tCO2e);

V_y - total technical loss reduction in the power distribution system during the period *y* of the project scenario compared with the baseline, MWh;

EFgrid,y - CO_2 emission factor in UPS of Ukraine for the the power replacement projects in the year y, tCO_2e/MWh;

y - the period for which estimates are made.

Key information and data used for baseline setting are provided below in tabular form:

Data/Parameter:	V_y
Data unit	MWh
Description	Total reduction of technical power losses in the power grid during the period y of the project scenario compared with the baseline scenario
Time of determination/monitoring	Monthly/annually
Source of data (to be) used	Statistical data of KYIVENERGO PJSC using approved methodology of technical power losses amount determination, in 0.38-150 kV power grids power supply company for the indirect carbon dioxide emission estimation[38]
Value of data applied (for ex ante calculations/determinations)	Estimated by the Developer using the statistical data of KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is an objective quantitative results display project.
QA/QC procedures (to be) applied	This parameter is defined according to the valid norms, rules and approved methodology based on the company's statistical data.
Any comment	

Data/Parameter:	*EFgrid,y*
Data unit	t CO_2e/MWh (kg CO_2e/kWh)
Description	Carbon dioxide emission factor for projects of power loss reduction in power transport networks of Ukraine
Time of determination/monitoring	Annually

[38] http://www.neia.gov.ua/nature/doccatalog/document?id=129688

Source of data (to be) used	Reference data (approved calculations and Orders of the National Agency for Environmental Investments as indicated below)
Value of data applied (for ex ante calculations/determinations)	For 2003 – 0.770[39] t CO_2e/MWh (kg CO_2e/kWh) For 2004 – 0.755[40] t CO_2e/MWh (kg CO_2e/kWh) For 2005 – 0.740[41] t CO_2e/MWh (kg CO_2e/kWh) For 2006-2007 p– 0.807[42] t CO_2e/MWh (kg CO_2e/kWh) For 2008 - 1.082[43] t CO_2e/MWh (kg CO_2e/kWh) For 2009 - 1.09[44] t CO_2e/MWh (kg CO_2e/kWh) For 2010 - 1.093[45] t CO_2e/MWh (kg CO_2e/kWh) For 2011-2025 - 1.090[46] t CO_2e/MWh (kg CO_2e/kWh)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Using such factors is a common practice when estimating JI projects.
QA/QC procedures (to be) applied	Only officially approved factors have been used for estimation.
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 JI project:

Sub-project 1

In the proposed project CO2 emissions to the atmosphere will be reduced due to improve the efficiency of heat and electricity generation by HPP after of regimes optimization, maintenance, repairs, fuel preparation, reconstruction of boiler, turbine, control system, generator and cooling system. The project envisages generation of additional electric and heat energy that will replace other, less efficient units and heat and power plants, and hence to reduce of fossil fuel consumption and reduce CO2 emissions to the atmosphere.

Additionality of the project

The demonstration that the project provides reductions in emissions by sources that are additional to any that would otherwise occur uses the following step-wise approach:

Step 1. Indication and description of the approach applied

a) If a JI specific approach is used, please explicitly indicate which of the approaches to demonstrate additionality, defined in paragraph 44 of the annex I to the "Guidance on criteria for baseline setting and monitoring", is chosen, and provide a justification of its applicability, with a clear and transparent description, as well as references, as appropriate.

b) If an approved CDM baseline and monitoring methodology is used in accordance with paragraph 10 of the .Guidance on criteria for baseline setting and monitoring., please provide clear

[39] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[40] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[41] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[42] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

[43] http://www.neia.gov.ua/nature/doccatalog/document?id=127171

[44] http://www.neia.gov.ua/nature/doccatalog/document?id=127172

[45] http://www.neia.gov.ua/nature/doccatalog/document?id=126006

[46] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

references (e.g. title of the baseline and monitoring methodology or tool, relevant version of the methodology or tool etc.) and describe why and how it is applicable.

The most recent version of the "Tool for the demonstration and assessment of additionality" version 6.0.0 is used, in accordance with the JI specific approach, defined in paragraph 2 (c) of the annex I to the "Guidance on criteria for baseline setting and monitoring".

Step 2. Application of the approach chosen

The Ukraine signed the Kyoto Protocol on 15 March 1999, and projects from 1 January 2000 are eligible under JI. The proposed project faces serious barriers as described above and is not considered the baseline scenario. The project was first developed after discussions in 2006 between the project developer and JI experts.

The additionality of the project activity is demonstrated and assessed below with using the last version of "Tool for the demonstration and assessment of additionality" version 6.0.0 which is approved by the CDM Executive Board. Tools include the steps listed below.

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

Because of the similarity of the approaches used to determine the baseline scenario in B.1. and the Additionality Tool, in line with the practice in methodologies Step 1 of the "Tool for the demonstration and assessment of additionality" is ignored. Therefore, as described in B.1 above, the baseline is:

continuation of the status quo, which is a continuation of the situation before the implementation of the project without modernization HPPs.

→ *Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis). (Project participants may also select to complete both steps 2 and 3.)*

Step 2. Investment Analysis

Step 2a. Determine appropriate analysis method

a) Possibility of the profit loss due to the decrease of regulated tariff on heat and power after the project implementation

HPPs operate on the regulated market of heat and power supply, where heat and power tariffs are set by the state regulator (National Commission of Power Sector Regulation / "NKRE"). Heat and power tariffs are set annually by NKRE based on the previous year's data on fuel consumption by an individual generator[47]. Thus the decrase of heat and power tariff should be included into the investment analysis of the HPP project as one of the side effects of rehabilitation measures involved in the project.Since such tariff decrease cannot be estimated quantitatively for the period 2008-2022, the investment analysis cannot provide the full picture of the project's attractiveness, and barrier analysis is the right method for demonstrating additionality for the proposed project.

b) Limited access to financial resources

Ukraine is considered to be a high risk country for doing business and investing in. Almost no private capital is available from domestic or international capital markets for mid to long term

[47] Decree of NKRE #896 dated 12.10.2005

investments, and any capital that is available has high cost. The table below represents risks of doing business in Ukraine according to various international indexes and studies.

Indicators	2008	2011	Note
Corruption index of Transparency International[48]	134 position from 180	152 position from 182	Index of corruption
Rating of business practices of The World Bank (The Doing Business)[49]	139 position from 178	145 position from 183	Rating of conduct of business (ease of company opening, licensing, staff employment, registration of ownership, receipt of credit, defence of interests of investors)
The IMD World Competitiveness Yearbook[50]	54 position from 55	57 position from 59	Research of competitiveness (state of economy, efficiency of government, business efficiency and state of infrastructure)
Index of Economic Freedom of Heritage Foundation[51]	133 position from 157	163 position from 179	Determination of degrees of freedom of economy (business, auction, financial, monetary, investment, financial, labour freedom, freedom from Government, from a corruption, protection of ownership rights)
Global Competitiveness Index of World Economic Forum[52]	72 position from 134	82 position from 142	Competitiveness (quality of institutes, infrastructure, macroeconomic stability, education, development of financial market, technological level, innovative potential)

Table.15 International ratings of Ukraine Indicators 2008 and 2011

The access to the financial resources on the international level is highly limited for the suggested project. The investment environment in Ukraine is rather poor in comparison with the neighbor countries. The confirmation of this is the sovereign rating of Ukraine according to the Fitch records in comparison with some neighbor countries of the Eastern Europe[53].

	Moody's	**Standard&Poor's**	**Fitch**
Ukraine	B2	B+	B
Poland	A2	A-	F2
Slovakia	A2	A	A+
Hungary	Ba1	BB+	B

Table.16 International ratings of Ukraine

The data above shows that both real and perceived risks of investing in Ukraine are in place and influence the availability of capital in Ukraine both in terms of size of the investments and in terms of capital costs.

As stated at the OECD Roundtable on Enterprise Development and Investment Climate in Ukraine[54], the current legal basis is not only inadequate, but to a large extent it sabotages the development of

[48] http://cpi.transparency.org/cpi2011/in_detail/
[49] http://www.doingbusiness.org/rankings
[50] http://www.imd.org/research/publications/wcy/upload/scoreboard.pdf
[51] http://www.heritage.org/index/ranking
[52] http://reports.weforum.org/global-competitiveness-2011-2012/
[53] http://www.datosmacro.com/en/ratings
[54] http://www.oecd.org/dataoecd/26/20/37051145.pdf

market economy in Ukraine. Voices in the western press can basically be summarized as follows: The reforms in the tax and legal systems have improved considerably with the adoption of the commercial Code, Civil Code and Customs Code on 1 January 2004 and new Tax Code on 1 January 2011 but still contain unsatisfactory elements and pose a risk for foreign investors[55]. Ukraine is considered to be heading in the right direction with significant reforms having been put into action but still has a long way to go to realize its full potential. Frequent and unpredictable changes in the legal system along with conflicting and inconsistent Civil and Commercial Codes do not allow for a transparent and stable enforced legal business environment[56]. Also new Tax Code has caused many disputes of the international community. Due with its adoption only beginning of 2011 is difficult to assess the quality of the changes and improvements introduced by them in the formation a business environment. This is perceived as a great source of uncertainty by international companies, which make future predictions of business goals and strategy risky.

The conclusion from the abovementioned is as follows: the investment climate of Ukraine is risky and unwelcoming, private capital is not available from domestic or international sources or available at prohibitively high cost due to real and perceived risks of doing business in Ukraine as shown by various sources. Alternatives markets, such as Russia, offer similar profile of investment opportunities with lower risk and better business environment.

c) Barriers due to the prevailing practice
Most of municipal power plants with combined generation of electric power in Ukraine belong to the state or the state owns significant stake in these companies. In spite that average age of such power plants is 30-40 years, the large scale HPP[57] modernization similar to the proposed project have not been observed for the last years in Ukraine. Implementation of the proposed project would result in market disadvantage of HPP compared to other producers of electricity because of possible risk of operation stops or equipment failure during the modernization process.

Step 2b. The impact of identified barriers on the alternative scenarios
As it was shown in part B.1 the only realistic alternative to the proposed JI project is continuation of existing situation at least till 2012. This scenario does not need substantial capital investments except the routine maintenance costs. Therefore, identified barriers do not influence the alternative scenario of continuing the existing situation.

Step 3. Investment analysis

Step 2b shows, that the only feasible baseline scenario is the continuation of the existing situation.
Therefore, using the barrier analysis and common practice analysis should be satisfactory for demonstrating additionality of the HPP project in accordance with the "Combined tool to identify the baseline scenario and demonstrate additionality" . Examples of similar approach used in similar district heating rehabilitation projects that have passed determination:

- Rehabilitation of the district heating system of Crimea[58]
- Rehabilitation of the District Heating System in Donetsk Region[59] and etc.

Step 4. Common practice analysis

[55] *Foreign Direct Investment in Ukraine – Donbass, Philip Burris, Problems of foreign economic relations development and attraction of foreign investments: regional aspect., ISSN 1991-3524, Donetsk, 2007. p. 507-510*

[56] *http://62.149.1.99/buznes-ekonomuka/20782-reakciya-zapadnoj-pressy-na-novyj-nalogovyj-kodeks-v-ukraine.html*

[57] *IEA, 2006*

[58] *http://ji.unfccc.int/JIITLProject/DB/KWHXFPDA7LXPLNZ8XUI7GVPWNUTFTO/details*

[59] *http://ji.unfccc.int/JIITLProject/DB/I71KB95JEW3XSFWSOSHFZG2TA5VUSF/details*

At this moment the common practice in energy sector of Ukraine is operation of existing equipment without implementation of large scale modernization projects. At the same time the projects similar to renovation of heat supply network of have been implemented at some enterprises of Ukraine. However, existing JI projects should not be included into analysis of common practice. For example see "Rehabilitation of district heating system in Kharkiv city" [60] , "Rehabilitation of the district heating system of Crimea", "Rehabilitation of district heating system in Chernihiv region" [61]. Therefore, proposed project is not the common practice in Ukraine.

Outcome of the analysis: Registration of the proposed project as JI will allow overcoming barriers connected with financing of the project. The additional benefit obtained from emission reductions sale will help to overcome barriers connected with the existing practice.

Conclusion: implementation of the proposed project as JI will eliminate economical/financial barriers and improve the project's indicators. The project scenario is additional compared to the baseline scenario.

Sub-project 2

The anthropogenic emissions of GHG in the project scenario will be reduced due to complex modernization of heat generating and distributing equipment with application of the technologies proposed in the project activities and described above, which include replacement of old obsolete boilers by new ones with higher efficiency, replacement of obsolete coal-fired boilers by the modern gas-fired ones, frequency controllers installation, installation of cogeneration units and heat pump station at the boiler houses, renovation of degraded heat distribution networks with using of the pre-insulated pipes.

Additionality of the project

The demonstration that the project provides reductions in emissions by sources that are additional to any that would otherwise occur uses the following step-wise approach:

Step 1. Indication and description of the approach applied

a) If a JI specific approach is used, please explicitly indicate which of the approaches to demonstrate additionality, defined in paragraph 44 of the annex I to the "Guidance on criteria for baseline setting and monitoring", is chosen, and provide a justification of its applicability, with a clear and transparent description, as well as references, as appropriate.

b) If an approved CDM baseline and monitoring methodology is used in accordance with paragraph 10 of the .Guidance on criteria for baseline setting and monitoring., please provide clear references (e.g. title of the baseline and monitoring methodology or tool, relevant version of the methodology or tool etc.) and describe why and how it is applicable.

Step 2. Application of the approach chosen

The Ukraine signed the Kyoto Protocol on 15 March 1999, and projects from 1 January 2000 are eligible under JI. The proposed project faces serious barriers as described above and is not considered the baseline scenario.

According to Paragraph 44 of Annex 1 to the Guidance on criteria for baseline setting and monitoring Version 03[62], approach B has been selected for demonstration of this project's additionality:

[60] *http://ji.unfccc.int/JIITLProject/DB/D2ZYZ533L116F3KQUPMM1N5HR3FT7S/details*

[61] *http://ji.unfccc.int/JIITLProject/DB/PWS73YAWOKYQ100MP5TH5U7SN06DYO/details*

[62] *http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf*

(b) Provision of traceable and transparent information that an accredited independent entity has already positively determined that a comparable project (to be) implemented under comparable circumstances (same GHG mitigation measure, same country, similar technology, similar scale) would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and a justification why this determination is relevant for the project at hand.

Selected approach, including its feasibility must be justified as a basis for the determination referred to in paragraph 33 of the Annex to decision 9/CMP.1 on guidelines for implementation of Article 6 of the Kyoto Protocol.

To support the choice of baseline and demonstrate additionality was chosen similar JI project such as "Rehabilitation of the District Heating System in Donetsk Region" (ITL project ID: UA1000026). In the checking of this approach, designated focal point (DFP) carefully evaluated and reviewed the reliability and accuracy of all data, rationale, assumptions, opinions and documents submitted by participants of similar project to support the choice of baseline and demonstrate additionality. Elements that are checked during this assessment and relevant conclusions transparently referred to in the conclusion of the determination /verification. Appropriate documentations such as PDD, Determination Report and Monitoring Report, Verification Report regarding these projects are available traceably and transparently on the UNFCCC JI[63].

The above mentioned projects have same GHG mitigation measure, same country, similar technology, similar scale.

1) The proposed and comparative projects suggest **same GHG mitigation measure**: The proposed GHG mitigation measure under the complex modernization of heat-generating and distribution equipment by introducing technologies proposed in the project activities and appropriate reducing combustion of fossil fuel.

2) The proposed and comparative projects are implemented within the **same country**: Projects are located in Ukraine.

3) The proposed and comparative projects utilize **similar technology**: The projects use the same technology, including the replacement of old boilers by new with highly efficient, setting frequency controllers, replacing outdated distribution network using pre-insulated pipes and others.

4) The proposed and comparative projects have **similar scale**: Projects are large scale JI projects. Both projects are large-scale joint implementation projects that have had approximately the same level of emission reductions over the crediting period about 1200 thousand CO2e.

Thus the criteria identified by the Guidance are satisfied and the identified project is indeed a comparable project implemented under comparable circumstances.

Project "Rehabilitation of the District Heating System in Donetsk Region" (ITL project ID: UA1000026) and the proposed project are implemented within the same geographic region of Ukraine. The implementation timeline is quite similar. Projects will share the same investment profile and market environment. The investment climate will be comparable in both cases with the heating sector being an almost non-profitable sector in Ukraine burdened by many problems. Market provision of heating services will also be the same for projects because participants are large companies that are major suppliers of heat and hot water in the region. Housing and public utilities sector is largely controlled by the state. Ministry of Housing and Public utilities fixes heat tariffs and regulates all companies that provide heat to consumers.

[63] http://ji.unfccc.int/JIITLProject/DB/I71KB95JEW3XSFWSOSHFZG2TA5VUSF/details

The proposed and comparative projects also share the investment climate of Ukraine which is far from being favourable. Investment climate in Ukraine is described in detail in Step 2 sub-project 1.

Outcome of the analysis: We have provided traceable and transparent information. Accredited independent entity has already positively determined that a comparable project implemented under comparable circumstances (same GHG mitigation measure, same country, similar technology, similar scale) would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and have provided justification on why this determination is relevant for the project at hand. Therefore, this project is additional.

Sub-project 3

Anthropogenic emissions of greenhouse gases in the project scenario will decrease due due to reduce losses of fossil fuels to generate additional electricity to compensate for the of electricity losses in the grid due to complex modernization of electricity grids through the implementation of the technologies proposed in the project activity as described above, including:

- Modernization and rehabilitation works in electrical grids and introduction of new energy efficient equipment;
- Improvement of the reliability of electricity supply to electricity consumers;
- Introduction of automated systems of electricity consumption commercial records (ASECCR) in the perimeter of energy supply company, ASECCR of consumers and subplants;
- Introduction of a complex Program on process losses of electricity decrease.

Additionality of the project

The demonstration that the project provides reductions in emissions by sources that are additional to any that would otherwise occur uses the following step-wise approach:

Step 1. Indication and description of the approach applied

a) If a JI specific approach is used, please explicitly indicate which of the approaches to demonstrate additionality, defined in paragraph 44 of the annex I to the "Guidance on criteria for baseline setting and monitoring", is chosen, and provide a justification of its applicability, with a clear and transparent description, as well as references, as appropriate.

b) If an approved CDM baseline and monitoring methodology is used in accordance with paragraph 10 of the .Guidance on criteria for baseline setting and monitoring., please provide clear references (e.g. title of the baseline and monitoring methodology or tool, relevant version of the methodology or tool etc.) and describe why and how it is applicable.

Step 2. Application of the approach chosen

The Ukraine signed the Kyoto Protocol on 15 March 1999, and projects from 1 January 2000 are eligible under JI. The proposed project faces serious barriers as described above and is not considered the baseline scenario.

According to Paragraph 44 of Annex 1 to the Guidance on criteria for baseline setting and monitoring Version 03[64], approach B has been selected for demonstration of this project's additionality:

(b) Provision of traceable and transparent information that an accredited independent entity has already positively determined that a comparable project (to be) implemented under comparable circumstances

[64] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

(same GHG mitigation measure, same country, similar technology, similar scale) would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and a justification why this determination is relevant for the project at hand.

Selected approach, including its feasibility must be justified as a basis for the determination referred to in paragraph 33 of the Annex to decision 9/CMP.1 on guidelines for implementation of Article 6 of the Kyoto Protocol.

To support the choice of baseline and demonstrate additionality was chosen similar JI project such as "Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC " (ITL project ID: UA1000321). In the checking of this approach, designated focal point (DFP) carefully evaluated and reviewed the reliability and accuracy of all data, rationale, assumptions, opinions and documents submitted by participants of similar project to support the choice of baseline and demonstrate additionality. Elements that are checked during this assessment and relevant conclusions transparently referred to in the conclusion of the determination /verification. Appropriate documentations such as PDD, Determination Report and Monitoring Report, Verification Report regarding these projects are available traceably and transparently on the UNFCCC JI[65].

The above mentioned projects have same GHG mitigation measure, same country, similar technology, similar scale.

1) The proposed and comparative projects suggest **same GHG mitigation measure**: The proposed GHG mitigation measure under the complex modernization of grid by the implementing technologies proposed in the project activities and described above.

2) The proposed and comparative projects are implemented within the **same country**: Projects are located in Ukraine.

3) The proposed and comparative projects utilize **similar technology**: The projects use the same technology, including organizational measures with methodological support, organizational and technical measures, technical measures for the processes of transmission and distribution of electricity.

4) The proposed and comparative projects have **similar scale**: Projects are large scale JI projects. Both projects are large-scale joint implementation projects that have had approximately the same level of emission reductions over the crediting period about 1200 thousand CO2e.

Thus the criteria identified by the Guidance are satisfied and the identified project is indeed a comparable project implemented under comparable circumstances.

Project "Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC" (ITL project ID: UA1000321) and the proposed project are implemented within the same geographic region of Ukraine. The implementation timeline is quite similar. Projects will share the same investment profile and market environment. The investment climate will be comparable in both cases with the electricity supply sector being an almost non-profitable sector in Ukraine burdened by many problems. Market provision of electricity supply services will also be the same for projects because participants are large companies that are major suppliers of electricity in the region. Electricity supply sector is largely controlled by the state. NKRE fixes heat tariffs and regulates all companies that provide electricity to consumers.

The proposed and comparative projects also share the investment climate of Ukraine which is far from being favourable. Investment climate in Ukraine is described in detail in Step 2 sub-project 1.

[65] http://ji.unfccc.int/JIITLProject/DB/KRS6S8H8G8UVWR4ESNMH3DUVFNTOM2/details

Outcome of the analysis: We have provided traceable and transparent information. Accredited independent entity has already positively determined that a comparable project implemented under comparable circumstances (same GHG mitigation measure, same country, similar technology, similar scale) would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and have provided justification on why this determination is relevant for the project at hand. Therefore, this project is additional.

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

Sub-project 1

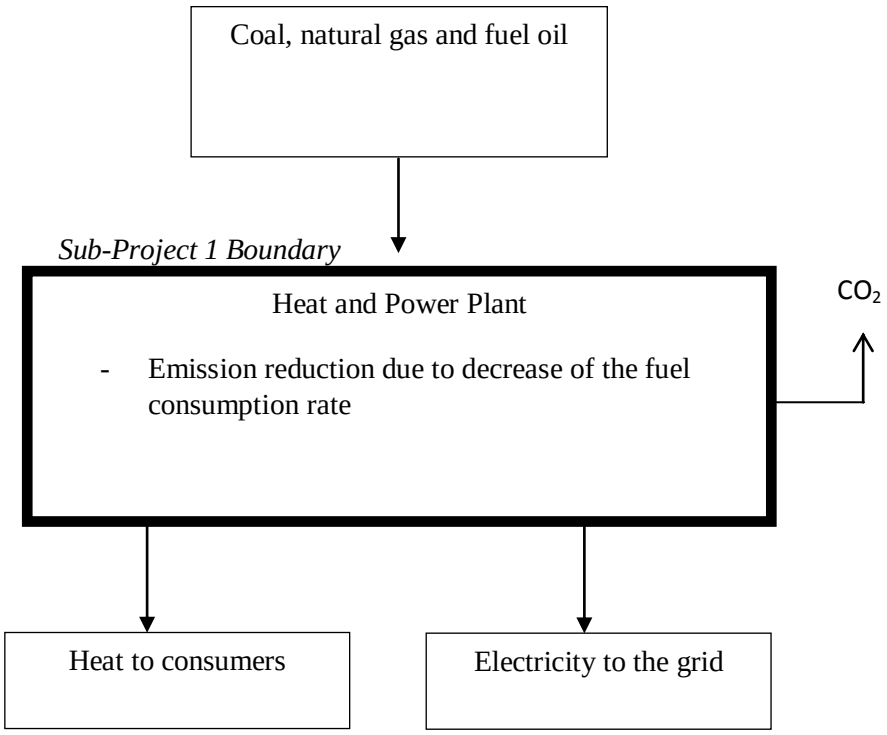

Fig.15 Scheme of project boundary

	Source	Gas	Included/ Excluded	Justification / Explanation
Baseline	Baseline HPP emission	CO_2	**Included**	CO_2 is formed with the combustion of fuels.
		CH_4	**Excluded**	Minor source, can be neglected (conservative approach).
		N_2O	**Excluded**	Minor source, can be neglected.
Project Activity	Project HPP emission	CO_2	**Included**	CO_2 is formed with the combustion of fuels.
		CH_4	**Excluded**	Minor source, can be neglected (conservative approach).
		N_2O	**Excluded**	Minor source, can be neglected

Table.17 Project boundaries and sources of emissions

Sub-project 2

The spatial extent of the project boundary comprises:

- All equipment installed and used as part of the project activity for the heat generation, and also transportation it to the costumer.
- Ukraine National Electricity Grid and the connected heat and power plants.

The project is limited mainly to boiler and heat supply systems. Reduction of the CO_2 emissions at phases of production and distributions of heat during a heat supply is supposed in the project. Increase of an overall performance of boilers and reduction of losses of heat in heating systems will lead to the common reduction of consumption of fuel by system. The reduced consumption of fuel will lead to reduction of emissions.

Greenhouse Gas Sources and Project Boundaries:

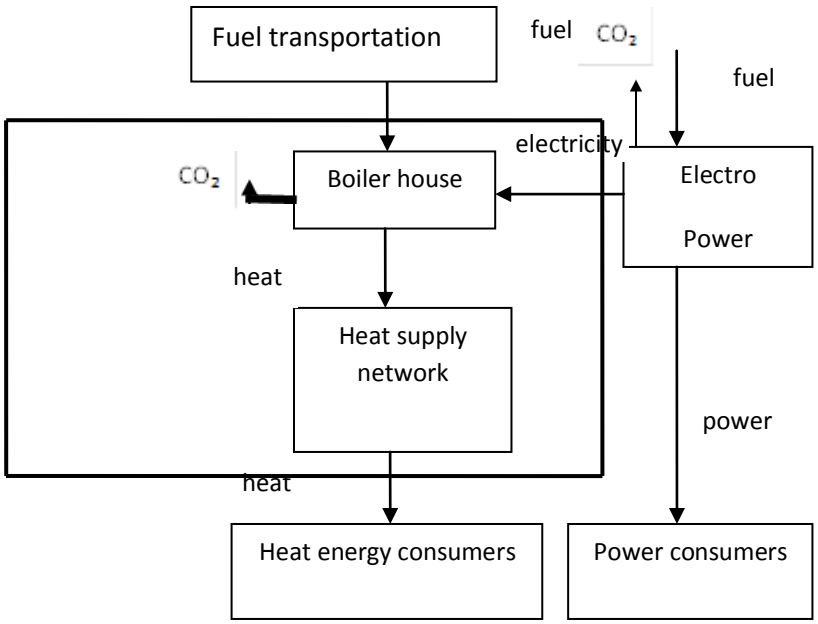

Fig.16 Scheme of project boundary

As shown in the figure, the project boundary for the baseline and project scenarios include CO_2 emissions from the boiler houses from fossil fuel combustion for heating and steam and include CO_2 emissions due to electricity consumption of the grid .

Emissions due to production and transportation of fuel are not included in project boundaries as well.

Direct and Indirect Emissions

Direct on-site emissions: CO_2 from natural gas combustion in boilers (in some cases fuel oil is used as a fue NO_x and CO emission from combustion in the existing boilers/ burners.

Direct off-site emissions: CO_2 emissions from power stations due to electricity production to the grid, tl consumed by boiler houses, which will be upgraded.

Indirect on-site emissions: none.

Indirect off-site emissions: CO_2 emissions from fuel extraction and transportation.

On-site emissions			
Current situation	Project	Direct or indirect	Include or exclude
CO_2 emissions from fuel combustion in boilers	Reduced CO_2 emissions from fuel combustion in boilers due to increased efficiency and fuel saving.	Direct	Include
CH4, NO_x and CO emission from combustion in existing boilers/ burners	Reduced CH4, NO_x and CO emissions from fuel combustion after boiler / burners' replacement	Direct	Exclude. Minor source, can be neglected
Off-site emissions			
Current situation	Project	Direct or indirect	Include or exclude
CO_2 emissions from heat and power plant(s) due to electricity production to the grid, that is consumed by boiler houses, which will be upgraded.	Reduced CO_2 emissions from heat and power plant(s) due to reduction of electricity consumption by boiler houses	Direct	Include
CO_2 emissions from fuel extraction and transportation.	Reduced CO_2 emissions from fuel extraction and transportation due to fuel saving.	Indirect	Exclude, not under control of project developer

Table.18 Project boundaries and sources of emissions

Sub-project 3

The boundaries of the project include:

- All equipment installed and used as part of the project activity for the heat generation, and also transportation it to the costumer.
- Ukraine National Electricity Grid and the connected heat and power plants.

The approach when estimating emissions takes into account only CO2 indirect emissions, which are formed due to the production of electrical energy needed to compensate for the grid losses and in the transformer stations and substations KYIVENERGO PJSC.
Project boundaries for Baseline and Project scenario for Sub-project 3 are represented on the graphical representation.

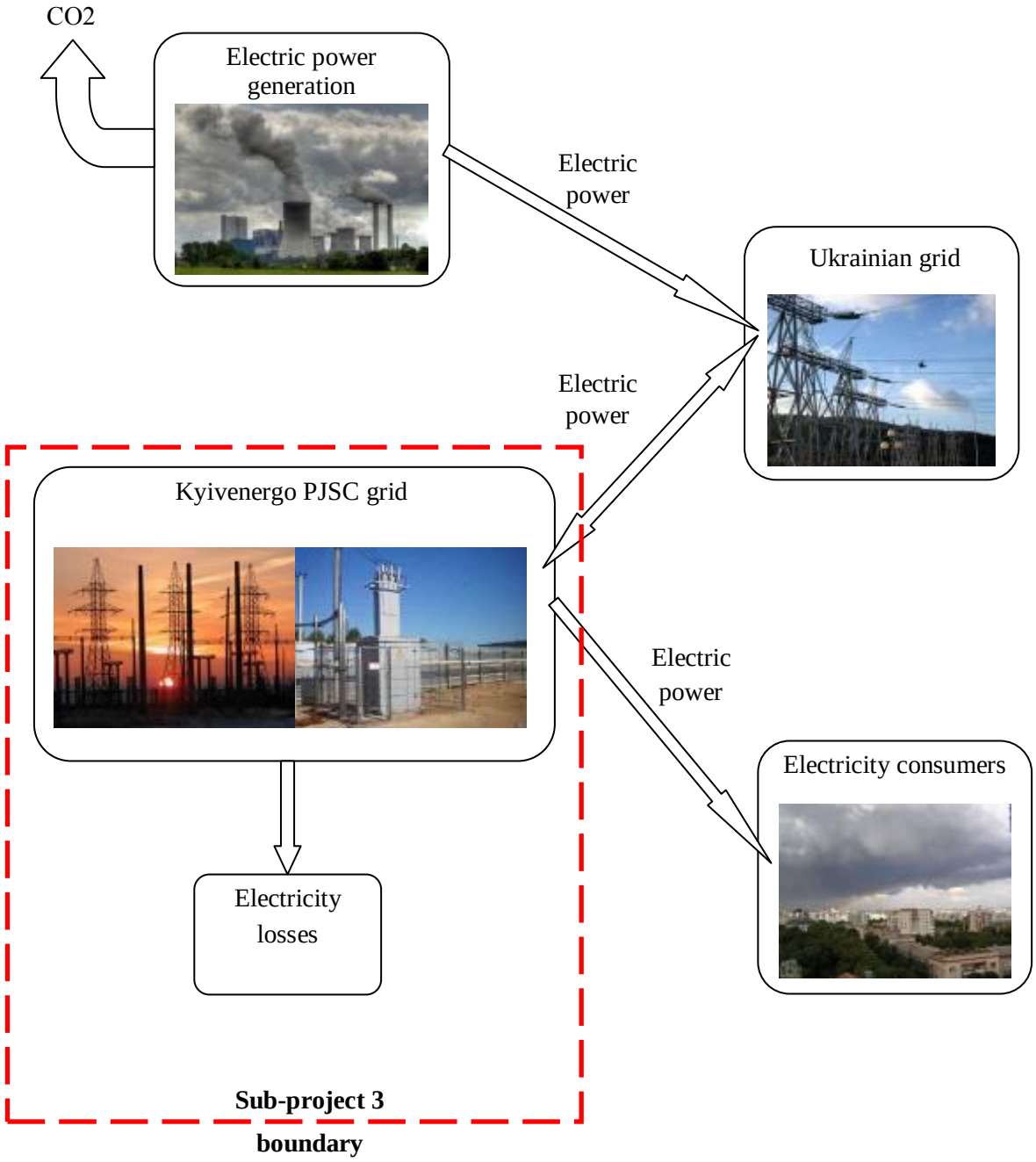

Fig.17 Scheme of project boundary

The list of the sources and the greenhouse gases that were included into the boundaries of the project is given in the table below.

	Source	Gas	Included / Excluded	Justification / Explanation

Baseline emissions	Ukrainian grid electric power stations that consume fossil fuel.	CO_2	Included	Emission is caused by burning of the fossil fuel by the Ukrainian grid electric power stations to generate electricity which is necessary to make amends for consumption in the electrical network of KYIVENERGO PJSC in the baseline.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification
Project emissions	Emissions related to the equipment installed in the project	SF_6	Excluded	Insulating gas (SF6), used in circuit breakers and other equipment KYIVENERGO PJSC is toxic and is listed as gas circulation and utilization of which is under the control of state environment organizations. Equipment containing Insulating gas is hermetically sealed and prevents leakage of gas into the atmosphere. In the case of it failure or decommissioning SF6 will be collected and reused by filling in new similar equipment. In connection with all the above SF6 emissions were excluded from the calculations.
	Ukrainian grid electric power stations that consume fossil fuel	CO_2	Included	Emission is caused by burning of the fossil fuel by the Ukrainian grid electric power stations to generate electricity which is necessary to make amends for technological power consumption in the electrical network of KYIVENERGO PJSC after the reduction of the technological power consumption volume as a result of the project activity.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification

Table.19 Sources of emissions and greenhouse gases included or excluded from the project boundary

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

Date of baseline setting: 16/01/2008

Contact information of the entity and persons responsible:
Thomas Winklehner , OHANA LLP
Email tw@ohanallp.com Tel/Fax: +44 208 786 0751.
OHANA LLP is a project participant listed in annex 1.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The starting date of the project is: 01.01.2004

The starting date of a JI project activity is the date on which the implementation or construction or real action of the project begins. Starting date of the implementation of the modernization of the district heating system and the first generation of emission reduction units.

C.2. Expected operational lifetime of the project:

Reconstructions in the project scenario provide for continuation of the operational equipment lifetime for 20 years.

According to conservatism principle and expecting that commitment period will be extended to 31/12/2022, for further calculations we assume operational lifetime for the project and the corresponding crediting period - 19 years or 228 months (2004-2022).

C.3. Length of the crediting period:

Start of the crediting period: 01/01/2004.
This is the date of first emission reductions of the project.

4 years 0 month for the pre-2008 period (01/01/2004-31/12/2007).
5 years 0 month for the first crediting period (01/01/2008-31/12/2012).
10 years 0 month for the second crediting period (01/01/2013-31/12/2022).

The first crediting period ends in line with the first commitment period under the Kyoto Protocol. A period after 2012 covers most of the remaining lifetime of the project activity. The period prior to the start of the first Kyoto commitment period starts with the start of operation of the project and ends with the start of the first crediting period under Kyoto.

The crediting period can extend beyond 2012 subject to the approval by the Host Party. If the past first commitment period under the Kyoto Protocol will be applicable, the crediting period may be extended to the end of the expected operational lifetime of the project (19 years or 228 months , 2004-2022).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

In accordance with annex 1 to the JI guidelines and following the guidance on criteria for baseline setting and monitoring[66] version 3. The monitoring plan will be described in the PDD, using the step-wise approach. At the same time the monitoring plan is based on the JI specific approach.

Sub-project 1

Step 1 Indication and description of the approach chosen regarding monitoring

The JI specific approach (a) is applied.
JI specific approach
In accordance with the guidance the monitoring plan shall provide for:
(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period;
(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary during the crediting period;
(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that are significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project;
(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable;
(v) Quality assurance and control procedures for the monitoring process;
(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project;
(vii) Documentation of all steps involved in the calculations referred to above.

Step 2 Application of the approach chosen

[66] Guidance on criteria for baseline setting and monitoring, version 03 (JISC 26).

In accordance with the guidance the monitoring plan provides for:
(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period; and
(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary during the crediting period.

During any period of monitoring must be collected and recorded data on the following parameters:
3. Fuel used (coal, natural gas, fuel oil).
4. Supply of heat energy.
5. Supply of electricity.
6. The Specific fuel rate (SFRy). The calculations of the fuel consumption by the HPP are being made in the tons of the equivalent fuel. One ton of the equivalent fuel is 7 Gkal or 29,3076 GJ . This method takes the NCV of the fuel into account and allows comparison of the parameters for the different years. It means, that the own consumption of the HPP is taken into account.

Data collection the number of combustion gas (fuel oil) and heat and electric energy occurs continually using equipment and automatic systems. Specific fuel consumption and other indicators are calculated and recorded in statistical reporting company. Based on these data, total volume of consumed gas is calculated. Thus, there is the collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of greenhouse gases within the project boundary during the crediting and baseline.

(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that is significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project.

Therefore, leakage emissions are conservatively considered zero.

(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable.

The host Party does not require the collection and archiving of information on environmental impacts of this project activity type.

(v) Quality assurance and control procedures for the monitoring process.

All measurements are conducted with calibrated measurement equipment according to relevant industry standards. Consumption of gas, electricity and heat generated are cross checked against sales receipts.

All monthly data is checked and signed off by the JI Project Manager.

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project.

The reductions of anthropogenic emissions by the proposed JI project are calculated and reported by the JI Project Management Team on a monthly basis.
Leakage equal zero.
Description of the approximate calculation, formulas, parameters, data sources and key factors are presented in D.1.2.2 below. Section D.1.3 are measure of inaccuracy for each parameter.

(vii) Documentation of all steps involved in the calculations referred to above.

All data collected as part of the monitoring are archived electronically and kept at least for 2 years after the last transfer of ERUs for the project. 100% of the data are monitored as indicated in the table below. All measurements are conducted with calibrated measurement equipment according to relevant industry standards.

Procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting
In cases if any errors, fraud, inconsistencies or situations when monitoring data are unavailable will be identified during the monitoring process special commission will appointed by project host management that will conduct a review of such case and issue an order that must also include provisions for necessary corrective actions to be implemented that will ensure such situations are avoided in future.
The project host management will also establish a communication channel that will make it possible to submit suggestions, improvement proposals and project ideas for more accurate future monitoring for every person involved in the monitoring activities. Such communications will be delivered to the project host management who is required to review these communications and in case it is found appropriate implement necessary corrective actions and improvements. Project participant - will conduct periodic review of the monitoring plan and procedures and if necessary propose improvements to the project participants. Also, to prevent the situations in which monitoring data are unavailable, all parameters are fixed and saved on paper and electronically in a database the Owner and Developer of the project separately.

Emergency preparedness for cases where emergencies can cause unintended emissions

The project operation does not foresee any factors or emergencies that can cause unintended GHG emissions. Safe operation of equipment and personnel is ensured by systematic safety training. Procedures for dealing with general emergencies such as fire, major malfunction etc. are developed as part of the mandatory business regulations and are in accordance with local requirements.

Indicator of project performance

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *reduction of specific fuel rate.* It can be defined as the difference between baseline specific fuel rate and specific fuel rate after project implementation.

Sub-project 2

Step 1 Indication and description of the approach chosen regarding monitoring

The JI specific approach (a) is applied.

JI specific approach

In accordance with the guidance the monitoring plan shall provide for:

(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period;

(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary during the crediting period;

(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that are significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project;

(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable;

(v) Quality assurance and control procedures for the monitoring process;

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project;

(vii) Documentation of all steps involved in the calculations referred to above.

Step 2 Application of the approach chosen

In accordance with the guidance the monitoring plan provides for:

(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period; and

(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary during the crediting period.

Data collection about the number of combustion gas, and generated heat is take place continuously by equipment and automatic systems. Based on these data, is calculated the total volume of consumed gas. Monitoring of electricity consumption is continuous. Thus, there is the collection and archiving of all data needed to assess or measure anthropogenic emissions of greenhouse gases within the project crediting period and baseline emissions.

With regard to emission factor for electricity grid in Ukraine, used a pre-set approved national rate (see Section B.1). This ratio will be monitored and adjusted at the stage of writing monitoring report for the period.

(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that is significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project.

Therefore, leakage emissions are conservatively considered zero.

(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable.

The host Party does not require the collection and archiving of information on environmental impacts of this project activity type.

(v) Quality assurance and control procedures for the monitoring process.

All measurements are conducted with calibrated measurement equipment according to relevant industry standards. Consumption of gas and electricity, generated heat are cross checked against sales receipts.

All monthly data is checked and signed off by the JI Project Manager.

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project.

The reductions of anthropogenic emissions by the proposed JI project are calculated and reported by the JI Project Management Team on a monthly basis.

Leakage equal zero.

Description of the approximate calculation, formulas, parameters, data sources and key factors are presented in D.1.2.2 below. Section D.1.3 are measure of inaccuracy for each parameter.

(vii) Documentation of all steps involved in the calculations referred to above.

All data collected as part of the monitoring are archived electronically and kept at least for 2 years after the last transfer of ERUs for the project. 100% of the data are monitored as indicated in the table below. All measurements are conducted with calibrated measurement equipment according to relevant industry standards.

Procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting

In cases if any errors, fraud, inconsistencies or situations when monitoring data are unavailable will be identified during the monitoring process special commission will appointed by project host management that will conduct a review of such case and issue an order that must also include provisions for necessary corrective actions to be implemented that will ensure such situations are avoided in future.

The project host management will also establish a communication channel that will make it possible to submit suggestions, improvement proposals and project ideas for more accurate future monitoring for every person involved in the monitoring activities. Such communications will be delivered to the project host management who is required to review these communications and in case it is found appropriate implement necessary corrective actions and improvements. Project participant - will conduct periodic review of the monitoring plan and procedures and if necessary propose improvements to the project participants. Also, to prevent the situations in which monitoring data are unavailable, all parameters are fixed and saved on paper and electronically in a database the Owner and Developer of the project separately.

Emergency preparedness for cases where emergencies can cause unintended emissions

The project operation does not foresee any factors or emergencies that can cause unintended GHG emissions. Safe operation of equipment and personnel is ensured by systematic safety training. Procedures for dealing with general emergencies such as fire, major malfunction etc. are developed as part of the mandatory business regulations and are in accordance with local requirements.

Indicator of project performance

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *fuel saving*. It can be identified as a difference between baseline fuel consumption and fuel consumption after project implementation. If boilers consume fuel at the projected level, than all other relevant indicators such as efficiencies of new boilers and burners as well as heat losses in pre-insulated pipes are adequate.

Sub-project 3

Step 1 Indication and description of the approach chosen regarding monitoring

The JI specific approach (a) is applied.

JI specific approach

In accordance with the guidance the monitoring plan shall provide for:

(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period;

(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary during the crediting period;

(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that are significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project;

(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable;

(v) Quality assurance and control procedures for the monitoring process;

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project;

(vii) Documentation of all steps involved in the calculations referred to above.

Step 2 Application of the approach chosen

In accordance with the guidance the monitoring plan provides for:

(i) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions of GHGs occurring within the project boundary during the crediting period; and

(ii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions of GHGs within the project boundary

during the crediting period.
During any period of monitoring must be collected and recorded data on the following parameters:

- actual losses of electricity

The actual losses of electricity during its transmission have four components[67].

1. Technical losses of electricity are caused by physical processes that occur during its transmission in electricity grids and are expressed by converting its part into heat in the element of grid;
2. Consumption of electricity for company's own substations needs to ensure the operation of technical equipment of substations;
3. The losses of electricity are caused by control and metering equipment and tools (instrumental losses);
4. Above standard losses are caused by the theft of electricity, disparity of payment by consumers, delayed payments, non-payment of bills and other causes, and are equal to the difference between electricity volume incoming into the distribution grid and electricity volume incoming to consumers.

Parameters for the baseline emission monitoring:
V_y = Total reduction of technical power losses in the power grid during the period y of the project scenario compared with the baseline scenario
This parameter is defined according to the valid norms, rules and approved methodology based on the company's statistical data. This parameter is an objective quantitative representation of the project implementation results.
EFgrid = Carbon dioxide emission factor for projects of power loss reduction in power transport networks of Ukraine. This value objectively reflects specific carbon dioxide emissions due to power losses during transportation. Using such factors is a common practice when estimating JI projects. Only officially approved factors have been used for estimation.

(iii) The identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions of GHGs outside the project boundary that is significant and reasonably attributable to the project during the crediting period. The project boundary shall encompass all anthropogenic emissions of GHGs under the control of the project participants that are significant and reasonably attributable to the JI project.

Therefore, leakage emissions are conservatively considered zero.

(iv) The collection and archiving of information on environmental impacts, in accordance with procedures as required by the host Party, where applicable.

The host Party does not require the collection and archiving of information on environmental impacts of this project activity type.

[67] *Zhelezko U. Rate setting of process losses of electricity in grids – new calculation methodology. / / Electric technology news. Informational edition. № 5 (23), 2003.*

(v) Quality assurance and control procedures for the monitoring process.

All measurements are conducted with calibrated measurement equipment according to relevant industry standards. Consumption of gas and electricity, generated heat are cross checked against sales receipts.
All monthly data is checked and signed off by the JI Project Manager.

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by the proposed JI project, and for leakage effects, if any. Leakage is defined as the net change of anthropogenic emissions of GHGs which occurs outside the project boundary, and that is measurable and attributable to the JI project.

The reductions of anthropogenic emissions by the proposed JI project are calculated and reported by the JI Project Management Team on a monthly basis.
Leakage equal zero.
Description of the approximate calculation, formulas, parameters, data sources and key factors are presented in D.1.2.2 below. Section D.1.3 are measure of inaccuracy for each parameter.

(vii) Documentation of all steps involved in the calculations referred to above.

All data collected as part of the monitoring are archived electronically and kept at least for 2 years after the last transfer of ERUs for the project. 100% of the data are monitored as indicated in the table below. All measurements are conducted with calibrated measurement equipment according to relevant industry standards.

Procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting
In cases if any errors, fraud, inconsistencies or situations when monitoring data are unavailable will be identified during the monitoring process special commission will appointed by project host management that will conduct a review of such case and issue an order that must also include provisions for necessary corrective actions to be implemented that will ensure such situations are avoided in future.
The project host management will also establish a communication channel that will make it possible to submit suggestions, improvement proposals and project ideas for more accurate future monitoring for every person involved in the monitoring activities. Such communications will be delivered to the project host management who is required to review these communications and in case it is found appropriate implement necessary corrective actions and improvements. Project participant - will conduct periodic review of the monitoring plan and procedures and if necessary propose improvements to the project participants. Also, to prevent the situations in which monitoring data are unavailable, all parameters are fixed and saved on paper and electronically in a database the Owner and Developer of the project separately.

Emergency preparedness for cases where emergencies can cause unintended emissions
The project operation does not foresee any factors or emergencies that can cause unintended GHG emissions. Safe operation of equipment and personnel is ensured by systematic safety training. Procedures for dealing with general emergencies such as fire, major malfunction etc. are developed as part of the mandatory business regulations and are in accordance with local requirements.

Indicator of project performance

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *fuel saving*. It can be identified as a difference between baseline fuel consumption and fuel consumption after project implementation. If boilers consume fuel at the projected level, than all other relevant indicators such as efficiencies of new boilers and burners as well as heat losses in pre-insulated pipes are adequate.

Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination
Parameters B1.2, B2.2, B2.3, B2.19 mentioned below.

Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), but that are not already available at the stage of determination
None

Data and parameters that are monitored throughout the crediting period
All parameters mentioned in tables **D.1.1.1., D.1.1.3.** excluded parameters B1.2, B2.2, B2.3, B2.19.

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

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

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

Sub-project 1								
P1.1	*PEy* Greenhouse gasses project emission	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	See section D.1.1.2.
P1.2	*SFRy* Specific Fuel Rate in year *y*	calculations	tef/GJ	m/c	Monthly/ annually	100%	Electronic and paper	
P1.3	*SFiy* The share of fuel *i* consumed for energy production in year *y*	Scales, gas meter, fuel meter	ratio	m/c	Monthly/ annually	100%	Electronic and paper	Meters measure fuel consumption in real time, then based on net caloric value fuel is calculated this parameter
P1.4	*OXIDiy* Oxidation factor of the fuel *i* in year *y*	IPCC 1996[68] and National Inventories of Ukraine[69]	ratio	e	annually	100%	Electronic and paper	See section B.1.
P1.5	*EFiy* Emission factor of the fuel *i* in	IPCC 1996[70] and National Inventories of Ukraine[71]	tCO2/TJ	e	annually	100%	Electronic and paper	See section B.1.

[68] http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm

[69] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

[70] http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm

[71] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

	year *y*							
P1.6	*AHSy* The amount of the output heat in period *y*	Data of the company	Gkal	m/c	Monthly/annually	100%	Electronic and paper	Measured continuously with daily, monthly and annually archiving.
Sub-project 2								
P2.1	*PEy* Greenhouse gasses project emission	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	See section D.1.1.2.
P2.2	B_r Fuel consumption at boiler houses:	Every Boiler house		m	Every day	100%	Registered in the journal (paper and/or electronic)	Consumption of fuel is the main data, which allows to calculate greenhouse gas emissions in the period
P2.2.1	Natural Gas		1000 m^3					
P2.3	HCV_r Average annual Heating Value of a fuel calculated by Lower Heating Value	Fuel Supplier's Report or Chem. Lab Analysis Report		m, c	Once per month/annually	100%	Registered in the journal (paper and/or electronic)	Data, which allows to calculate greenhouse gas emissions in the period
P2.4.1	Natural Gas		MJ/m^3					
P2.5	P_r	Boiler houses	MWh	m	monthly/an	100%	Registered in the	Data, which allows

	Power consumption	and heating points where frequency controllers, new pumps and heat exchangers will be installed, as well as heat pump station			nually		journal (paper and/or electronic)	to calculate greenhouse gas emissions in the period
Sub-project 3								
P3.1	*PEy* Greenhouse gasses project emission	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	

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

Sub-project 1

The Project emission is being calculated as follows:

$$PEy = 29,3*\sum(SFRy * SFiy * OXIDi * EFi) * (4,187*AHSy) \quad \textbf{(1.1)}$$

where:

PEy– project emission in period *y*, tons of CO2;
SFRy – specific fuel rate of the HPP in period *y*, tef/GJ;
SFiy - share of fuel *i* (coal, natural gas or a heavy fuel oil), consumed in period *y*, ratio;
OXIDiy – oxidation factor of the fuel *i*,ratio;
EFiy - emission factor of the consumed fuel *i*, tons of CO2/GJ;

AHSy – amount of the output heat of the HPP in period *y*, Gkal;
4,187 - conversion factor, GJ/Gkal.
29,3 - conversion factor, GJ/tef

$SFRy = \sum(Fiy)/(4{,}187*AHSy)$ **(1.2)**

where

SFRy – specific fuel rate of the HPP in period *y*, tef/GJ;
Fiy – amout of fuel *i* consumed in period *y*, tef.;
AHSy – amount of the output heat of the HPP in period *y*, Gkal;
4,187 - conversion factor, GJ/Gkal.

Sub-project 2

$$E_i^r = E_{1i}^r + E_{cons\,i}^r ; \quad (2.1)$$

where:
E_{1i}^r – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the reporting period, t CO_2e;
$E_{cons\,i}^r$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the reporting period, t CO_2e.

$$E_{1i}^r = HCV_r * Cef_r * B_{ri} , \quad (2.2)$$

where:
B_{ri} – amount of fuel consumed by a boiler-house in the reporting period, ths m^3 or tons;
HCV_{ri} – Average annual lower heating value for each type of fuel, MJ/m^3 (MJ/kg)
Cef_i – carbon dioxide emission factor for each type of fuel, $ktCO_2/TJ$;

$$E_{cons\,i}^r = P_r * EFgrid \quad (2.3)$$

where:

P_r – electric power consumption by the boiler-houses and central heating points with energy saving measures implemented (frequency controllers, new pumps and heat exchangers will be installed), MWh;
EFgrid – Carbon dioxide emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh;
[$_r$] index – related to the reporting period

Sub-project 3

The mission reduction will be achieved by reducing power losses in the company's power grids which in its turn will be achieved as a result of the project implementation.

Since the baseline emissions are calculated based on difference between of power loss before and after the project implementation, consequently the project emission will equal zero.

$$PE_y = 0$$

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proamount of data to be monitored	How will the data be archived? (electronic/ hard copy)	Comment
Sub-project 1								
B1.1	BE_y Baseline emissions	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	
B1.2	*SFRb* Specific Fuel Rate in year *y*	Historical data	tef/GJ	c	Before start	100%	Electronic and paper	
B1.3	*SFiy*	Scales, gas	ratio	m/c	Monthly/	100%	Electronic and	Meters measure

	The share of fuel *i* consumed for energy production in year *y*	meter, fuel meter			annually		paper	fuel consumption in real time, then based on net caloric value fuel is calculated this parameter
B1.4	*OXIDiy* Oxidation factor of the fuel *i* in year *y*	IPCC 1996[72] and National Inventories of Ukraine[73]	ratio	e	annually	100%	Electronic and paper	See section B.1.
B1.5	*EFiy* Emission factor of the fuel *i* in year *y*	IPCC 1996[74] and National Inventories of Ukraine[75]	tCO2/TJ	e	annually	100%	Electronic and paper	See section B.1.
B1.6	*AHSy* The amount of the output heat in period *y*	Data of the company	Gkal	m/c	Monthly/annually	100%	Electronic and paper	Measured continuously with daily, monthly and annually archiving.
Sub-project 2								
B2.1	BE_y Baseline emissions	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	See section D.1.1.2.
B2.2	B_b	Data of the company,		m	Before start	100%	Registered in	Fuel

[72] http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm

[73] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

[74] http://www.ipcc-nggip.iges.or.jp/public/gl/invs6a.htm

[75] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

	Fuel consumption at boiler houses	boiler house					the journal (paper and/or electronic form)	consumption at boiler houses is the main data which allows to calculate GHG emissions in the baseline period
B2.2.1	Natural Gas		1000 m^3	m				
B2.3	HCV_b Average annual Heating Value of a fuel calculated by Lower Heating Value	Fuel Supplier's Report or Chem. Lab Analysis Report		m, c	Before start	100%	(paper and/or electronic)	Data, which allows to calculate greenhouse gas emissions in the period
B2.3.1	Natural Gas		MJ/m^3					
B2.4	$T_{out\ b}$ *and* $T_{out\ r}$ Average outside temperature during the heating season	Meteorological Service	^0C (K)	m, c	Monthly/annually Daily temperature is registered every day	100%	Report of Meteorological Service (paper and/or electronic form)	Auxiliary data which allows correcting of the dynamic baseline
B2.5	$T_{in\ b}$ *and* $T_{in\ r}$ Average inside temperature during the heating season	Data of the company	^0C (K)	m,c	Ones per heating period	100%	paper and/or electronic form	Auxiliary data which allows correcting of the dynamic baseline
B2.6	n_{wb} *and* n_{wr} Number of Customers	Data of the company	Number	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the

								dynamic baseline
B2.7	$F_{h\,b}$ *and* $F_{h\,r}$ Heating area (total)	Data of the company	m^2	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.8	k_{hb} Average heat transfer factor of heated buildings in the base period	SNIP 2.3.79 (1998)	kW/m^2*K	e	Once	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.9	$F_{h\,t\,r}$ Heating area of buildings (previously existed in the base period) with the renewed (improved) thermal insulation in the reporting period	Data of the company	m^2	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.10	$F_{h\,n\,r}$ Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reporting period	Data of the company	m^2	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.11	$k_{h\,n}$ Heat transfer factor of buildings with new	State Buildings Norms (B.2.6-31:2006)	kW/m^2*K	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the

	thermal insulation							dynamic baseline
B2.12	N_{hb} *and* N_{hr} Heating period duration	Data of the company	Hours	m	Monthly/annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.13	N_{wb} *and* N_{wr} Duration of period of hot water supply service	Data of the company	Hours	m	Monthly/annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.14	L_h^b *and* L_h^r Maximum connected load to the boiler-house, that is required for heating	Data of the company	Gkal	c	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.15	L_w^b *and* L_w^r Connected load to the boiler-house, that is required for hot water supply service	Data of the company	Gkal	c	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.16	v_{wr} *and* v_{wb} Standard specific discharge of hot water per personal account	Data of the company	kWh/h	e	Once	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the dynamic baseline
B2.17	Cef_b *and* Cef_r Carbon dioxide emission factor	National Inventory [76]	kt CO_2/TJ	e	Annually	100%	Special report (paper and/or electronic)	Auxiliary data which allows correcting the

[76] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

								dynamic baseline
B2.17.1	Natural Gas							
B2.18	*g* Recalculating factor for average load during heating period	Data of the company	ratio	e	Once per monitoring period	100%	Special Reports (paper and/or electronic)	
B2.19	P_b Electricity consumption	Boiler houses and heating points where frequency controllers, new pumps and heat exchangers will be installed, as well as heat pump station	MWh	m	Before start	100%	Registered in data journal (in paper and electronic form)	Data which allows to calculate GHG emissions in the base period
Sub-project 3								
B3.1	BE_y Baseline emissions	calculations	tCO2e	c	Monthly/ annually	100 %	Electronic and paper	
B3.2	V_y Power loss reduction in power distribution system during period *y*	Greenhouse gas emission monitoring	MWh	c	annually	100 %	Electronic and paper	Calculated in line with approved methodology [77]
B3.3	*EFgrid* CO_2 emission factor in grid of Ukraine for the the power replacement projects in the year y	DFP Orders	t CO_2e/MWh	e	annually	100%	Electronic and paper	All reference documents listed in section B.1

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

[77] http://www.neia.gov.ua/nature/doccatalog/document?id=129688

Sub-project 1

$SFRy = \sum(Fiy) / (4.187 * AHSy)$ **(1.1)**

where

SFRy – specific fuel rate of the HPP in period *y*, tef/GJ;
Fiy – amout of fuel *i* consumed in period *y*, tef.;
AHSy – amount of the heat output in period *y*, Gkal;
4.187 - conversion factor, GJ/Gkal.

$BEy = 29{,}3 * \Sigma (SFR_b * SFiy * OXIDi * EFi) * 4{,}187 * AHSy$ **(1.2)**

where:

BEy – Baseline emission in period *y*, tons of CO2;
SFR_b – specific fuel rate of the heat and heat and power plant in the Baseline Scenario, tef/GJ;
SFiy - share of fuel *i* (coal, natural gas or a heavy fuel oil), consumed in period *y*, ratio;
OXIDiy – oxidation factor of the fuel *i*,ratio;
EFiy - emission factor of the fuel *i* consumed, tons of CO2/GJ;
AHSy – amount of the heat output in period *y*, Gkal;
4.187 - conversion factor, GJ/Gkal.
29.3 - conversion factor, GJ/tef

$SFRb = \sum((Fib) / (4.187 * AHSb))$ **(1.3)**

where:

SFRb - specific fuel rate of the heat and heat and power plant in the Baseline Scenario, tef/GJ;
Fib – amout of fuel *i* consumed in the Baseline Scenario, tef.;
AHSb– amount of the heat output of the HPP in the Baseline Scenario, Gkal;
4.187 - conversion factor, GJ/Gkal.

Sub-project 2

$$E_i^b = E_{1i}^b + E_{cons\,i}^b, \quad (2.\ 1)$$

where:
E_{1i}^b – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base period, t CO_2e;
$E_{cons\,i}^b$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the base period, t CO_2e.

For each i boiler-house:

$$E_1^b = HCV_b * Cef_b * B_b; \quad (2.\ 2)$$

$$E_{cons}^b = P_b * EFgrid, \quad (2.\ 3)$$

where:

HCV_b – lower heating value of fuel in the baseline scenario, MJ/m^3 (MJ/kg);
Cef_b – carbon dioxide emission factor of fuel combustion in the baseline scenario, kt CO_2/TJ;
B_b – fuel consumption by a boiler-house in the baseline scenario, ths m^3 or tons;
P_b – electric power consumption by a boiler-house where energy saving measures are scheduled to be implemented, MWh;
EFgrid – carbon dioxide emission factors for reducing electricity consumption in Ukraine[78], tCO_2e/MWh;

[$_b$] index – related to the base period;

If any boiler-house consumes more than one type of fuel, the calculations of E are to be made for each type of fuel separately, and results are to be summed.

According to the Dynamic Baseline assumption, the efficient value of E_1^b may be defined as follows:

[78] *For the years 2008-2011 – NEIA Orders No.43 dated 28.03.2011, No.62 dated 15.04.2011, No.63 dated 15.04.2011,No.75 dated 12.05.2011*

http://neia.gov.ua/nature/control/uk/publish/category?cat_id=111922

$$E_{1i}^{b} = E_{hi}^{b} + E_{wi}^{b}, \quad (2.4)$$

where the first term describes emissions from fuel consumption for heating, and the second one – from fuel consumption for hot water supply.

For the case when in the base period the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is:

$$E_1^{b} = HCV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_b * (1-a_b) * K_1 * K_w], \quad (2.5)$$

where the first term in brackets describes fuel consumption for heating, and the second one – fuel consumption for hot water supply.

For the case when in the base period the hot water supply service was absent at all ($(1-a_b) = 0$), and in the reporting period this service was provided (due to improvement of heat supply service quality for population), the formulae for E_1^b is:

$$E_1^{b} = HCV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_r * (1-a_r) * K_1 * K_{w0}], \quad (2.6)$$

where:
HCV_b – lower heating value, MJ/m^3 (MJ/kg);
Cef_b – carbon dioxide emission factor, kt CO_2/TJ;
$B_{b,r}$ – amount of fuel consumed by a boiler-house, ths m^3 or tons per period;
K_1, K_h, K_w, K_{w0} – adjustment factors;
$a_{b,r}$ – portion of fuel (heat), consumed for heating purposes;
$(1-a_r)$ – portion of fuel (heat), consumed for hot water supply services;
$[_b]$ index – related to the base period;
$[_r]$ index – related to the reporting period.

$$a_b = L_h^{b} * g * N_h^{b} / (L_h^{b} * g * N_h^{b} + L_w^{b} * N_w^{b}); \quad (2.7)$$
$$a_r = L_h^{r} * g * N_h^{r} / (L_h^{r} * g * N_h^{r} + L_w^{r} * N_w^{r}), \quad (2.8)$$

where:
L_h, L_w – maximum connected load to the boiler-house, that is required for heating and for hot water supply service, MW;
g – recalculating factor for average load during heating period (is determined for each boiler-house on historical base, usually is in the range 0,4 – 0,8);
N_h, N_w – duration of heating period and period of hot water supply service per period, hours.

Adjustment factors:

K_1 (change in the lower heating value of fuel):

$$K_1 = HCV_b / HCV_r, \quad (2.\ 9)$$

Adjustment factors for heating should be used for creation the Dynamic Baseline which takes into account changes of the external factors such as weather conditions, heating area, etc.

Fuel consumption for heating is proportional to the required amount of heat during heating period, Q_h:

$$B_h = B_b * a_b = Q_h / HCV_b * \eta, \quad (2.\ 10)$$

where η is overall heating system efficiency.

According to the assumption of the Dynamic Baseline, the required amount of heat in the base period for correct comparison should be reduced to real conditions (external to the project) in the reporting period:

$$Q_{h\,br} = Q_{h\,b} * K_h = Q_{h\,r}, \quad (2.\ 11)$$

where:
$Q_{h\,br}$ – required heat for Dynamic Baseline, is assumed equal to Q_r – required heat in the reporting period,
$Q_{h\,b}$ – required heat in the base period,
K_h – averaged adjustment factor for heating.

From this 2. it is possible to determine the averaged adjustment factor:

$$K_h = Q_{h\,r} / Q_h, \quad (2.\ 12)$$

Required amount of heat for heating of buildings during a year, according to the "Codes and regulations on rationing of fuel and heat energy for heating of residential and public buildings, as well as for communal and domestic requirements in Ukraine. KTM 204 Ukraine 244-94"[79], is determined by [ibid, 2. 2.17]:

[79] Codes and regulations on rationing of fuel and heat energy for heating of residential and public buildings, as well as for communal and domestic requirements in Ukraine. KTM 204 Ukraine 244-94. Kyiv, 2001, 376 p.

$$Q_h = F_h * k_h * (T_{in} - T_{out}) * N_h, \quad (2.\ 13)$$

where:
Q_h – required amount of heat for heating, kWh;
F_h – heating area of buildings, m^2;
k_h – average heat transfer factor of buildings, kW/m^2*K;
T_{in} – average inside temperature for the heating period, K (or ^0C);
T_{out} – average outside temperature for the heating period, K (or ^0C);
N_h – duration of the heating period per period, hours.

Then:

$$K_h = (F_{h\,r} * k_{h\,r}) * (T_{in\,r} - T_{out\,r}) * N_{h\,r} / F_{h\,b} * k_{h\,b} * (T_{in\,b} - T_{out\,b}) * N_{h\,b}\ , \quad (2.\ 14)$$

2.1. K_2 (temperature change factor):

$$K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b}), \quad (2.\ 15)$$

2.2. K_3 (heating area and building thermal insulation change factor):

$$K_3 = (F_{h\,r} * k_{h\,r}) / F_{h\,b} * k_{h\,b} = [(F_{h\,r} - F_{h\,t\,r} - F_{h\,n\,r}) * k_{h\,b} + (F_{h\,n\,r} + F_{h\,t\,r}) * k_{h\,n}] / F_{h\,b} * k_{h\,b}, \quad (2.\ 16)$$

where:
$F_{h\,b}$ – heating area of buildings in the base period, m^2;
$F_{h\,r}$ – heating area of buildings in the reporting period, m^2;
$F_{h\,n\,r}$ – heating area of new buildings connected to DH system (assumed with the new (improved) thermal insulation) in the reporting period, m^2;
$F_{h\,t\,r}$ – heating area of buildings (previously existed in the base period) in reporting period with the renewed (improved) thermal insulation, m^2;
$k_{h\,b}$ – average heat transfer factor of heated buildings in the base period, W/m^2*K;
$k_{h\,r}$ – average heat transfer factor of heated buildings in the reporting period, W/m^2*K;
$k_{h\,n}$ – heat transfer factor of heated buildings with the new thermal insulation (new buildings or old ones with improved thermal insulation), W/m^2*K.

2.3. K_4 (heating period duration change factor):

$$K_4 = N_{h\,r} / N_{h\,b} \quad (2.\ 17)$$

where:
$N_{h\,b}$ – duration of the heating period in the base period, hours;
$N_{h\,r}$ – duration of the heating period in the reporting period, hours.

Thus,

$$K_h = K_2 * K_3 * K_4 , \quad (2.\ 18)$$

3. Adjustment factors for hot water supply service should be used for creation the Dynamic Baseline which takes into account changes of the external factors such as weather conditions, number of customers, etc.:

Fuel consumption for hot water supply service is proportional to the required amount of heat during the service rendered period, Q_w:

$$B_w = B_b*(1-a_b) = Q_w / HCV_b * \eta , \quad (2.\ 19)$$

where η is overall hot water supply system efficiency.

According to the assumption of the Dynamic Baseline, the required amount of heat for hot water supply service in the base period for correct comparison should be reduced to real conditions (external to the project) in the reporting period:

$$Q_{w\,br} = Q_{w\,b} * K_w = Q_{w\,r} , \quad (2.\ 20)$$

where:
$Q_{w\,br}$ – required heat for hot water supply service for Dynamic Baseline, is assumed equal to $Q_{w\,r}$ – required heat for hot water supply service in the reporting period,
$Q_{w\,b}$ – required heat for hot water supply service in the base period,
K_w – averaged adjustment factor for hot water supply service.

From this 2. it is possible to determine the averaged adjustment factor:

$$K_w = Q_{w\,r} / Q_{w\,b.} \quad (2.\ 21)$$

The components of K_w may be illustrated by correlation of heat used for hot water supply service in the base and reporting periods:

$$Q_w = n_w * v_w * N_w, \quad (2.\ 22)$$

where:

Q_w – required amount of heat for hot water supply service, kWh;
n_w – average number of service's customers, personal accounts;
v_w – standard specific discharge of hot water per personal account (in heat units, kWh/h);
N_w – duration of the service period per period, hours.

Then:

$$K_w = n_{w\,r} * v_{w\,r} * N_{w\,r} / n_{w\,b} * v_{w\,b} * N_{w\,b}, \quad (2.\ 23)$$

3.1. K_5 (number of customers change factor):

$$K_5 = n_{w\,r} / n_{w\,b}, \quad (2.\ 24)$$

3.2. K_6 (standard specific discharge of hot water per personal account change factor):

$$K_6 = v_{w\,r} / v_{w\,b}, \quad (2.\ 25)$$

At present the standard specific discharge of hot water is valid in Ukraine that was established by the KTM 204 Ukraine 244-94[1] in 1993. and no information is available on any propositions to change it, thus $K_6 = 1$ and does not require special monitoring.

3.3. K_7 (hot water supply period duration change factor):

$$K_7 = N_{w\,r} / N_{w\,b}, \quad (2.\ 26)$$

where:
$N_{w\,b}$ – duration of the hot water supply period in the base period, hours;
$N_{w\,r}$ – duration of the hot water supply period in the reporting period, hours.

Thus,

$$K_w = K_5 * K_6 * K_7. \quad (2.\ 27)$$

3.4. Adjustment factors for hot water supply service in case when there was no hot water supply service in base period, and in the reporting period this service was provided:

Since in case when there was no hot water supply service in base period, number of customers, standard specific discharge of hot water per personal account and duration of hot water supply period in the base period are assumed to be equal to these values in the reporting period,

$K_5 = K_6 = K_7 = 1.$ (2. 28)

Thus

$K_{w0} = 1.$ (2. 29)

If data for the calculation of any of the coefficients K_1-K_7, K_w, K_h, a_r, a_b are unavailable conservative coefficient for which this assumption applies is taken equal to 1.

Sub-project 3

Therefore, the baseline emissions are:

$$BE_y = V_y \cdot CEF_y, \quad (3.1)$$

where

BE_y = baseline emissions (tCO2e);

V_y = total technical loss reduction in the power distribution system during the period *y* of the project scenario compared with the baseline, MWh;

CEF_y = CO_2 emission factor in UPS of Ukraine for the the power replacement projects in the period y, tCO_2e/MWh;

y = the period for which estimates are made.

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

This section is left blank on purpose, as option 1 is chosen.

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

This section is left blank on purpose, as option 1 is chosen.

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

This section is left blank on purpose, as option 1 is chosen.

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

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. Project participants must undertake an assessment of the potential leakage of the proposed JI project and explain which sources of leakage are to be calculated, and which can be neglected. All sources of leakage that are included shall be quantified and a procedure for an ex ante estimate shall be provided.

No leakage is expected. Dynamic baseline (based on collected monitoring data) will exclude all possible leakages.

D.1.3.1.If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number (Please use numbers to ease cross-	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proamount of data to be monitored	How will the data be archived? (electronic/	Comment

referencing to D.2.)							paper)	

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

No leakages are expected.

The project is not expected any activity that could lead to the formation of leakage.

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

Emissions reductions are defined by the following equation:

$$ER_y = BE_y - (PE_y + LE_y),$$

Where:

ER_y = emission reduction during the period y, t CO2e;
BE_y = baseline emission of the greenhouse gases in the period y, t CO2e;
PE_y = greenhouse gases emission caused by the project activity in the period y, t CO2e;
LE_y = leakage emission in the period y , t CO2e.

D.1.5. Where applicable, in accordance with procedures as required by the Host Party, information on the collection and archiving of information on the environmental impacts of the project:

The project implementation does not require gathering of information on the influence on the environment in excess of information collected at the company prior to the project inception.

D.2. 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.
Sub-project 1		
P1.1	*low*	Calculated on the basis of the parameters P1.3 -P1.6
P1.2	*low*	Calculated on the basis of the parameters P1.3 and P1.6
P1.3(B1.3)	*low*	The gas meter is controlled and calibrated by the gas supplying company in accordance with its procedures and current legislation. The defected meter should be replaced. Inaccuracy of measurement devices included in the calculations. Data about used fuel oil are checked by the payments for purchased fuel, and are commercial.
P1.4 (B1.4)	*low*	Data from the National Inventory. Quality assurance is not required.
P1.5 (B1.5)	*low*	Data from the National Inventory. Quality assurance is not required.
P1.6 (B1.6)	*low*	Measuring instruments must be calibrated according to national regulations. The defected meter should be replaced. Inaccuracy of measurement devices included in the calculations. These data are used in commercial activities of the company. Statistical reports.
B1.1	*low*	Calculated on the basis of the parameters B1.2-B1.6
B1.2	*low*	Calculated on the basis of historical data from the meters of used fuel and generated heat and electricity. The gas meter is controlled and calibrated by the gas supplying company in accordance with its procedures and current legislation. The defected meter should be replaced. Inaccuracy of measurement devices included in the calculations. Data about used fuel oil are checked by the payments for purchased fuel, and are commercial. The data from the controlled electric meter are controlled after installation and regularly controlled and calibrated in accordance with the service instruction of the producer and national regulations. The defected meter should be replaced.
Sub-project 2		

P2.1	*low*	Calculated on the basis of the parameters P2.2-P2.5
P2.2 (P2.2.1, B2.2, B2.2.1)	*low*	Measuring instruments must be calibrated according to national regulations. The defected meter should be replaced. Inaccuracy of measurement devices included in the calculations.
P2.3 (P2.4.1, B2.3, B2.3.1)	*low*	Measuring instruments must be calibrated according to national regulations. Data of laboratory studies.
P2.5 (B2.19)	*low*	The data from the controlled electric meter are controlled after installation and regularly controlled and calibrated in accordance with the service instruction of the producer and national regulations. The defected meter should be replaced.
B2.1	*low*	Calculated on the basis of the parameters B2.2-B2.19
B2.4	*low*	Measuring instruments must be calibrated according to national regulations. Data of weather service.
B2.5	*low*	Calculated from the sum of returned payments caused by insufficient heating (in case of normative level is not satisfied. Quality assurance is not required.
B2.6	*low*	Statistical data. Quality assurance is not required.
B2.7	*low*	Statistical data. Quality assurance is not required.
B2.8	*low*	Data from the regulations. Quality assurance is not required.
B2.9	*low*	Statistical data. Quality assurance is not required.
B2.10	*low*	Statistical data. Quality assurance is not required.
B2.11	*low*	Data from the regulations. Quality assurance is not required.
B2.12	*low*	Statistical data. Quality assurance is not required.
B2.13	*low*	Statistical data. Quality assurance is not required.
B2.14	*low*	Calculated on the basis of regulations using parameters B2.4, B2.5
B2.15	*low*	Calculated on the basis of regulations using parameters B2.4, B2.5
B2.16	*low*	Data from the regulations. Quality assurance is not required.
B2.17 (B2.17.1)	*low*	Data from the National Inventory. Quality assurance is not required.
B2.18	*low*	Calculated on the basis of the parameters B2.4
Sub-project 3		
P3.1	*low*	Equal to 0. Quality assurance is not needed.
B3.1	*low*	Calculated on the basis of the parameters B3.2-B3.3

B3.2	*low*	Determined according to the approved methodology based on statistical data of the company.
B3.3	*low*	For the calculations are used only approved coefficients.

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

1. Introduction

The project adopts a JI specific monitoring approach. This monitoring plan describes the responsibilities of the JI Project Management Team and the methods and procedures to be adopted to implement the monitoring plan described in the Project Design Document in respect of this project activity.

2. Project Management & Responsibilities

The operational and management structure (as shown in below the figure) and the responsibilities of the principals are as follows. Ultimate responsibility for the project rests with the JI Project Manager.

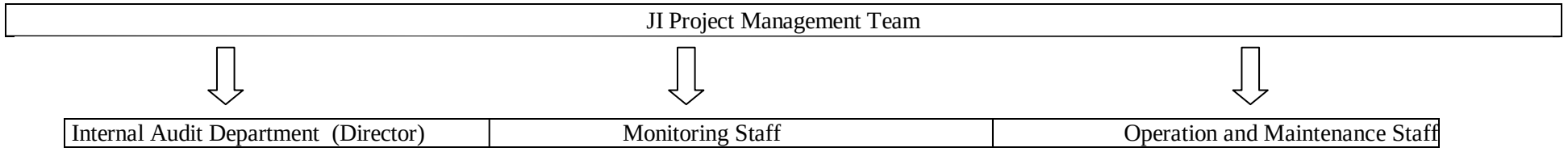

Fig.18 The management structure of the project

The JI Project Manager is responsible for:

- Checking and signing off all project operational-related activities
- Appointing and liaising with the accredited independent entity (AIE)
- Identifying an audit team leader to be appointed by the Chief Engineer or a delegated authority
- Appointing a JI technical team to undertake the operational activities
- Organizing training and refresher courses
- Preparing and supervising a Health and Safety Plan for the JI technical team
- Supervising the work of the JI technical team

- Cross checking reported volumes and sales receipts

Internal Audit Department (Director)

The project owner – KYIVENERGO PJSC will implement provisions of this monitoring plan into its organizational and quality management structure. For monitoring, collection, registration, visualization, archiving, reporting of the monitored data and periodical checking of the measurement devices the management team headed by the management led by Project Manager according to the order № 750 dated 01/11/2012.

The monitoring staff is responsible for:

- Monitoring and recording of the relevant parameters

The operation and maintenance staff are responsible for:

- Operation and maintenance of the project infrastructure
- Service and maintenance equipment is performed by technical personnel of KYIVENERGO PJSC.

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

Contact information of the entity and persons responsible:
Thomas Winklehner , OHANA LLP
Email tw@ohanallp.com Tel/Fax: +44 208 786 0751.
OHANA LLP is a project participant listed in annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The formulas used to estimate anthropogenic emissions by sources of greenhouse gases, a description of the calculations according to these formulas and all used assumptions are described in Section D.1.1.2.

Sub-project 1

Year	Estimated emissions in Project scenario, t CO_2e
2004	0
2005	0
2006	3877361
2007	3537693
2004-2007	**7415054**
2008	3355990
2009	3356897
2010	3429691
2011	3456718
2012	3456718
2008-2012	**17056014**
2013	3456718
2014	3456718
2015	3456718
2016	3456718
2017	3456718
2018	3456718
2019	3456718
2020	3456718
2021	3456718
2022	3456718
2013-2022	**34567180**
2004-2022	**59038248**

Table.20 Estimated emissions in Project scenario

Sub-project 2

Year	Estimated emissions in Project scenario, t CO_2e
2004	1831025
2005	1780623

2006	1783711
2007	1714250
2004-2007	**7109609**
2008	1668446
2009	1745453
2010	1799270
2011	1803389
2012	1742043
2008-2012	**8758601**
2013	1742043
2014	1742043
2015	1742043
2016	1742043
2017	1742043
2018	1742043
2019	1742043
2020	1742043
2021	1742043
2022	1742043
2013-2022	**17420430**
2004-2022	**33288640**

Table.21 Estimated emissions in Project scenario

Sub-project 3
$PE_y = 0$.

Year	Sub-project 1	Sub-project 2	Sub-project 3	Total Estimated Emissions in Project scenario, t CO_2e
2004	0	1831025	0	1831025
2005	0	1780623	0	1780623
2006	3877361	1783711	0	5661072
2007	3537693	1714250	0	5251943
2004-2007	**7415054**	**7109609**	**0**	**14524663**
2008	3355990	1668446	0	5024436
2009	3356897	1745453	0	5102350
2010	3429691	1799270	0	5228961
2011	3456718	1803389	0	5260107
2012	3456718	1742043	0	5198761
2008-2012	**17056014**	**8758601**	**0**	**25814615**
2013	3456718	1742043	0	5198761
2014	3456718	1742043	0	5198761
2015	3456718	1742043	0	5198761
2016	3456718	1742043	0	5198761
2017	3456718	1742043	0	5198761

2018	3456718	1742043	0	5198761
2019	3456718	1742043	0	5198761
2020	3456718	1742043	0	5198761
2021	3456718	1742043	0	5198761
2022	3456718	1742043	0	5198761
2013-2022	**34567180**	**17420430**	**0**	**51987610**
2004-2022	**59038248**	**33288640**	**0**	**92326888**

Table.22 Estimated emissions in Project scenario for all sub-projects

Note: Project emissions conservatively rounded to the upper an integer tone

E.2. Estimated leakage:

Leakage is not expected.

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

Project Emissions + Leakages

Year	Total Estimated Emissions in Project scenario, t CO_2e	Total Estimated Leakages, t CO_2e	Total, t CO_2e
2004	1831025	0	1831025
2005	1780623	0	1780623
2006	5661072	0	5661072
2007	5251943	0	5251943
2004-2007	**14524663**	**0**	**14524663**
2008	5024436	0	5024436
2009	5102350	0	5102350
2010	5228961	0	5228961
2011	5260107	0	5260107
2012	5198761	0	5198761
2008-2012	**25814615**	**0**	**25814615**
2013	5198761	0	5198761
2014	5198761	0	5198761
2015	5198761	0	5198761
2016	5198761	0	5198761
2017	5198761	0	5198761
2018	5198761	0	5198761
2019	5198761	0	5198761
2020	5198761	0	5198761
2021	5198761	0	5198761
2022	5198761	0	5198761
2013-2022	**51987610**	**0**	**51987610**
2004-2022	**92326888**	**0**	**92326888**

Table.23 Total estimated project emissions and leakages

Note about Sub-project 3. Since the leakage LEy = 0, and the project emissions $PE_y = 0$ the sum of the leakage and project emissions $PE_y + LE_y = 0$.

E.4. Estimated baseline emissions:

The formulas used to estimate the baseline anthropogenic emissions by sources of greenhouse gas emissions using the baseline methodology, description of calculations by these formulas and all the used assumptions are described in Section D.1.1.4.

Sub-project 1

Year	Estimated emissions in Baseline scenario, t CO_2e
2004	0
2005	0
2006	4799728
2007	4638556
2004-2007	**9438284**
2008	4385831
2009	4643342
2010	4713222
2011	4459930
2012	4459930
2008-2012	**22662255**
2013	4459930
2014	4459930
2015	4459930
2016	4459930
2017	4459930
2018	4459930
2019	4459930
2020	4459930
2021	4459930
2022	4459930
2013-2022	**44599300**
2004-2022	**76699839**

Table.24 Estimated emissions in Baseline scenario

Sub-project 2

Year	Estimated emissions in Baseline scenario, t CO_2e
2004	1969221
2005	1969221
2006	1969221
2007	1969221
2004-2007	**7876884**
2008	1969221

2009	1969221
2010	1969221
2011	1969221
2012	1969221
2008-2012	**9846105**
2013	1969221
2014	1969221
2015	1969221
2016	1969221
2017	1969221
2018	1969221
2019	1969221
2020	1969221
2021	1969221
2022	1969221
2013-2022	**19692210**
2004-2022	**37415199**

Table.25 Estimated emissions in Baseline scenario

Sub-project 3

Year	**Estimated emissions in Baseline scenario, t CO_2e**
2004	
2005	30353
2006	55530
2007	60105
2004-2007	**145988**
2008	222367
2009	252867
2010	265117
2011	341591
2012	341591
2008-2012	**1423533**
2013	341591
2014	341591
2015	341591
2016	341591
2017	341591
2018	341591
2019	341591
2020	341591
2021	341591
2022	341591

2013-2022	**3415910**
2004-2022	**4985431**

Table.26 Estimated emissions in Baseline scenario

Year	Sub-project 1	Sub-project 2	Sub-project 3	Total Baseline emissions, t CO_2e
2004	0	1969221		1969221
2005	0	1969221	30353	1999574
2006	4799728	1969221	55530	6824479
2007	4638556	1969221	60105	6667882
2004-2007	**9438284**	**7876884**	**145988**	**17461156**
2008	4385831	1969221	222367	6577419
2009	4643342	1969221	252867	6865430
2010	4713222	1969221	265117	6947560
2011	4459930	1969221	341591	6770742
2012	4459930	1969221	341591	6770742
2008-2012	**22662255**	**9846105**	**1423533**	**33931893**
2013	4459930	1969221	341591	6770742
2014	4459930	1969221	341591	6770742
2015	4459930	1969221	341591	6770742
2016	4459930	1969221	341591	6770742
2017	4459930	1969221	341591	6770742
2018	4459930	1969221	341591	6770742
2019	4459930	1969221	341591	6770742
2020	4459930	1969221	341591	6770742
2021	4459930	1969221	341591	6770742
2022	4459930	1969221	341591	6770742
2013-2022	**44599300**	**19692210**	**3415910**	**67707420**
2004-2022	**76699839**	**37415199**	**4985431**	**119100469**

Table.27 Estimated emissions in Baseline scenario for all sub-projects

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

Emission Reductions = (Baseline Emissions) – (Project Emissions+Estimated leakages)
Amount of the Emission Reduction, t CO_2e:

Sub-project 1

Year	Estimated emissions reduction , t CO_2e
2004	0
2005	0
2006	922367
2007	1100863
2004-2007	**2023230**
2008	1029841
2009	1286445
2010	1283531
2011	1003212

2012	1003212
2008-2012	**5606241**
2013	1003212
2014	1003212
2015	1003212
2016	1003212
2017	1003212
2018	1003212
2019	1003212
2020	1003212
2021	1003212
2022	1003212
2013-2022	**10032120**
2004-2022	**17661591**

Table.28 Estimated emissions reduction

Sub-project 2

Year	**Estimated emissions reduction , t CO_2e**
2004	138196
2005	188598
2006	185510
2007	254971
2004-2007	**767275**
2008	300775
2009	223768
2010	169951
2011	165832
2012	227178
2008-2012	**1087504**
2013	227178
2014	227178
2015	227178
2016	227178
2017	227178
2018	227178
2019	227178
2020	227178
2021	227178
2022	227178
2013-2022	**2271780**
2004-2022	**4126559**

Table.29 Estimated emissions reduction

Sub-project 3

Year	Estimated emissions reduction , t CO_2e
2004	
2005	30353
2006	55530
2007	60105
2004-2007	**145988**
2008	222367
2009	252867
2010	265117
2011	341591
2012	341591
2008-2012	**1423533**
2013	341591
2014	341591
2015	341591
2016	341591
2017	341591
2018	341591
2019	341591
2020	341591
2021	341591
2022	341591
2013-2022	**3415910**
2004-2022	**4985431**

Table.30 Estimated emissions reduction

Year	Sub-project 1	Sub-project 2	Sub-project 3	Total Estimated Emissions Reduction, t CO_2e
2004	0	138196	0	138196
2005	0	188598	30353	218951
2006	922367	185510	55530	1163407
2007	1100863	254971	60105	1415939
2004-2007	**2023230**	**767275**	**145988**	**2936493**
2008	1029841	300775	222367	1552983
2009	1286445	223768	252867	1763080
2010	1283531	169951	265117	1718599
2011	1003212	165832	341591	1510635
2012	1003212	227178	341591	1571981
2008-2012	**5606241**	**1087504**	**1423533**	**8117278**
2013	1003212	227178	341591	1571981
2014	1003212	227178	341591	1571981
2015	1003212	227178	341591	1571981
2016	1003212	227178	341591	1571981

2017	1003212	227178	341591	1571981
2018	1003212	227178	341591	1571981
2019	1003212	227178	341591	1571981
2020	1003212	227178	341591	1571981
2021	1003212	227178	341591	1571981
2022	1003212	227178	341591	1571981
2013-2022	**10032120**	**2271780**	**3415910**	**15719810**
2004-2022	**17661591**	**4126559**	**4985431**	**26773581**

Table.31 Estimated emissions reduction for all sub-projects

E.6. Table of values obtained from the aforementioned formula:

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)
2004	1831025	0	1969221	**138196**
2005	1780623	0	1999574	**218951**
2006	5661072	0	6824479	**1163407**
2007	5251943	0	6667882	**1415939**
Total (tonnes of CO_2 equivalent)	14524663	0	17461156	**2936493**

Table.32 Estimated balance of emissions under the proposed project for period from 2004 to 2007

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)
2008	5024436	0	6577419	**1552983**
2009	5102350	0	6865430	**1763080**
2010	5228961	0	6947560	**1718599**
2011	5260107	0	6770742	**1510635**
2012	5198761	0	6770742	**1571981**
Total (tonnes of CO_2 equivalent)	25814615	0	33931893	**8117278**

Table.33 Estimated balance of emissions under the proposed project over the crediting period

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)
2013	5198761	0	6770742	**1571981**
2014	5198761	0	6770742	**1571981**
2015	5198761	0	6770742	**1571981**
2016	5198761	0	6770742	**1571981**
2017	5198761	0	6770742	**1571981**
2018	5198761	0	6770742	**1571981**
2019	5198761	0	6770742	**1571981**
2020	5198761	0	6770742	**1571981**
2021	5198761	0	6770742	**1571981**
2022	5198761	0	6770742	**1571981**
Total (tonnes of CO_2 equivalent)	51987610	0	67707420	**15719810**

Table.34 Estimated balance of emissions under the proposed project for period from 2013 to 2022

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:

Sub-project 1

According to Ukrainian legislation[80], the environmental impacts of the project should be analyzed in the EIA, which is part of the project documentation, which receives approval after a comprehensive examination. For the proposed JI project was not necessary to develop a single project document, because the project is to modernize separate parts of the existing facility. The project was implemented in accordance with the documentation developed for its components (replacement capacitors, installing condensing pumps, installation of the control system of the new monitoring equipment, sensors and actuators, etc.), for which EIA is not required. So he does not pass authorization procedure, part of which is to collect comments of relevant stakeholders. Existing EIA covers measures taken at the HPP for its modernization was carried out on a voluntary basis as a measure to improve the environmental management system.

Also, these achievements are important in the cross-border impact of the project as atmospheric pollution tend to be transported over long distances from the emission source. Reducing air pollution reached by project has positive transboundary impact.

The project is located outside the national parks, species of flora and fauna species listed as endangered, in the project do not occur. In fact, the project is limited to the territory of HPP, it requires no additional territory.

Sub-project 2

According to the Ukrainian legislation, the design documentation for the new building, reconstruction and technical re-equipment of industrial and civil objects must include the environmental impact assessment, the main requirements for which are listed in the State Building Norms of Ukraine A.2.2-1-2003.

KYIVENERGO PJSC has the necessary Environmental Impact Assessment for its activity according to Ukrainian legislation.

Overall, the Project will have a positive effect on environment.

The main environmental impacts of the project caused by emissions of combustion products from the boiler (NO2, CO, SO2). These emissions are monitored annually and emissions reported to the State Environmental Inspection of Kyiv by submitting official annual statistical sample form 2-TP (air) Data on Air Protection. Emissions of these gases are within permitted levels.

Sub-project 3

List of the ecological reportings of the company:
- atmospheric air protection report;
- water usage report;
- report balance of the groundwaters usage;
- report of the environmental protection expenses and the ecological payments;
- report of the formation, handling and utilization of the I-III hazard classes wastes;
- monthly reports from all SU about the carrying out of the environmental protection measures;

[80] http://zakoni.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=45%2F95- %E2%F0

- wastes registration is carried out in every SU according to the approved typical form № 1-VT;
- package of documents is made to receive the permission and the limit for the formation and location of the wastes; permission for the emission of pollutants into the atmospheric air; permission for the special water usage.

Process of the wastes utilization is carried out in every SU of the company.
Wastes utilization procedure:
- a person in charge of the ecological problems proposes the company administration the offers of several firms, which have the economic activity licences in the sphere of the hazard wastes handling (storage, transportation, utilization) ;
- every SU chooses the firm with which it is easy to work, signs an agreement and hands over the wastes for the utilization once in a quarter and receives tax invoices as well as the acts of performed works.

Implementation of the works will not cause any substantial influences on the environment except the reduction of greenhouse gasses emissions into the atmosphere.

Transboundary impacts on the environment by the project activity are not anticipated.

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

Sub-project 1
The main environmental impacts of the project caused by emissions of combustion products from the boiler (NO2, CO, SO2). These emissions are monitored annually and emissions reported to the State Environmental Inspection of Kyiv by submitting official annual statistical sample form 2-TP (air) Data on Air Protection. Emissions of these gases are within permitted levels.

All necessary permits have been obtained in accordance with the current legislation of Ukraine, namely: Law of Ukraine "On Environmental Protection", "On Ecological Expertise", "On Protection of Atmospheric Air," "On ensuring sanitary and epidemiological welfare" and "On the local council and local government, "and according to the Water Code, Land Code and Forest Code.

Compared to the baseline, level of negative environmental impact is much lower. According to the EIA, the project has had a positive impact on the environment, particularly air quality. As a result of the project emissions of atmospheric pollutants from power plant was reduced.

Sub-project 2

Impact on the water medium
Impact on the water medium is present. Impact on water resources is will be the same as in baseline scenario. The existing technology of heat energy production exploited at the objects of KYIVENERGO PJSC foresees discharging of waste water to the sewage network with obligatory chemical control in accordance to Water Code of Ukraine, GOST 28.74-82 “Hygienic regulations and quality control”, SNiP 4630-92 on determining maximum concentration limits for internal water bodies. Discharge of wastewater to the open water bodies will not take place.
Project implementation will have positive environmental effect. It will allow to decrease the water consumption and as a result – to decrease the amount of waste water.

Effects on the ambient air

The project implementation will have positive effect on ambient air:

1) Reduction of NO_x, SO_x, CO and PM due to application of cleaner technologies at boiler houses;
2) Reduction of electricity consumption results in lower emissions of the same air pollutants;
3) Heat stress on the atmosphere (due to lower temperatures of flue gases);
4) Lower emissions per unit of fuel at the same load on boiler house.

Effects on land use

Impact on the land medium is not present.

Relevant regulation is the sphere of land use is presented by the Land Code of Ukraine. National technological practice / standard: GOST 17.4.1.02.-83 "Protection of Nature, Soils. Classification of chemical substances for pollution control".

Effects on biodiversity

Impact on biodiversity is not present.

Waste generation, treatment and disposal

Waste generation, treatment and disposal are present. In the process of project implementation the generation of waste will occur after disassembling of physically and morally obsolete equipment, burners, pipes, etc. Also there will occur some construction waste due to destruction of boiler settling, boiler house foundations, etc.

Possible recycling of the old equipment will by definition have a positive effect on the environment.

According to the "Law on waste products", (article 17) "Obligations of economical activity subjects in sphere of waste treatment":

- enterprises must apply statistic reports on waste creating, gathering, transporting keeping, treating, utilizing, decontaminating and excreting.
- provide complete gathering, appropriate keeping and non-admission waste destruction and spoilage, for utilization of which there is an appropriate technology in Ukraine.

Reasoning from aforesaid KYIVENERGO PJSC delivers old equipment to metal recycling.

Sub-project 3

According to the regulations threshold mass of hazardous substances for identification of high-risk objects defined by CMU on July 11, 2002 № 956 by specialized organization is defined categories of equipment that have properties that allow them to be attributed to dangerous substances (Form ARF -1) Форма ОПН -1. They are in the company of toxic substances of group - 3 (harmful to humans and the environment), namely: nickel compounds (fines powder), mercury and its compounds, lead and its compounds, sulfuric acid contained in fluorescent lamps and batteries, and group 1 (explosives).

Other equipment that has properties which allow to include it to any categories of hazardous substances at the enterprise according to the Resolution dated of 11 July 2002 № 956, is absent.

The company identified the special places for this equipment storage, which are inspected and approved by relevant decisions of the Sanitary control and environmental protection.

Company according to the register card is referred to objects of waste formation and according to permit temporarily stores waste in accordance with the established limits (until their transfer to disposal or removal) to specialized enterprises. Company does not perform the disposal of waste.

Most of the metal at the enterprise is formed as a result of operation of transformer substations, part of which after the repair and regeneration of transformer oil returns and is put into operation, and another part that can not be repaired or unusable after oil regeneration is deducted and transferred to a specialized recycling companies according to an agreement.

Since 2005 PJSC "KYIVENERGO" started replacing outdated, fire and explosive equipment, including fleet air and oil switches 35-110 kV, for modern elegas (SF6)-insulated equipment. In order to prevent leakage of elegas (SF6), they have purchased the special equipment for gas search. Works on adjustment and commissioning the equipment were performed by service centers and staff representatives from factories - manufacturers in Ukraine.

As part of the project activity, at the Enterprise facilities was installed electrical equipment containing in its composition elegas (SF6), which is a toxic gas. During operation elegas (SF6) does not lose its properties, so after the equipment life period is over or in case of removing it from the operation for any other reasons, elegas (SF6) is disposed by pumping with subsequent re-use in new equipment. To prevent unauthorized leaks of elegas (SF6), at all sites where this equipment is present, elegas (SF6) leakages alarm signal sensors are installed.

The proposed project will have a positive overall impact on the environment compared to the existing condition because reconstruction will improve the efficiency of energy consumption and reduce emissions of air pollutants. Thus the whole effect of the reconstruction is small.

List of basic accounting documentation on the impact of enterprise activities on the environment are presented in Section F.1 above.

SECTION G. Stakeholders' comments

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

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 in the internet during the determination procedure.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

See Section B for the Baseline information

Sub-project 1

The Project emission reductions are achieved due to lowering of the fuel consumption per unit of produced heat energy by the project. The rehabilitation of the equipment allows increasing the efficiency of the fuel usage by the HPP. This allows lowering the emission coefficient of the produced heat energy from 0.092 tef/GJ to 0.060 tef/GJ for HPP-5 and from 0.077 tef/GJ to 0.060 tef/GJ for HPP-6.

For the calculation the following values of the coefficients of CO_2 emissions (*EFi*), oxidation factor (*OXIDi*), defined in the National Inventory Report in Ukraine for 1990 – 2010[81], hereinafter Inventory, are used:

The CO2 emission factor (*EFi*) is used:

	2005	2006	2007	2008	2009	2010	2011	2012
Cnatural gas,y	15.19	15.22	15.16	15.17	15.20	15.17	15.17	15.17
Cfuel oil.y	21.10	21.10	21.10	21.10	21.10	21.10	21.10	21.10
Transfer coefficient	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000
EFnatural gas,y	0.0557	0.0558	0.0556	0.0556	0.0557	0.0556	0.0556	0.0556
EFfuel oil,y	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774

For the following years is used indicator for the latest reporting year of Inventory submission.
In monitoring reports will be used the coefficient for the latest approved periods.

The oxidation factor (*OXIDi*) of the fuel is used:

	2005	2006	2007	2008	2009	2010	2011	2012
OXIDnatural gas,y	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
OXIDfuel oil,y	0.995	0.995	0.995	0.995	0.995	0.995	0.995	0.995

For calculations of the baseline emissions the historical data of the years 2003, 2004 and 2005 was used.
During these years the HPPs were in operation and this data allows seeing the average parameters of in the baseline scenario:

Annual heat energy supply by the HPP-5 for the period 2003-2005:

[81] http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

AHS2003 = 4 781 556.0 Gkal;

AHS2004= 4 492 917.0 Gkal;

AHS2005 = 4 470 129.0 Gkal.

Annual heat energy supply by the HPP-6 for the period 2003-2005:

AHS2003 = 3 970 203.0 Gkal;

AHS2004= 3 900 983.0 Gkal;

AHS2005 = 3 820 623.0 Gkal.

Fuel consumption by the HPP-6 for the period 2003-2005:

F2003= 1 695 417.6 tef.;

F2004= 1 822 633.2 tef.;

F2005= 1 794 925.5 tef.

Fuel consumption by the HPP-6 for the period 2003-2005:

F2003= 1 257 357.3 tef.;

F2004= 1 247 114.3 tef.;

F2005= 1 239 901.7 tef.

The heat energy producing will substitute the less effective by the HPP, which would have occur in the Baseline Scenario. For the Calculations of the Baseline emission the value of the Specific Fuel Rate (*SFR*) was used. This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per the energy taking into account the calorific value of fuel used.

$$SFRy = \sum(Fiy) / (4.187 * AHSy) \quad \textbf{(1.1)}$$

where

SFRy – specific fuel rate of the HPP in period *y*, tef/GJ;
Fiy – amout of fuel *i* consumed in period *y*, tef.;
AHSy – amount of the heat output in period *y*, Gkal;
4.187 - conversion factor, GJ/Gkal.

The fixed value of the SFR parameter in the Baseline scenario allows taking into account the effect of the planned repairs at the HPP where the project is implemented. In the other case, the parameter would have been lowering every year due to due to physical wear of equipment.

This parameter measured in the tons of the equivalent fuel per GJ of the heat supplied. One ton of the equivalent fuel (tef) is 29.3 GJ or 7 Gkal. The calculation of the SFR shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel

(specifically consumed) and these values are summed up. The use of the SFR parameter shows the fuel efficiency of the HPP independent of the fuel quality and the net caloric value and allows comparing the fuel efficiency data of the different time periods.

The energy efficiency of the HPP has to be determined prior to the implementation of the project activity. For this purpose, the value of the SFR parameter in the baseline scenario should be calculated taking into account the value of the parameter in at least 3 (three) years prior to the project implementation.

$$SFRb = \frac{\sum_{i=1}^{n} SFRyi}{n} \quad \text{, або } SFRb = \sum((Fib)/(4.187*AHSb)) \qquad \textbf{(1.3)}$$

Where:

SFRb - specific fuel rate of the heat and heat and power plant in the Baseline Scenario, tef/GJ;
SFRyi – specific fuel rate of the heat and heat and power plant for years in prior to project implementation, tef. / GJ;
n - number of years ($n \geq 3$).
Fib – amout of fuel *i* consumed in the Baseline Scenario, tef.;
AHSb– amount of the heat output of the HPP in the Baseline Scenario, Gkal;
4.187 - conversion factor, GJ/Gkal.

For the Baseline Emission calculation the following historical data for 3 years (2003-2005):

HPP-5
SFR2003 = 0.085 tef/GJ

SFR2004 = 0.097 tef/GJ

SFR2005 = 0.096 tef/GJ

SFRb = (*SFR2003* + *SFR2004* + *SFR2005*) / 3 = **0.092 tef/GJ**

HPP-6

SFR2003 = 0.076 tef/GJ

SFR2004 = 0.076 tef/GJ

SFR2005 = 0.078 tef/GJ

SFRb = (*SFR2003* + *SFR2004* + *SFR2005*) / 3 = **0.077 tef/GJ**

The Baseline emissions are calculated for each year in accordance with changes in the annual heat energy output and changes in the fuel mix. The fixed parameters are common indicators of emission from the combustion of a fuel, oxidation factor for a particular type of fuel, as well as of specific fuel rate is recognized as resistant to the implementation of the measures provided for project.

The key information and data used to establish the baseline (variables, parameters, data sources etc.) are presented below.

Data/Parameter	*SFRy*
Data unit	tef/GJ
Description	Specific Fuel Rate
Time of determination/monitoring	Minimum once per year
Source of data (to be) used	Calculated by the equation 1.1
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per unit of the output heat energy including net caloric value. The calculation of the *SFR* shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up and the sum is divided by the amount of output heat energy. SFR indicator shows fuel consumption not in natural value, but in energy units, that makes it possible to move away from the specifics of a particular type of fuel and compare the efficiency of equipment in different time intervals.
QA/QC procedures (to be) applied	During the calculations take into account uncertainties and errors of measuring instruments. All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be excluding from calculation emission reductions.
Any comment	

Data/Parameter	***SFiy***
Data unit	ratio
Description	The share of fuel *i* combusted by the heat and power plant for the energy production in period *y*, taken in the energy units.
Time of determination/monitoring	Minimum once per year
Source of data (to be) used	Calculated on the basis of data from statistical reports 17-energy.
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	n/a
QA/QC procedures (to be) applied	n/a
Any comment	

Data/Parameter	*OXIDi*
Data unit	ratio
Description	Oxidation factor of the fuel *i* in period *y*
Time of determination/monitoring	Ones per year
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010[82]
Value of data applied (for ex ante calculations/determinations)	*OXIDi* for

	2008	2009	2010
Heavy fuel oil	0.99	0.99	0.99
Natural gas	0.995	0.995	0.995

Justification of the choice of data or description of measurement methods and procedures (to be) applied	The *OXIDiy* parameter shows the share of the fossil fuel fully oxidised during the combustion
QA/QC procedures (to be) applied	
Any comment	

Data/Parameter	*EFi*									
Data unit	tons of CO2/TJ									
Description	Emission factor of the fuel *i* in year *y*									
Time of determination/monitoring	Ones per year									
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010[83]									
Value of data applied (for ex ante calculations/determinations)			2005	2006	2007	2008	2009	2010	2011	2012
	Carbon content of natural gas, tC/TJ	*Cnatural gas,y*	15.19	15.22	15.16	15.17	15.20	15.17	15.17	15.17
	Carbon content of fuel oil, tC/TJ	*Cfuel oil,y*	21.10	21.10	21.10	21.10	21.10	21.10	21.10	21.10
	transfer coefficient		44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000	44/12 /1000

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http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

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http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

		EFnatural gas,y	0.0557	0.0558	0.0556	0.0556	0.0557	0.0556	0.0556	0.0556
		EFfuel oil,y	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774	0.0774
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The *EFiy* parameter shows the CO2 emission from the combustion of the fossil fuel of different types.									
QA/QC procedures (to be) applied	n/a									
Any comment										

Data/Parameter	***AHSy***
Data unit	Gkal
Description	The amount of the output heat supplied in the period y
Time of determination/monitoring	Calculated at least once a year. Monitoring during the crediting period
Source of data (to be) used	Statistic data of KYIVENERGO PJSC. Form statistical reports 6-tp (es)
Value of data applied (for ex ante calculations/determinations)	Provided by KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	n/a
QA/QC procedures (to be) applied	All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions.
Any comment	

Data/Parameter	*SFRb*
Data unit	tef/GJ
Description	Specific Fuel Rate
Time of determination/monitoring	Determined in the PDD
Source of data (to be) used	Historic day for the last at least three years prior to project implementation. Data is collected by the company and is calculated by the developer of the project using equation 1.3.

Value of data applied (for ex ante calculations/determinations)	**HPP-5 0.092 tef/GJ** **HPP-6 0.077 tef/GJ**
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is commonly used in energy sector and it shows the fuel (energy) consumption per unit of the output heat energy including net caloric value. The calculation of the *SFR* shows the fuel consumption irrelative of the type of the fuel. All the amount of the natural fuel is multiplied by the net caloric value of the fuel (specifically consumed) and these values are summed up and the sum is divided by the amount of output heat energy. SFR indicator shows fuel consumption not in natural value, but in energy units, that makes it possible to move away from the specifics of a particular type of fuel and compare the efficiency of equipment in different time intervals.
QA/QC procedures (to be) applied	During the calculations take into account uncertainties and errors of measuring instruments. All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be excluding from calculation emission reductions.
Any comment	

Sub-project 2

Data/Parameter	**B_b**
Data unit	Ths.m^3
Description	Fuel consumption at a boiler-house. Natural gas
Time of determination/monitoring	Once after the end of the baseline period
Source of data (to be) used	Gas flow meter
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Indication of meters is recorded in special paper journals in boiler house
QA/QC procedures (to be) applied	Meters pass periodic calibration and verification under national standards
Any comment	

Data/Parameter	**HCV_b**
Data unit	TJ/mln.m^3 or TJ/ths.t
Description	Heat CaloricValue of fuel
Time of determination/monitoring	Once after the end of the baseline period

Source of data (to be) used	Supplier's Certificates
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	If the parameter change in the basis document that it will be changed according to new values

Data/Parameter	**$T_{out\ b}$** and **$T_{out\ r}$**
Data unit	^0C
Description	Average outside temperature during the heating period
Time of determination/monitoring	Once per heating period. Daily temperature is registered every day of heating period
Source of data (to be) used	Meteorological Centre sends the Report every decade or month for every day of heating season. Reports are filed in special journals
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Average outside temperature during the heating season is calculated from the daily outside temperature values taken by dispatcher from Meteorological Centre every day of heating period
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	**$T_{in\ b}$**
Data unit	^0C
Description	Average inside temperature during the heating period
Time of determination/monitoring	Daily temperature is registered every day of heating period
Source of data (to be) used	Journal of records
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement of thermometer
QA/QC procedures (to be) applied	According to the national legislation
Any comment	

Data/Parameter	$T_{in\,r}$
Data unit	^0C
Description	Average inside temperature during the heating period
Time of determination/monitoring	Once
Source of data (to be) used	KTM 204 Ukraine 244-94
Value of data applied (for ex ante calculations/determinations)	18
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	n_{wb} and n_{wr}
Data unit	
Description	Number of Customers for hot water supply service
Time of determination/monitoring	Once per year.
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data of the company
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	F_{hb} and F_{hr}
Data unit	M^2
Description	Heating area
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal

QA/QC procedures (to be) applied	The data is taken for January, 01 for every year
Any comment	

Data/Parameter	**k_{hb}**
Data unit	kW/m^2*K
Description	Average Heat transfer factor of buildings in baseline
Time of determination/monitoring	Heat transfer factor is recorded ones per period at recording of connection or disconnection of any heating area to boiler-houses included in project.
Source of data (to be) used	SNIP 2-3-79 (1998)
Value of data applied (for ex ante calculations/determinations)	0.63
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	For calculation of Heat transfer factor of buildings for every boiler-house, the method of Weighted average value was used, that depends on heating area of existing buildings and heating area of the new buildings. Values of the heat transfer factor for existing buildings were taken from SNiP 2-3-79 (1998) - not higher than 0.63. Values of the heat transfer factor of new buildings were taken according to State Buildings Norms (B.2.6-31:2006) - not higher than 0.36.
Any comment	

Data/Parameter	**F_{htr}**
Data unit	m^2
Description	Heating area of buildings (previously existed in the baseline period) with the renewed (improved) thermal insulation in the reporting period
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal
QA/QC procedures (to be) applied	The data is taken for January, 01 for every year
Any comment	

Data/Parameter	**F_{hnr}**

Data unit	m^2
Description	Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reporting period
Time of determination/monitoring	Once per year
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The information is collected by the certificate of on the property right in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal
QA/QC procedures (to be) applied	The data is taken for January, 01 for every year
Any comment	

Data/Parameter	$\mathbf{k_{h\,n}}$
Data unit	kW/m^2*K
Description	Heat transfer factor of new buildings and buildings with new thermal insulation
Time of determination/monitoring	Once per monitoring period
Source of data (to be) used	SBN (B.2.6-31:2006)
Value of data applied (for ex ante calculations/determinations)	0.36
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Value of the heat transfer factor of new buildings were taken from State Buildings Norms (B.2.6-31:2006)
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{N_{h\,b}}$ and $\mathbf{N_{h\,r}}$
Data unit	hour
Description	Heating period duration
Time of determination/monitoring	Each month of heating period
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	The duration of the Heating period is accepted in accordance

	with item 7.9.4 of "Rules of technical exploitation of heating equipment and networks. 2007". Beginning and ending of the heating period are determined in every town separately. The heating period begins if the average daily outside temperature is 8 ^{o}C or lower during 3 days, and finishes if average daily outside temperature is 8 ^{o}C or higher during 3 days.

Data/Parameter	$\mathbf{N_{w\,b}}$ and $\mathbf{N_{w\,r}}$
Data unit	hour
Description	Duration of the period of hot water supply service
Time of determination/monitoring	Once per month
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data of the company
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{L_h^b}$ and $\mathbf{L_h^r}$
Data unit	Gkal
Description	Maximum connected load to the boiler-house, that is required for heating
Time of determination/monitoring	Once per monitoring period.
Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Maximum connected load to the boiler-house, that is required for heating, is calculated by KYIVENERGO PJSC for every heating season. It is calculated according to heat demand at outside temperature -25 ^{o}C.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	$\mathbf{L_w^b}$ and $\mathbf{L_w^r}$
Data unit	Gkal
Description	Maximum connected load to the boiler-house, that is required for providing the hot water supply service
Time of determination/monitoring	Once per monitoring period.

Source of data (to be) used	Data of the company
Value of data applied (for ex ante calculations/determinations)	Provided by the KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Maximum connected load to the boiler-house, that is required for hot water supply service, is calculated by the company in accordance with the needs of water supply and temperature conditions.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	v_{wr} and v_{wb}
Data unit	kWh/h
Description	Standard specific discharge of hot water per personal account
Time of determination/monitoring	Once per monitoring period
Source of data (to be) used	"KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it.
Value of data applied (for ex ante calculations/determinations)	$v_{wb}/v_{wr}=1$
Justification of the choice of data or description of measurement methods and procedures (to be) applied	At present the standard specific discharge of hot water is valid in Ukraine that was established by the "KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it.
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	Cef
Data unit	$KtCO_2/TJ$
Description	Carbon dioxide emission factor for different fuels
Time of determination/monitoring	Annualy
Source of data (to be) used	National Inventory Report of anthropogenic emissions of Ukraine [84]
Value of data applied (for ex ante calculations/determinations)	See section B.1.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A

84 http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/ukr-2012-nir-13apr.zip

QA/QC procedures (to be) applied	N/A
Any comment	If the parameter changes in the reporting period must be corrected

Data/Parameter	g
Data unit	ratio
Description	Recalculating factor for average load during heating period
Time of determination/monitoring	Calculated one for monitoring period
Source of data (to be) used	N/A
Value of data applied (for ex ante calculations/determinations)	Recalculating factor for average load during heating period is determined for boiler-house on historical base, usually it is in the range (0,4 – 0,8)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	$g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$ where: g – recalculating factor for average load during heating period; F_h – heating area of buildings, m^2; k_h – average heat transfer factor of heated buildings,(W/m^2*K); T_{in} – average inside temperature for the heating period, K ; $T_{out\ av}$ – average outside temperature for the heating period, K (or ^0C); $T_{out\ min}$ – minimal outside temperature for the heating period, K (or ^0C).
QA/QC procedures (to be) applied	N/A
Any comment	

Data/Parameter	P_b
Data unit	MWh
Description	Electric power consumption
Time of determination/monitoring	Once after the end of the baseline period
Source of data (to be) used	Electricity supply meters
Value of data applied (for ex ante calculations/determinations)	Provided by KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by Electricity supply meters
QA/QC procedures (to be) applied	n/a
Any comment	

Data/Parameter	**EFgrid**
Data unit	tCO_2/kWh or tCO_2/MWh

Description	Carbon dioxide emissions factor at electricity consumption
Time of determination/monitoring	Yearly
Source of data (to be) used	DFP Orders
Value of data applied (for ex ante calculations/determinations)	See section B.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	

If data for the calculation of any of the coefficients K_1-K_7, K_w, K_h, a_r, a_b are unavailable conservative coefficient for which this assumption applies is taken equal to 1.

Sub-project 3

Data/Parameter:	V_y
Data unit	MWh
Description	Total reduction of technical power losses in the power grid during the period y of the project scenario compared with the baseline scenario
Time of determination/monitoring	Monthly/annually
Source of data (to be) used	Statistical data of KYIVENERGO PJSC using approved methodology of technical power losses amount determination, in 0.38-150 kV power grids power supply company for the indirect carbon dioxide emission estimation[85]
Value of data applied (for ex ante calculations/determinations)	Estimated by the Developer using the statistical data of KYIVENERGO PJSC
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is an objective quantitative results display project.
QA/QC procedures (to be) applied	This parameter is defined according to the valid norms, rules and approved methodology based on the company's statistical data.
Any comment	

Data/Parameter:	*EFgrid,y*
Data unit	t CO_2e/MWh (kg CO_2e/kWh)
Description	Carbon dioxide emission factor for projects of power loss reduction in power transport networks of Ukraine

[85] http://www.neia.gov.ua/nature/doccatalog/document?id=129688

Time of determination/monitoring	Annually
Source of data (to be) used	Reference data (approved calculations and Orders of the National Agency for Environmental Investments as indicated below)
Value of data applied (for ex ante calculations/determinations)	For 2003 – 0.770[86] t CO_2e/MWh (kg CO_2e/kWh) For 2004 – 0.755[87] t CO_2e/MWh (kg CO_2e/kWh) For 2005 – 0.740[88] t CO_2e/MWh (kg CO_2e/kWh) For 2006-2007 p– 0.807[89] t CO_2e/MWh (kg CO_2e/kWh) For 2008 - 1.082[90] t CO_2e/MWh (kg CO_2e/kWh) For 2009 - 1.09[91] t CO_2e/MWh (kg CO_2e/kWh) For 2010 - 1.093[92] t CO_2e/MWh (kg CO_2e/kWh) For 2011-2025 - 1.090[93] t CO_2e/MWh (kg CO_2e/kWh)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Using such factors is a common practice when estimating JI projects.
QA/QC procedures (to be) applied	Only officially approved factors have been used for estimation.
Any comment	

[86] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[87] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[88] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[89] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

[90] http://www.neia.gov.ua/nature/doccatalog/document?id=127171

[91] http://www.neia.gov.ua/nature/doccatalog/document?id=127172

[92] http://www.neia.gov.ua/nature/doccatalog/document?id=126006

[93] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

Annex 3

MONITORING PLAN

Detailed description of the monitoring plan presented in Section D of this PDD.