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

"District Heating System Rehabilitation of Chernihiv Region"

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

"District Heating System Rehabilitation of Chernihiv Region"

PDD Version: 11, dated July 09, 2009

A.2. Description of the project:

The project main goal is fuel consumption reduction, in particular reduction of natural gas consumption (which is imported to Ukraine), coal and fuel oil consumption by means of district heating system rehabilitation in the Chernihiv region. Such fuel consumption reduction will result in decrease of greenhouse gas emissions (CO_2 mainly). The purpose of the project is sustainable development of the region through implementation of energy saving technologies.

Chernihiv region's district heating (DH) utility (system of heat supply enterprises) supplies and sells heat energy in forms of heat and hot water to local consumers, namely households, municipal consumers and state-owned organizations. It is a natural monopolist of heat production in the region. Heat supply market in the region is stable for years.

The project was initiated in 2002 to rehabilitate Chernihiv region's district heating system, including boiler and distribution network equipment replacement and rehabilitation.

The 124 boiler-houses with 458 boilers (total maximal connected load 423.9 Gkal/hour, 2002) and 227 km of heat distributing networks in Chernihiv city and Chernihiv Region, which belong to "Oblteplocomunenergo" are involved in the project as well as the 65 boiler-houses with 223 boilers (total maximal connected load 173.8 Gkal/hour, 2002) and 125 km of heat distributing networks in Chernihiv Region, which belong to other heat supply enterprises that empowered JSC "Oblteplocomunenergo" to represent their interests in this project.

The total number of boiler-houses which are involved in the project is 189 with 681 boilers (435 of which are for reconstruction and replacement within this project) and 352 km heat distribution networks (198 of which are for reconstruction and replacement within this project). This is approximately 80% of Chernihiv regional DH system, and project may be expanded by including the other DH objects in the region.

After complete project implementation 32.8 mln. Nm^3 of natural gas, 890 tons of heavy oil and 6358 tons of coal will be saved annually. Such reduction of fuel consumption is based on increase of the boiler efficiencies and reduction of heat losses in networks. The following activities will ensure fuel saving:

- Replacement of old boilers by new highly efficient boilers;
- Upgrading of boilers,
- Upgrading of boilers' burners;
- Installation of heat utilizers, including condensation ones;
- Fuel switch from coal and fuel oil to gas;
- Decreasing pipelines length and replacing the 4-pipe lines by 2-pipe lines, with application of the new insulation and the pre-insulated pipes.

Estimated project annual reductions of GHG emissions, in particular CO_2, increase from 6.2 thousand tons to 66.7 thousand tons during 2003 – 2010, and will be about 79 thousand tons per year starting from 2011, comparing to business-as-usual or baseline scenario.

Implementation of the project will provide substantial economic, environmental, and social benefits to the Chernihiv region. Social impact of the project is positive since after project implementation heat supply service will be improved and tariffs for heat energy will not be raised to cover construction costs. Environmental impact of the project is expected to be very positive as an emission of the greenhouse and toxic gases such as CO_2, NO_x, and CO will be reduced. Also due to a better after-implementation service, some part of population will cease to use electric heaters thus reducing electricity consumption, which is related to power plants emissions of CO_2, SO_x, NO_x, CO and particulate matter.

JSC “Oblteplocomunenergo” fulfils 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. More economically feasible and realistic scenario without carbon credits sales is a baseline scenario with very slow reconstruction activities than to make a major overhaul of the heating system. Tariffs for heat do not include the resources for prospective reconstruction of the district heating 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. This scenario is less environmentally favorable for the near future (including first commitment period 2008-2012), since GHGs emissions of Supplier will continue to be kept at the same level or even higher, but economically such scenario is more attractive

Estimated project risks are limited and minimized. Ukraine has claimed district heating and municipal energy sector as a priority for the national energy-saving development.

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)	JSC "Oblteplocomunenergo"; Chernihiv Regional State Administration; Institute of Engineering Ecology, Ltd	No
Germany	Deutsche Bank AG	No

The project is initiated by three partners that distribute their functions in the project as follows:

- ***JSC "Oblteplocomunenergo"***: is a project implementation agency (**Supplier**), which represents heat supply enterprises of Chernihiv region. It operates equipment for heat production and distribution, and renders the heat supply services. As far as this organization 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. Besides, this enterprise has all licenses and permissions, required under Ukrainian legislation, to perform designing and rehabilitating of the equipment. It is responsible for designing, engineering and installation works execution by its own personnel or with the aid of subcontractors. It finances this project (partly on credit base) and receives profits.

Historical details:

The Enterprise "Chernihivteplomerezha" was founded on the basis of Order No. 353 of the Minister of Municipal Housing of USSR and Decision No.#714 of the Executive committee of the City Council of Deputies from December 31st, 1968. It has started its work on January 1st, 1969, with 4 boiler-houses and 32 km of heat networks. To the end of 1969 the set load was increased up to 120.5 Gkal/hour, heat network length - up to 52.9 km. The number of employers achieved 187. The main tasks of the enterprise's activity were:

- qualified operation of boiler-houses, central heating points, heat networks and other equipment with the purpose of continuous heat and hot water supply;
- mechanization, automatization of technical processes with simultaneous liquidation of small and ineffective boiler-houses, first of all of the built-in ones;
- switching of boiler-houses to gas fuel with simultaneous increasing of its load.

The newly created operational units in Nizhyn and Pryluki towns and district centers inside the region joined the enterprise. Since 1982 the enterprise has become the regional production association "Chernihivteplomerezha". On the 27-th of August, 1985, the enterprise was re-named to the Oblast Production Association (OPA) «Chernihivteplocomunenergo». On 25.03.1992 the enterprise has become State Municipal Enterprise (SME)"Oblteplocomunenergo".

In 1990 all boiler-houses on the enterprise were switched to gas fuel.

In 1990 separate enterprises were allocated from the structure of the union. They are "Nizhynteplocomunenergo", "Prylukiteplocomunenergo", "Bahmachteplocomunenergo", "Varavateplo-comunenergo", "Nosovkamezhraygas" and Korop PMU.

In 1995 the privatization of enterprise objects was hold. On 31.07.95 the SME "Oblteplocomunenergo" was re-named to the Joint Stock Company "Oblteplocomunenergo". By the data of 1998 the enterprise included 108 boiler-houses and 103 central heating points, the length of heat networks is 297.1 km in 2-pipe lines. Load on the boiler-house was 518.6 Gkal/hour.

According to the data of 1.10.98, the enterprise includes 20 operational sites in the following districts of the region:

Kulykovsky district, Gorodnyansky district, Koryukivsky district, Schorsky district, Novgorod-Seversky district, Sosnytsky district, Semenivsky district, Kozeletsky district, Ostersky district, Repkynsky district, Ichnyansky district, Sribnyansky district, Talalayivsky district, Lubechsky district, M. Kotsubinskoho district, Koropsky district, Kyensky district, Kolychivsky district, Khmelnytsya district, Mensky district.

Today the JSC "Oblteplocomunenergo" is one of the powerful heat supply enterprises in Ukraine; it supplies heat and hot water to over 270 thousands of personal accounts in Chernihiv Region.

The stuff of the enterprise consists of about 1,5 ths workers. They provide continuous operation of the heat generating, transporting and distributing equipment.

At present the JSC "Oblteplocomunenergo" includes 18 exploitation districts in the region: Koryukivsky district, Sosnytsky district, Mensky district, Schorsky district, Gorodnyansky district, Ichnyansky district, Semenivsky district, Novgorod-Seversky district, Sribnyansky district, Talalayivsky district, Lubechsky district, Koropsky district, Kulykovsky district, Kozeletsky district, Ostersky district, Repkynsky district, Zamglajsky district, Ladan district.

JSC "Oblteplocomunenergo" has all the necessary permissions and licenses, issued by the State Inspection on Labor Safety, that allow performing of the following activities:

1. to operate, repair and install the steam and hot-water boilers, steam and hot-water pipelines;
2. to perform building and installation works;
3. to perform designing works;
4. to conduct adjustment and alignment of fuel-using equipment.

- ***Chernihiv Regional (Oblast) State Administration:*** is a legal representative of territorial communities that are the owners of the equipment under consideration. It is the governmental authority responsible for project administration. It is also responsible for in-time payments for heat supply services consumed by state-owned organizations. It will be the co-financer for the project.

Chernihiv Regional State Administration has about 110 employers in the central staff, and manages the activity of 22 district (regional inside Chernihiv oblast) state administrations with over 600 employers.

Chernihiv RSA initiated the intensive activity in Chernihiv region on gasification of inhabited localities and switching boiler-houses from solid and liquid fuel to the natural gas (e.g.: in Bakhmach district – 4 boiler-houses were switched during 1998-2002; in Borzna district – 3 boiler houses during 2000-2002). It also encourages liquidation of inefficient and low-loaded boiler houses, which are then replaced by new more effective ones, including the individual boilers.

Also, after the initiative and support of Chernihiv RSA, the heat supply networks are upgraded by the replacement of heat supply networks, which have traditional low-efficient heat insulation, by the modern pre-insulated pipes. Private and municipal buildings are being equipped with heat meters and regulation devices. It also initiated rehabilitation or replacement of low-efficiency boiler's equipment by the modern one (replacement of boilers, burners, installation of additional heating surfaces, air heaters and economizers, etc.)

Chernihiv RSA also manages all other fields of region economy. Thus, for example, in the region there is intensive renovation of auto roads, including approaches to inhabited areas, in particular the main bridge via Desna was reconstructed; the modern road junctions and overpasses were built, also, roadways in the central part of the Chernihiv city are under renovation.

- ***Institute of Engineering Ecology, Ltd:*** is a research and engineering organization. It is responsible for development of project feasibility study, development of the Joint Implementation project, choice and development of appropriate technologies, and further selection of necessary equipment. It will also take part in project validation, monitoring and verification processes

Historical details:

Institute of Engineering Ecology (IEE), Ltd., is the independent nongovernmental professional organization, created in February, 1992. It deals mainly with the engineering ecological problems in industrial sphere. Its activity is aimed at development, production and application of the new ecologically clean technologies and various equipment for fuel and energy saving and environmental protection, as well as at carrying out ecological and energetic investigations and examinations, development of Joint Implementation projects on GHG emissions reduction in industry and district heating systems according to the Kyoto Protocol mechanisms.

Institute's activity is being executed by well-qualified and experienced specialists, including possessing DrSci and PhD degrees, in fields of heat power engineering, industrial and municipal heat supply, district heating, gas cleaning, toxic substances formation and decomposition in burning processes, waste utilization, etc.

Among the Institute's developments there are such new technologies and equipment as hot water boilers (with heat capacity of 0.63 and 2.0 MW), heat utilizers (condensation, contact, contact-surface), air-heaters, modernized hearth radiation burners, intensification of furnace heat-exchange, increasing of dust and gas-cleaning efficiency, etc.

IEE has accomplished a number of projects on development and application of the technologies for energy saving in the processes of heat generation and reduction of toxic and greenhouse gas emissions. Such projects are applied, in particular, in the municipal district heating systems of the cities of Kyiv, Zhytomyr, Vinnytsia, Sumy, Luhansk, Yalta, Khmelnytsky, Odesa, Sevastopol, Simferopol, etc., as well as at industrial enterprises in Kharkiv, Lviv, Kyiv, Donetsk and Khmelnytsky regions, and also in Moscow and Moscow region.

IEE deals with questions related to the global climate change, greenhouse gas mitigation and Kyoto protocol, since 1998.

IEE is the main scientific and engineering organization of the Ministry of Housing and Municipal Economy of Ukraine (under the management of which there are all district heating enterprises of the country, that consume over 30% of total fuel consumption by the country) in field of control and reduction of CO_2 emission, and by the order of this Ministry (previously the State Committee) has executed the expert estimation of potential and possibilities for reduction of CO_2 emission into atmosphere from the municipal district heating utilities of Ukraine.

To date, IEE has prepared the Project Idea Notes (PINs) for the JI projects on the rehabilitation of the district heating systems for several cities (Vinnitsa, Khmelnytsky, Luhansk, Chernihiv, Donetsk, Rivne, Kharkiv, etc) and regions (Chernihiv and Donetsk regions, Autonomous Republic of Crimea) of Ukraine, under preparation there are the Project Design Documents (PDDs) for some of these projects and PINs for cities Dnipropetrovsk, Zhytomyr, Odesa and several industrial enterprises. The complete PDDs developed for Chernihiv region (the first in Ukraine JI project), Donetsk region and AR Crimea, already successfully passed the international validation process and received the Letters of Approval from Ukrainian government.

Questions of energy saving and reduction of GHG traditionally take the considerable part of reports at International conferences «Problems of ecology and exploitation of energy objects», annually held by IEE in Crimea.

IEE was the co-organizer of the First (October 3-5, 2005, Kyiv, Ukraine) and the Second (October 23-25, 2006, Kyiv, Ukraine) International Conferences on JI Projects in Ukraine "Climate Change and Business".

- ***Deutsche Bank AG:*** is the purchaser of emission reduction units generated from this project. It is a corporation domiciled in Franfurt am Main, Germany, operating in the United Kingdom under branch registration number BR000005, acting through its London branch located at Winchester House, 1 Great Winchester Street, London EC2N 2DB, United Kingdom.

Founded in Berlin in 1870 to support the internationalization of business and to promote and facilitate trade relations between Germany, other European countries, and overseas markets, Deutsche Bank has developed into a leading global provider of financial services.

A leader in Germany and Europe, the bank is powerful and growing in North America, Asia and key emerging markets.

As of March 31, 2009, Deutsche Bank has over 80 thousand employees in 72 countries.

Deutsche Bank won a series of important awards, e.g. IFR "Bank of the Year" twice in three years.

Deutsche Bank's presence in the UK dates back to 1873, when it opened a branch in London. This became the Bank's most important foreign branch, until its closure at the outbreak of the First World War in 1914. Deutsche Bank returned to London in 1973 with a representative office, which was converted into a branch in 1976.

A.4. Technical description of the project:

A.4.1. Location of the project:

The Project is located in Chernihiv Region of Ukraine, in the Northern part of Ukraine (**Fig.1**).

Fig. 1. The map of Ukraine with dividing into regions and with neighboring countries

A.4.1.1. Host Party(ies):

Ukraine is an Eastern European country that ratified the Kyoto Protocol to UN FCCC on February 4, 2004, is listed in the Addition 1 to it and thus is eligible for the Joint Implementation projects.

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

The Project is situated in Chernihiv Region (Oblast). Chernihiv Region is located in the Northern part of Ukraine. Its territory is 31.9 ths km^2 (5.3% of the total area of Ukraine), and it's a second largest region in Ukraine. Chernihiv region has a mild-continental climate with average temperatures: -7 ^{0}C in January, and +19 ^{0}C in July. Average annual precipitation is 550-660 mm.

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

Chernihiv city, towns and villages of the Chernihiv Region.

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

On January 1st, 2002, Chernihiv region accounted for 394617 residential buildings, 175 boiler houses and 386.5 km of heat and steam networks that belong to the communal property. Population was 1299.8 ths, with slight negative dynamics – 1206.8 ths on 1.01.2004.

Chernihiv region borders in the north with Russian Federation, in the north-west – with Belarus, in the east – with the Sumy region, in the south – with Kyiv and Poltava regions. There are three cities of regional submission in Chernihiv region: Chernihiv, Nizhyn and Pryluky. The territory is divided into 22 districts: Bahmachsky, Bobrovitsky, Borznansky, Varvynsky, Gorodnyansky, Ichnyansky, Kozeletsky, Koropsky, Koryukivsky, Kulykivsky, Mensky, Nizhynsky, Novgorod-Siversky, Nosivsky, Pryluksky, Ripkynsky, Semenivsky, Sosnytsky, Sribnyansky, Talalaivsky, Chernihivsky, Schorsky.

In total Chernihiv region covers 1539 inhabited localities, including 15 cities and towns, 30 urban villages and other small villages.

It should be noted that the district heating systems from almost all territorial districts (excluding Bobrovitsky) of the Chernihiv Region are involved in the project in question (**Fig. 2**). Places involved in the project are marked with circles; Chernihiv city and other places where the boiler-houses belong to JSC "Oblteplocomunenergo" (Project Supplier) are marked with red circles, the other places where the Project Supplier is empowered to represent the owners of boiler-houses are marked with blue circles.

JSC "Oblteplocomunenergo" is empowered to represent the interests of other heat-supply enterprises of Chernihiv Region. The enterprises "Nizhynteplomerezhi" Ltd., Municipal enterprise (ME) "Prilukiteplovodopostachannya", ME "Bahmachteplomerezhi", Production enterprise of heating networks (PEHN) "Borznateplocomunenergo", ME "Nosivski teplovi merezhi" and Varva filial of JSC "Volodar" are included to the project also. Short characterization of these enterprises is given in Table 1.

№	Enterprise	Number of boiler-houses included in project	Number of boilers included in project	Installed capacity of boilers included in project, MW	Scheduled GHG emission reduction after complete implementation of the project, t CO_2
1	JSC "Oblteplocomunenergo"	124	458	847.8	44005
2	"Nizhynteplomerezhi" Ltd.	15	81	163.2	18606
3	ME "Prilukiteplovodopostachannya"	22	69	159.7	10151
4	ME "Bahmachteplomerezhi"	5	10	37.0	1353
5	PEHN "Borznateplocomunenergo"	7	24	9.4	3767
6	ME "Nosivski teplovi merezhi"	11	24	34.8	1158
7	Varva filial of JSC "Volodar"	5	15	18.6	593
	Total	**189**	**681**	**1270.4**	**79632**

Table 1.Heat-supply enterprises included in the project

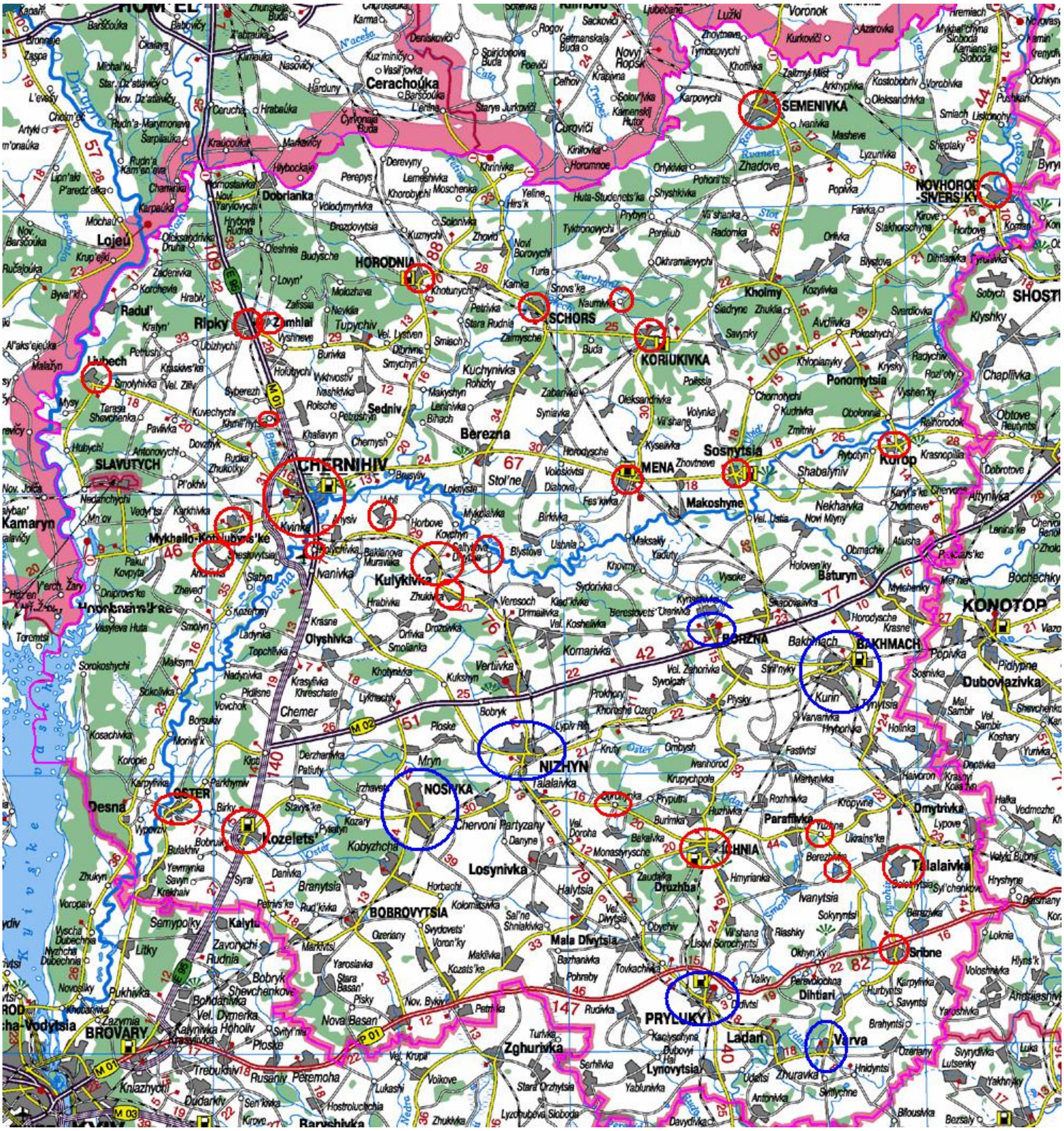


Fig. 2. Location of Chernihiv Region's major cities and towns where project will be implemented.

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

Sectoral scope related to approved CDM methodologies and DOEs (version 18 Jan 08) are:

- Energy industries (renewable - / non-renewable sources);
- Energy distribution;
- Energy demand.

Measures that will be used to improve the efficiency of Chernihiv DH utility are the follows:

- Obsolete boilers will be replaced by new highly efficient ones that will result in efficiency increase from 55-70% up to 91-93%.
- Obsolete coal-fired and fuel oil-fired boilers will be partially switched to or replaced by gas-fired ones.
- Upgrading of boilers' burners will increase the efficiency by 3-5% due to improved combustion with excess air coefficient decreasing and reducing CO and NO_x emissions.
- Rehabilitation of obsolete but able to work boilers with using various technologies, including developed by the Institute of Engineering Ecology (project partner), will lead to 6-9% increase in efficiency. Particularly, existing burners will be replaced by modernized ones, intensity of furnace heat exchange and heat transfer will be raised due to increasing of the radiant component, excess air inflows will be diminished due to improving of the gas impermeability of boilers, etc.
- Contact and surface heat-recovery gas-cleaning apparatuses (utilizers), including developed by the Institute of Engineering Ecology, will be installed in order to utilize and recover the exhaust gases heat as well as the additional heat of steam condensation, occurring when the temperature of exhaust gases fall below dew point. The implementation of this technology will result in increasing the fuel consumption efficiency by 7-9%.
- The efficiency of distribution networks system will be considerably increased by:
    - decreasing pipelines length (moving heat generating source closer to consumer);
    - 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;
    - improving of pipes insulation (JSC "Oblteplocomunenergo" has already mastered serial production of modern insulating parts).

The measures from this list will be implemented at boiler-houses subject to rehabilitation.

The generalised schedule of their implementation will be the following:

- boiler-houses rehabilitation - 2003 – 2007;
- network rehabilitation – 2003 – 2010.

Achieved results of employing of these technologies and measures are listed in the **Appendixes 1 – 4.**

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

In the basic situation, DH systems included in the project consumed 152.2 mln Nm^3/yr of natural gas. Project implementation allows reducing of this amount by more than 32.8 mln Nm^3/yr (by about 21.5%).

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

The project activities, including rehabilitation of boilers and heat distribution networks, will increase energy efficiency of Chernihiv Region DH system, thus enabling it to produce the same amount of heat energy with less fuel consumed. Reduced fuel consumption will make lower CO_2 emissions.

In the absence of the proposed project, all equipment, including the old one, low efficient but still workable for a long life period, will operate in as-usual mode, and any emission reductions would not occur.

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.

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

In course of project implementation, the following emission reductions will be achieved, at the stages of project implementation (by the years to the first commitment period of the Kyoto Protocol):

Length of the crediting period	**Years**
2004-2023	20
Year	**Estimate of annual emission reduction in tonnes CO_2 equivalent**
2004	6210.7
2005	9323.0
2006	16814.2
2007	24403.1
Subtotal 2004 - 2007	**56751.1**
2008	48676.4
2009	53828.1
2010	66730.0
2011	79631.8
2012	79631.8
Subtotal 2008 - 2012	**328498.1**
2013	79631.8
2014	79631.8
2015	79631.8
2016	79631.8
2017	79631.8
2018	79631.8
2019	79631.8
2020	79631.8
2021	79631.8
2022	79631.8
2023	79631.8
Subtotal 2013 - 2023	**875949.8**
Total estimated emission reduction over the crediting period (tones of CO_2 equivalent)	**1261199.0**
Annual average of estimated emission reduction over the crediting period (tones CO_2 equivalent)	**63060.0**

Table 2.Estimated amount of CO_2e Emission Reductions

Thus the estimated amount of emission reductions over the commitment period is **328498,1** tons of CO_2e, over the crediting period - is **1261199.0** tons of CO_2e. For more detailed information see **Appendixes 1 – 4**.

Average annual amount of ERUs will be the following:

During commitment period 2008-2012 years – 65700 t CO_2e;
After commitment period 2013-2017 years – 79632 t CO_2e.

Description of formulae used to estimate emission reductions is represented in paragraph D.1.4.

A.5. Project approval by the Parties involved:

The project is already approved by local authorities, namely Chernihiv Regional State Administration, and Ukrainian government representatives, namely Ministry for Environmental Protection of Ukraine (the Local focal point for Kyoto Protocol in Ukraine) and Ministry of Construction, Architecture, Housing and Municipal Economy of Ukraine (which manages the District heating in Ukraine). Letter of Endorsement was issued in January, 2004. Letter of Approval was issued in April, 2005, but was withdrawn in May, 2005 due to lack of the national procedure for JI projects. The Letter of Approval (# 6 in Ukraine) was re-issued on May 14th, 2007. Therefore, organizational risk for this project is minimized.

The project was initiated in 2002.

January, 2003 – Agreement was signed between the JSC "Oblteplocomunenergo" and the Institute of Engineering Ecology on development of the Joint Implementation Project on Green House Gas Emissions Reduction through rehabilitation of the district heating system belonging to JSC "Oblteplocomunenergo". Starting of Project planning and implementation.

June, 2003 - Agreement was signed between the Chernihiv Regional State Administration and the European Institute for safety, security, insurance and environmental technics (SVT e.V.) (Germany), to fulfill the preparation of the project proposal for the JI project for submission to potential buyer.

July, 2003 – Agreement was signed between the Department of Housing and Municipal Economy of the Chernihiv Region State Administration and the Institute of Engineering Ecology on development of the Joint Implementation Project on Green House Gas Emissions Reduction through rehabilitation of the district heating system belonging to regional district heating enterprises.

January, 2004 – Expression of Interest for the Project was submitted to ERUPT 4 tender (the Netherlands). EoI and than full project proposal (PDD) successfully passed this tender, but due to lack of the Letter of Approval the further process of making ERPA was aborted.

April, 2004 – Order of the Chernihiv Region State Administration on realization of the project on reduction of GHG emission, with listing of the activity favouring its implementation.

May, 2004 – Positive Final Determination report (by TÜV Süddeutschland, Germany) for the Project.

March, 2005 – Letter of Approval was issued by Ministry for Environmental Protection of Ukraine, but was withdrawn in May, 2005 due to lack of the national procedure for JI projects.

August, 2006 – Agreement was signed between the JSC "Oblteplocomunenergo" and the company "E energy B.V." (The Netherlands), potential buyer of the ERUs to be generated from this project.

May, 2007 – Letter of Approval was re-issued.

November, 2008 – The same Final Determination report (by TÜV Süddeutschland, Germany) for the Project was re-signed.

December, 2008 - Agreement on termination of the Agreement on purchase of emission reduction unit between the JSC "Oblteplocomunenergo" and the company "E energy B.V." was signed.

July, 2009 – Emission reduction purchase agreement was signed between the JSC "Oblteplocomunenergo" and the Deutsche Bank AG.

SECTION B. Baseline

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

At the time when this Project was developed, no approved CDM methodology for such project activity existed. Our own-developed methodology is partly similar to later appeared “Baseline and monitoring methodology AM0044”. But the AM0044 was not used because the project “District Heating System Rehabilitation of Chernihiv Region” has some differences from applicability conditions of this methodology.

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. That’s why the European Institute for safety, security, insurance and environmental technics - “SVT e.V.” (Germany) and Institute of Engineering Ecology (Ukraine) invented the special methodology, that takes into account all measures involved in the project and it’s peculiarities. This methodology is presented in section D (monitoring plan). It was already approved by IAE for JI Project for Chernihiv region and similar JI Projects for Donetsk region and Republic of Crimea.

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 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, 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").

Besides, in section "Scope of Application" it is mentioned, that the scope of application of the Methodology AM0044 is limited only to the increase of boilers’ efficiency by means of their replacement or modernization, and it does not apply to the fuel type switch. At the same time our project includes also such kind of modernization as well as some others such as the replacement of burner equipment, installation of cogeneration units, etc.

The developed "Methodology" 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 and for hot water supply, etc.

The developed "Methodology" 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 municipal 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.

Approved Consolidated Methodology ACM0009 "Consolidated baseline methodology for fuel switching from coal or petroleum fuel to natural gas" proposes the dependences for baseline and reporting year emissions quantity definition (see pages 4 and 5), that contain determination of Energy efficiency $\varepsilon_{project,i,y}$ and $\varepsilon_{baseline,i}$ for equipment. In the chapter "Baseline emissions" on the page 6 there is an explanation that: Efficiencies for the project activity ($\varepsilon_{project,i,y}$) should be measured monthly throughout the crediting period, and annual averages should be used for emission calculations. Efficiencies for the baseline scenario ($\varepsilon_{baseline,i}$) should be measured monthly during 6 months before project implementation, and the 6 months average should be used for emission calculations. These requirements are confirmed by tables for monitoring on the pages 13-15.

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.

For this reason, the own project specific methodology was developed, that 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.

In additional, the proposition in ACM0009 to take (by conservatism principle) the baseline efficiency of equipment equal to 100 % is unacceptable in "District Heating" type projects, because not only fuel switch, but mainly namely increasing of equipment (boilers) efficiency are implemented in these projects. Accepting of such calculated baseline would lead to essential underestimation of results of implemented measures. And, anyway, as it was shown before, this would not solve the problem with impossibility of monthly measurements for getting energy efficiency $\varepsilon_{project,i,y.}$

As it was already mentioned before, the majority of the heat supply enterprises and heat customers in Ukraine are not equipped with heat meters or devices for heat-carrier output (hot water for heating and hot water service) determination. Just for this reason, the methodology was developed that is based on the permanent measuring of the fuel consumption and corrections for possible changes of parameters in reporting year comparing to the baseline. The changeable parameters may be the lower heating value of fuels, quality of heating service (providing of normative temperature value inside apartments), weather features, number of customers, etc. As it was mentioned before, this approach eliminates any possibility of reduction of fuel consumption and correspondingly GHG emission due to incomplete delivery of heat to consumers.

In view of the above mentioned, in contrast to the methodologies AM0044 and ACM0009, our Methodology, developed for "District Heating" projects in Ukrainian conditions and used in JI Projects "Rehabilitation of the District Heating System in Chernihiv Region", "Rehabilitation of the District Heating System in Donetsk Region", "Rehabilitation of the District Heating System of Crimea", "Rehabilitation of the District Heating System in Kharkiv city" and others, is the most appropriate, precise, corresponding to the principle of conservatism, and the most closely reflects the aims, goals and spirit of Kyoto Protocol.

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

There were two different versions of Baseline scenario that were discussed before starting this project.

The first version of Baseline scenario is a business-as-usual scenario with minimum reconstruction (in fact repair) 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.

The second version of Baseline scenario is to make reconstruction works 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.

Thus, the first version was chosen for Baseline scenario.

Status and adequacy of the current delivery system
Current supply of Chernihiv city and Chernihiv region DH systems is primarily based on Ukrainian and Russian made gas, fuel oil and coal fired boilers including NIISTU-5, TVG-8M, KVG-6.5, KVG-7.56, KV-GM-10, KV-GM-20, KSVa-3G, E-1/9, KSV-1, DKVR-6.5, DKVR-10, DKVR-20, DE-16, DE-10, KBN-G-2.5, Fakel-1, VK-32, VK-34, VK-21 and few others. Detailed information is presented in **Appendixes 1, 2 (Boilers)**. Current efficiencies of these boilers are in the range of 55-90 %.

Current distribution networks are characterized by heat losses from 10-20 % to 30 %. Detailed information is presented in **Appendix 3 (Networks)**.

Construction of the Baseline Scenario
Current operation of the Chernihiv region's district heating system results in continuous deterioration of the heat-generating and distribution equipment, followed by continuous slight efficiency droop. However, at the same time operative maintenance increases efficiency, which pretty much compensates deterioration, and makes annual total emissions level (the Baseline) about the same for years.

Calculation of Baseline Carbon Emission Factors
For all fuels we used CO_2 emission factors from the data table provided in Annex C of the Operational Guidelines for Project Design Documents of Joint Implementation Projects [Volume 1: General guidelines; Version 2.2].

Cef (natural gas) = 0.0561 $KtCO_2/TJ$;
Cef (mazut) = 0.0774 $KtCO_2/TJ$; (taken as "Residual fuel oil").

Cef (coal) = 0.0946 KtCO_2/TJ; (taken as "Other bituminous coal").

We assume that CO_2 emission factors for the fuels will be the same for period 2002-2012. For our calculations we assume that the Lower Heating Value of a fuel (LHV) doesn't change during that time, however in the Monitoring Plan the LHV factor will be taken into account for the baseline adjustment for any year until 2012. From the Table below it is evident that LHV changes insignificantly from year to year. Table 3 gives historical LHV of natural gas provided by gas supplying company:

Years	1997	1998	1999	2000	2001	2002	2003
Average lower heating value of natural gas, Gcal	8278	8277	8371	8341	8383	8297	8311
Average lower heating value of natural gas, MJ	34,77	34,76	35,16	35,03	35,21	34,85	34,91

Table 3. Lower heating value of natural gas for period (1997-2003)

In Table 4 average lower heating value of fuels used by **Supplier** is represented:

Fuel type	Average lower heating value of fuel	
	Kkal/m^3 (Kkal/kg)	MJ/m^3 (MJ/kg)
Natural gas	8286	34.8
Coal	5000	21
Heavy oil	9690	40.7

Table 4. Average lower heating value of fuels

Calculation of conversion factors of CO_2:

Conversion factor =LHV (Lower heating value) * Cef (Carbon emission factors)

LHV (Lower heating value) of natural gas: Q_l =34.8 MJ/m^3 (Baseline year 2002)

Receipt from 1000 m^3 of natural gas = 34.8 [MJ/m^3] * 0.0561 [KtCO_2/TJ] = 1.952 t CO_2

LHV of heavy oil: Q_l = 40.7 MJ/kg

Receipt from 1t of heavy oil = 40.7 [MJ/kg] * 0.0774 [KtCO_2/TJ] = 3.15 t CO_2

LHV of coal: Q_l = 21 KJ/kg

Receipt from 1t of coal= 21 [MJ/kg]*0.0946 [KtCO_2/TJ] = 1.99 t CO_2.

Calculation of Activity Level

Activity level is represented by annual fuel consumption. For calculation of Baseline emissions, the 2002 was taken as the Base year. This year is one of the typical years concerning the outside temperature in heating period, as well as concerning the conditions of production and consumption of the heat.

	Baseline Natural Gas Consumption, ths Nm3/yr	Baseline Heavy Oil Consumption, t/yr	Baseline Coal Consumption, t/yr
JSC „Oblteplocomunenergo", Chernihiv city	70187.0	-	-
JSC „Oblteplocomunenergo", Chernihiv Region	23735.5	-	-
JSC „Oblteplocomunenergo", **Subtotal**	**93922.5**	**-**	**-**
"Nizhynteplomerezhi" Ltd	25655.4	0.0	2720.0
ME "Prilukiteplovodopostachannya"	24635.0	445.0	86.0
ME "Bahmachteplomerezhi"	4309.1	445.4	0.0
PEHN "Borznateplocomunenergo"	53.0	0.0	3355.0
ME "Nosivski teplovi merezhi"	1496.0	0.0	197.0
Varva filial of JSC "Volodar"	2212.4	0.0	0.0
Other enterprises, Chernihiv Region, Subtotal	**58360.0**	**891**	**6358**
Total	**152282.5**	**891**	**6358**

Table 5. Baseline fuel consumption

Detailed information is represented in **Annex 1 (Boiler JSC)** and **Annex 2 (Boiler Region).**

Calculation of Baseline Carbon Emissions

There is only one type of GHG emissions involved in the baseline scenario: CO_2 emissions from boilers operated by JSC „Oblteplocomunenergo" and other enterprises involved in the project,

Baseline calculations in every year of the emission reduction purchasing will be based on taking into account the real situation with correction of the adjustment factors which have an influence to the baseline. For more detailed information see **paragraph D.1.**

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

The anthropogenic emissions of GHG will be reduced due to complex modernization of heat generating and distribution 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 and fuel oil-fired boilers by the modern gas-fired ones, installation of new modern burners as well as heat recovery apparatuses, renovation of degraded heat distribution networks with using the new insulation and the pre-insulated pipes.

The more obvious description of how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the JI project, may be represented by dynamic baseline, which is the function of the stage of project implementation (see Fig. 3).

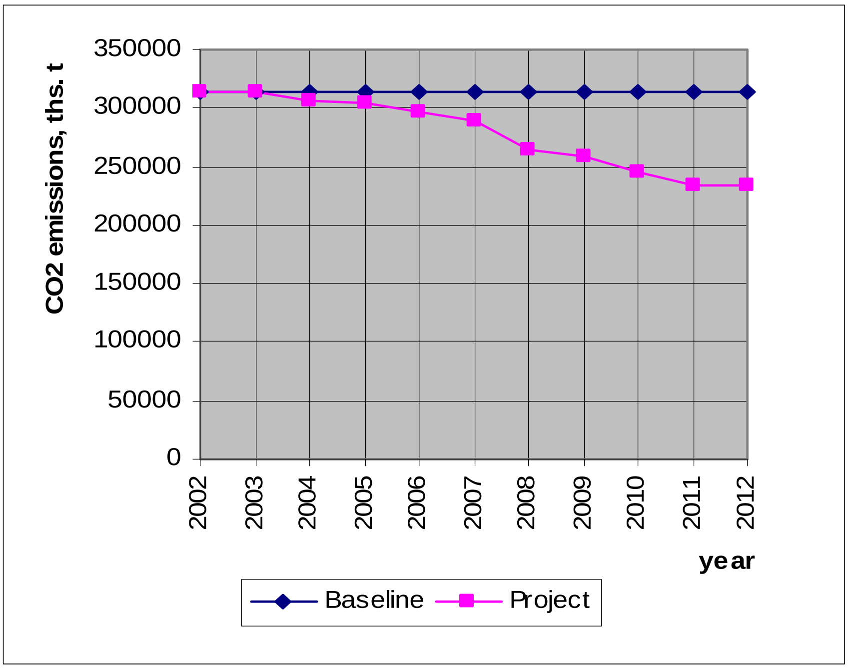


Fig. 3. Dynamic baseline and project emissions of GHG

Additionality of the project

The additionality of the project activity is demonstrated and assessed below using the “Tool for the demonstration and assessment of additionality” (Version 04). This tool was originally developed for CDM projects but can be applied to JI projects as well. This tool is used for the project in accordance with the guidance on its use provided in the partly similar “Baseline and monitoring methodology AM0044”.

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

Sub-step 1a. Define alternatives to the project activity:

There are three real alternatives to this project (the first two were already discussed in section B1).

1. The first alternative is business-as-usual scenario with minimum reconstruction (in fact repair) works, approximately balanced by overall degradation of the DH system.
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 50-60 th. and earlier in Ukraine, if they successfully pass the technical examination by the authorized body (“Derzhnagliadohoronpratsi”).

2. The second alternative is to make reconstruction works without JI mechanism.

3. The third alternative is the shortened project activity, without any of the non-key type of activity, for example elimination of frequency controllers installation, etc., from the project.

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

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.

JSC “Oblteplokomunenergo” and other regional enterprises included in the project have such licenses.

The Project “District Heating System Rehabilitation of Chernihiv Region” has been prepared according to 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”.
Also the alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.
Hence, the Step 1 is satisfied.

Step 2: Investment analysis

According to methodology AM0044, the step 2 - Investment analyses - is mandatory only if the project activity is implemented by a third party as financial analysis is required to confirm additionality of the project activity. In this case, the project is implemented and financed by Supplier.

Step 3: Barrier analysis

Sub-step 3a: Identification of barriers that would prevent the implementation of the proposed project activity

Investment barrier

All project activities require substantial investment – about 30.8 million EUR (The prices for the new equipment, that is planned to be installed in the project, are represented on the pages Parameters in the **Appendixes 1-3** in Excel format, based on the averaged prices of the manufacturers. These prices are used for future calculations of investment costs, and should be corrected in future according to actual manufacturer's prices (changed due to inflation, etc.). The final table with necessary investments for each year is available in the **Appendix 4 (Total)**. Operational and maintenance costs are not included in the project because it is assumed that they will remain at the previous level or even decreased due to less such costs for the new equipment).

The financial indicators Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated for two cases of project implementation – with and without the JI mechanism (see **Appendix 5**). Calculations were made with the help of Microsoft office Excel financial functions.

In both cases the project is not attractive for investment, since the IRR values (7.8 % and 8.5 % respectively) are significantly lower than typical values of deposit interest rate in Ukrainian banks (from 9 % to 12 % in Euro/USD up to 18 % in Ukrainian hryvnas, see for example KreditPromBank [www.kreditprombank.com], UkrGasBank [www.ukrgasbank.com] and deposit market review [http://news.finance.ua/ru/orgtrg/~/3/1/114/130266], etc.). But using of JI mechanism enables to improve project attractiveness.

The general situation in District Heating sector in Ukraine may be characterized as quite insufficient, and is analyzed and described in several available reviews and reports. Some citations, especially describing technical and financial situation, are given below.

"The existing district heating systems suffer from the same, well-known problems as those in other Central and European Countries. Old-fashioned Russian technology, oversized equipment, neglected maintenance and repairs, have resulted in increasing inefficiency. Typically, the overall efficiency of the DH systems (from fuel consumption in boilers to heat supplied to the building entrance) is about 50%. Including the losses within the buildings, it is estimated that only one third of the energy of the fuel is useful heat for the final consumers.
The bad technical state of the DH systems has its counterpart in the bad financial state. Non cost-covering tariffs can not meet the revenue requirements and subsidy payments are too small to cover all costs and are often delayed. In addition, collection rates are going in line with increasing tariffs" [Report: Market Potential for District Heating Projects in the Ukraine and their Modernization with Austrian Technology, Vienna, 2004, p.3. http://www.energyagency.at/(publ)/themen/elektrizitaet_index.htm].

"The current regulatory framework and tariff policy makes it difficult to attract private investors to district heating. Yet the main stakeholders, *e.g.* municipalities and residents, in most cases lack the necessary financing capacity. (P. 324).
District heating in Ukraine suffers from inefficiency and urgently needs investment in refurbishment and modernisation. … Yet, the current policy framework does not make district heating attractive for investment, which undermines its sustainability. Barriers to investment and efficiency improvements include (but are not limited to): the current pricing policy; lack of metering; the focus on heat production, not consumption; unclear ownership and management of buildings; and difficult access to financing for interested parties. It is vital to

create adequate policy and regulatory conditions for attracting private investments in the sector. (P. 328). [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006. http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1819].

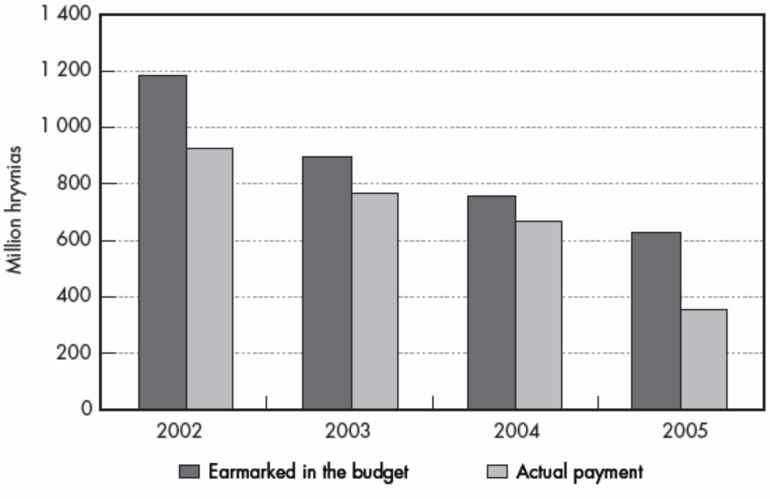
"District heating suffers from inefficiency and low level of investment. The major impediments for investment include the unclear pricing policy, unregulated management and ownership conditions, the accumulated debt of heat producers" [Overview of Heating Sector in Ukraine, CASE, 2007. Огляд сектору теплової енергетики в Україні].

The energy efficiency projects in the district heating sector in Ukraine could not be implemented at the expense of tariffs for heat energy, since the innovative constituent in tariffs is usually absent, and even "In some regions of Ukraine heat tariffs are below the cost coverage level, which results in debt accumulation of heat producers to the creditors (fuel supply companies, staff etc.)" [Overview of Heating Sector in Ukraine, CASE, 2007].

As to loans, the Ukrainian DH heat supply companies practically couldn't get loans from Ukrainian banks, where the annual interest rates due to high risks, etc. are usually up to 20 % and even more [http://news.finance.ua/ru/~/3/20/all/2008/07/14/131967]. Thus, the DH system rehabilitation without additional external investments (grants, subsidy, subvention, etc.) practically isn't possible, and in current situation practically only municipal or state financing might be used for this purposes. But Ukrainian government does not have enough funds for this, and insufficiency and delay of the budget financing of activity in this sector is the main its problem.

Moreover, the real budget financing is usually significantly lower than scheduled (see diagram below, [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006].

State Budget Subsidies for Housing and Communal Services Payments, 2002-05



Source: Ministry of Construction, Architecture, Housing and Communal Services.

Also, as discussed earlier, "district heating tariffs do not cover costs and the difference must be covered by direct subsidies to heat providers, which come from local or state budgets". But even these payments are often delayed or even not paid: "Budget payments, however, are often delayed, which results in significant accumulated debt to district heating companies" [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006].

From the other side, the additional financing of the project activity from JI mechanism is not only important for project financing, but also is a very positive factor that even can allow to shift the priorities of budget financing, thus decreasing the investment barrier. The evidence for this, namely for this JI project, is available in the letter from the local authority – the Chernihiv Regional State Administration, citation (English translation) from which is given below:

"… during last years the tariffs on services for heat supply for the population, approved by the local authorities, for the majority of towns of Chernihiv region are socially directed to a great extent, and do not provide complete compensation of costs for the generation, transportation and supply of the heat energy. The difference between tariff and actual cost of heat energy is subjected to compensation for the account of local budgets in accordance with the current legislation of Ukraine. Thus, an innovative constituent in such tariffs is absent, that causes impossibility of execution of rehabilitation of the heat generation equipment for the own enterprises' accounts.

Situation at the external and internal markets of loan capital was and remains unfavorable for the heat supply enterprises of the region with the municipal ownership on the assets, as a result of high interest rates, and the necessity of the fulfillment of additional requirements of banks on insurance of risks of not returning of credit resources that are claimed to the subjects of economy in field of housing and communal services.

Taking into account the fact of signing of the external economic contract between the base organization on implementation of this project (JSC "Oblteplokomunenergo", Chernihiv city) and the purchaser of the Emissions reduction units, and the above mentioned circumstances, the funds of subventions from the state budget to the budgets of the local councils were distributed with the priority to the heat supply field of the region, with purpose to provide fulfillment of international liabilities on the joint implementation project".

Technological barrier

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 project implementation properly and in time.
2. 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. Unfortunately it could lead to impossibility of boiler houses fuel switch from coal to natural gas.

Organizational barrier

The management experience in implementation of JI projects is absent, including international collaboration, validation, 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. Thus the project is additional.

Sub-step 3b: Explanation that the identified barriers would not prevent the implementation of at least one of the alternatives

One of the alternatives is to continue business-as-usual scenario. Therefore, as the barriers mentioned above are directly related to investing into upgrading of the Chernihiv Region district heating system, there is no impediment for JSC "Oblteplocomunenergo" to maintain the district heating system at its present level.
Hence, the Step 3 is satisfied.

Step 4: Common practice analysis

Sub-step 4a. Analysis of other activities similar to the proposed project activity.

It should be noted that the district heating systems from almost all territorial districts (excluding Bobrovitsky) of the Chernihiv Region are involved in the project. The enterprises “Nizhynteplomerezhi” Ltd., ME “Prilukiteplovodopostachannya”, ME “Bahmachteplomerezhi”, PEHN “Borznateplocomunenergo”, ME “Nosivski teplovi merezhi” and Varva filial of JSC “Volodar” are the main heat-supply enterprises in their towns. JSC “Oblteplocomunenergo” is empowered to represent the interests of other heat-supply enterprises of Chernihiv region. JSC “Oblteplocomunenergo” is one of the main heat supply service enterprise in Chernihiv city. Besides JSC “Oblteplocomunenergo”, the heat supply service in Chernihiv city is provided by MEB ‘Chernihiv CHP” of “TehNova” Ltd. The technology for heat energy production used by MEB ‘Chernihiv CHP” is not similar with technology for heat energy production used by JSC “Oblteplocomunenergo”. MEB ‘Chernihiv CHP” uses combined heat and power production technology with high-capacity coal fired steam boilers employment. Thus the similar projects are not observed in the Chernihiv region.

At present there are at least 4 District Heating Projects with JI mechanism in Ukraine beside this project: for Donetsk region, AR Crimea, Kharkiv city and Lugansk city. But other JI project activities are not to be included in Common practice analysis. The common practice for district heating enterprises in Ukraine without JI is only a necessary repairment of the old equipment, and not the renewal. With the JI component it is possible to obtain the additional funds for real rehabilitation of the district heating system.

Since similar projects are not observed in the region, there is no basis for analysis of similar activities.

Conclusion

The above mentioned approach of JI leads to the conclusion that the project activity is additional.

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

Greenhouse Gas Sources and Project Boundaries in current and project scenarios are shown on the **Figures 4** and **5**:

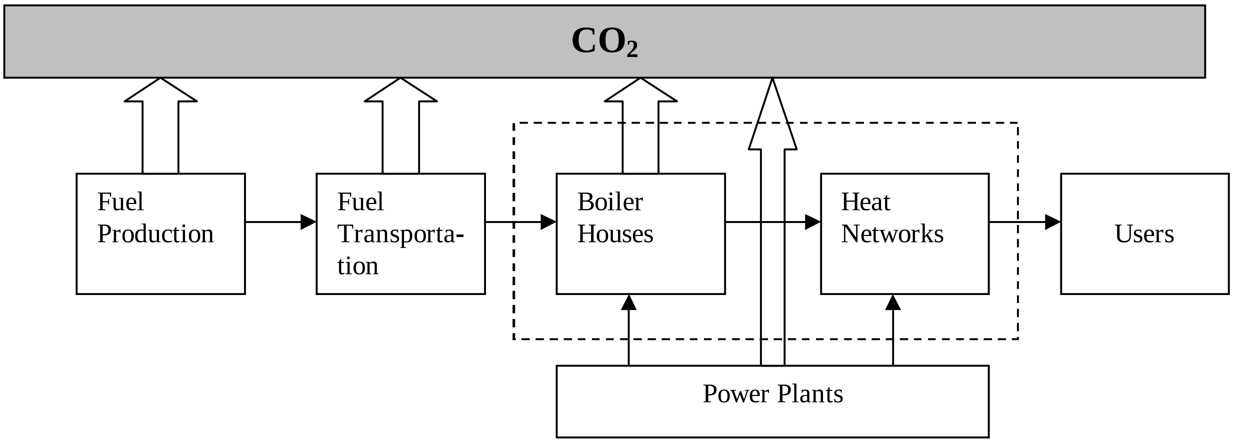


Fig.4. Flowchart of Project boundaries for Baseline scenario

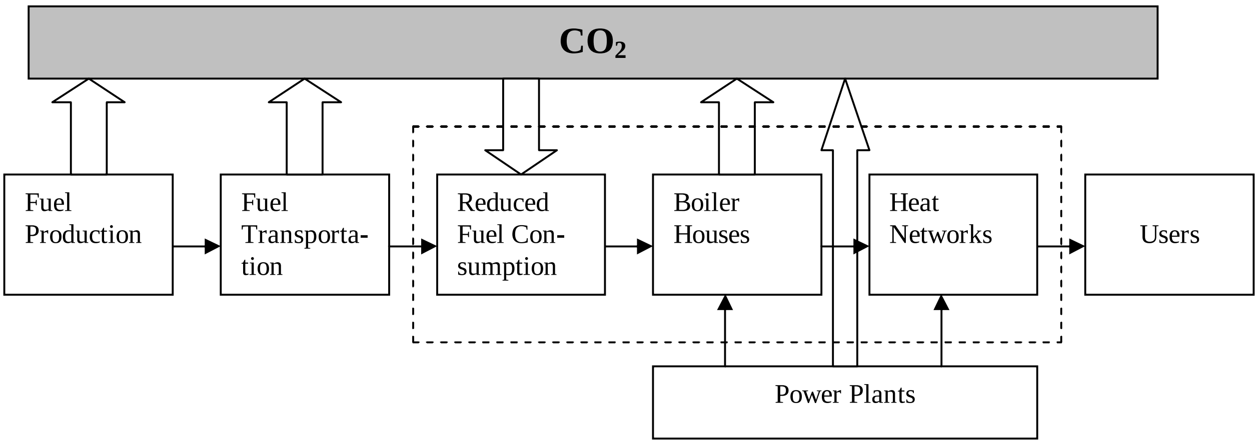


Fig.5. Flowchart of the Project boundaries for Project scenario

Direct and Indirect Emissions

Direct on-site emissions: CO_2 from natural gas combustion in boilers (in a few cases coal and mazut are used as a fuel). NO_x and CO emission from combustion in the existing boilers/ burners.

Direct off-site emissions: CO_2 emissions from power plant(s) due to power consumption used for heating by Chernihiv oblast customers. It takes place due to inefficiencies of heat supply service quality for many consumers in the current situation. Exploitation of power heaters is quite typical and widespread.

CO_2 emissions from power station(s) due to heat networks power consumption. It is not efficient due to water leakages, and extended networks' distance.

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 (fuel economy)	Direct	Include
NO_x and CO emission from combustion into existing boilers/ burners	Reduced NO_x and CO emissions from fuel combustion after boiler burners' replacement	Direct	Exclude. NO_x and CO are not GHGs.
Off-site emissions			
Current situation	Project	Direct or indirect	Include or exclude
CO_2 emissions from power plant(s) due to power consumption used for heating by Chernihiv region customers. It takes place due to inefficiencies of heat supply service quality for many consumers in the current situation. Exploitation of electric heaters is quite typical and widespread.	Reduced CO_2 emissions from power plant(s) due to reduction of power consumption for heating by Chernihiv region customers. This will take place after project implementation when heat supply service will become more efficient. Exploitation of electric heaters will decrease substantially.	Direct	Exclude, not under control of project developer
CO_2 emissions from power station(s) due to heat networks power consumption. It is not efficient due to water leakages, and extended networks' distance.	Reduced CO_2 emissions from power station(s) due to reduction of power consumption of rehabilitated heat networks. This will take place due to water leakage decreasing, replacing 4-pipe lines by 2-pine lines, and reduction of the total network length.	Direct	Exclude, not under control of project developer
CO_2 emissions from fuel extraction and transportation.	Reduced CO_2 emissions from fuel extraction and transportation.	Indirect	Exclude, not under control of project developer

Table 6. Project boundaries

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

Date of baseline setting: 30/09/2003.

The baseline is determined by the Institute of Engineering Ecology (IEE), project developer and project partner, in collaboration with European Institute for safety, security, insurance and environmental techniques (SVT e.V.), project consultant, and JSC "Oblteplocomunenergo", project supplier.

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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The starting date of the project is: 01/01/2003 (planning, designing; implementation).

C.2. Expected operational lifetime of the project:

Minimum 20 years (the nominal lifetime of the new boiler and network equipment). The real average lifetime of the new boiler and network equipment is estimated to be up to 30 – 40 years. Thus the expected operational lifetime of the project may be about 30 years. According to conservatism principle, for further calculations we assume lifetime and corresponding crediting period for the project equal to 20 years (2004 – 2023).

C.3. Length of the crediting period:

Earning of the ERUs corresponds to the commitment period of 5 years (January 1, 2008 – December 31, 2012).

The starting date of the crediting period is set to the date where the first emission reduction units are expected to be generated from the project, that is January 1, 2004. The end of the crediting period is the end of the lifetime of the main equipment, that is minimal December 31, 2023. Thus the length of the crediting period is 20 years (240 months).

If the post-first commitment period under the Kyoto Protocol will be applicable, the commitment period may be expanded up to the end of the expected operational lifetime of the project (20 years, 2004 – 2023).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

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

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 a projected level than all other relevant indicators such as efficiencies of new boilers, efficiencies of heat utilizers, and burners, as well as heat losses in pre-insulated pipes are adequate.

Verification of project performance indicators

JSC "Oblteplocomunenergo" collects data on fuel bought for heating in form of fuel bills. Information on saved fuel will be attached to verification reports on a yearly basis (before April 1st for all years of project implementation) with all relevant documentation and historical information on fuel purchasing transactions made by Supplier

Verification of Emission Reduction Units and Baseline Scenario

For any project year, the baseline scenario may be different due to the influence of external factors such as weather conditions, possible changes of the lower heating value of fuel(s), number of customers, heating area, etc. The Baseline and the amount of ERUs for each project year should be corrected with taking into account these and some other factors.

The following methodology is proposed to be used.

Amount of the Emission Reduction Units (ERUs), t CO_2e:

$$ERUs = \sum[E_i^b - E_i^r]$$

The sum is taken over all boiler-houses (i) which are included into the project.

$E_i^b = E_{1i}^b + E_{gen\ i}^b + E_{cons\ i}^b$,
$E_i^r = E_{1i}^r + E_{gen\ i}^r + E_{cons\ i}^r$,

where:
E_{1i}^b and E_{1i}^r – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base year and in the reported year, respectively, t CO_2e;
$E_{gen\ i}^b$ and $E_{gen\ i}^r$ – CO_2 emissions due to electric power generation associated to the project for an i boiler-house in the base year (consumed from greed, amount to be substituted in the reported year), and generated by included into the project objects in the reported year, respectively, t CO_2e;
$E_{cons\ i}^b$ and $E_{cons\ i}^r$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the base year and in the reported year, respectively, t CO_2e.

For each i boiler-house:

$E_1^b = LHV_b*Cef_b*B_b$

$E_1^r = LHV_r* Cef_r*B_r$

$E_{gen}^b = W_b*CEF_g+ Q_b*f_b/1000* LHV_r* Cef$

$E_{gen}^r = (W_b - W_r)*CEF_g+ [(Q_b-Q_r)*f_b/1000+ B_g]* LHV_r* Cef$

$E_{cons}^b = P_b*CEF_c$

$E_{cons}^r = P_r*CEF_c$

where:

LHV – lower heating value, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, kt CO_2/TJ;
B – amount of fuel consumed by a boiler-house, ths m^3 or tons;
W_b – scheduled electric power production by the new CHP units at a boiler-house, MWh;
W_r – electric power production by the installed new CHP units MWh;
CEF_g – Carbon Emission factor for electricity generation in Ukraine, tCO_2e/MWh;

P_b – electric power consumption by a boiler-house where energy saving measures are scheduled to be implemented, MWh;
P_r – electric power consumption by a boiler-house with energy saving measures implemented, MWh;
CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh;

Q_b – scheduled heat energy production by the new CHP units at a boiler-house, MWh;
Q_r – heat energy production by the installed new CHP units at a boiler-house in reported year, MWh;
f_b – specific natural gas consumption by a boiler-house, where CHP units are scheduled to be installed, m^3/MW;
B_g – amount of fuel (gas) consumed by the installed CHP units for heat and power generation, ths m^3;
[$_b$] index – related to the base year;
[$_r$] index – related to the reported year.

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.

In the case of this project "District Heating System Rehabilitation of Chernihiv Region", there are no electric power generation by any included objects, and no special power saving measures, therefore

$E_i^b = E_{1i}^b$;

$E_i^r = E_{1i}^r$;

According to the Dynamic Baseline assumption, the efficient value of E_1^b may be defined as follows:
$E_{1i}^b = E_{hi}^b, + E_{wi}^b$;
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 year the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is:
$E_1^b = LHV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_b * (1-a_b) * K_1 * K_w]$,
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 year the hot water supply service was absent at all ($(1-a_b) = 0$), and in the reported year this service was provided (due to improvement of heat supply service quality for population), the formulae for E_1^b is:

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

$E_1^r = LHV_r*Cef_r*B_r$

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

$a_b = L_h^b*g*N_h^b / (L_h^b*g*N_h^b+L_w^b*N_w^b)$;
$a_r = L_h^r*g*N_h^r / (L_h^r*g*N_h^r+L_w^r*N_w^r)$,

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 year, hours.

Adjustment factors:

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

$K_1 = LHV_b / LHV_r$

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:

$B_h = B*a = Q_h / LHV*\eta$,

where η is overall heating system efficiency.

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

$Q_{h\,br} = Q_{h\,b}*K_h = Q_{h\,r}$

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

From this equation it is possible to determine the averaged adjustment factor:
$K_h = Q_{h\,r} / Q_{h\,b.}$

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"[1], is determined by [ibid, equation 2.17]:

$Q_h = F_h*k_h*(T_{in} - T_{out})*N_h$,

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);

[1] 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.

T_{out} – average outside temperature for the heating period, K (or ^0C);
N_h – duration of the heating period per year, hours.

Then:
$K_h = (F_{h\,r}*k_{h\,r})*(T_{in\,r} - T_{out\,r})*N_{h\,r} / F_{h\,b}*k_{h\,b}*(T_{in\,b} - T_{out\,b})*N_{h\,b}$

2.1. K_2 (temperature change factor):

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

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

$K_3 = (F_{h\,r}*k_{h\,r}) / F_{h\,b}*k_{h\,b} = [(F_{h\,r} – F_{h\,t\,r} – F_{h\,n\,r})*k_{h\,b} + (F_{h\,n\,r} + F_{h\,t\,r})*k_{h\,n}] / F_{h\,b}*k_{h\,b}$,

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

2.4. K_4 (heating period duration change factor):

$K_4 = N_{h\,r} / N_{h\,b}$

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

Thus,

$K_h = K_2 * K_3 * K_4$

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:

$B_w = B*(1-a) = Q_w / LHV*\eta$,

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 year for correct comparison should be reduced to real conditions (external to the project) in the reported year:

$Q_{w\,br} = Q_{w\,b}*K_w = Q_{w\,r}$

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 reported year,
$Q_{w\,b}$ – required heat for hot water supply service in the base year,
K_w – averaged adjustment factor for hot water supply service.

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

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

$Q_w = n_w*v_w*N_w$,

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 year, hours.

Then:
$K_w = n_{w\,r} * v_{w\,r} * N_{w\,r} / n_{w\,b} * v_{w\,b} * N_{w\,b}$

3.1. K_5 (number of customers change factor):

$K_5 = n_{w\,r} / n_{w\,b}$

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

$K_6 = v_{w\,r} / v_{w\,b}$

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):

$K_7 = N_{w\,r} / N_{w\,b}$

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

Thus,

$K_w = K_5 * K_6 * K_7$.

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

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

$K_5 = K_6 = K_7 = 1$.

Thus

$K_{w0} = 1$.

The table of parameters included in the process of monitoring and verification for ERUs calculation, is represented in the Section **D.1.1.1** and **D.1.1.3.** Every year the table with foregoing factors will be updated with account for possible change of these factors, and the dynamic baseline will be developed as well as the amount of ERUs will be calculated**.**

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	Fuel consumption at boiler houses (B_r):	Every Boiler house			Every day	100%	Registered in the journal (paper (initial) and electronic (later))	Fuel consumption at boiler houses is the main data which allows to calculate GHG emissions in the

								report year
1.1	Natural gas		ths m^3	m				
1.2	Coal		ton	m				
1.3	Heavy oil		ton	m				
2	Average annual Heating value calculated by Lower Heating Value (LHV_r)	Fuel Supplier's Report or Chem. Lab Analysis Report		M, c	Once per month	100%	Registered in the journal (paper (initial) and electronic (later))	
2.1	Natural gas (average value for a season)		MJ/m^3	c				
2.2	Coal (average value)		MJ/kg	c				
2.3	Heavy oil		MJ/kg	c				

According to valid legislation, all measuring equipment in Ukraine should meet the specified requirements of corresponding standards and is subject to the periodical verifying (once per year).

For example, the gas flow meters of the SG type should meet the requirements of the standard TU 4213-001-07513518-02, in particular the measurement error should be not more than ± 2% in the flow range from Qmin to 0,2Qmax; ± 1% - in the range from 0,2Qmax to Qmax.

In case of failure of measurement equipment, it should be replaced or repaired as soon as possible. Such cases should be noted in monitoring reports.

JSC “Oblteplocomunenergo” has its own heat technical laboratory that is authorized to calibrate the measurement devices for own needs and for other enterprises (see Appendix 7 Permissions).

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

$E_i^r = E_{1i}^r$

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 reported year, t CO_2e;

$E_{1i}^{r} = LHV_r * Cef_r * B_{ri}$,

where:
LHV_{ri} – Average annual lower heating value, MJ/m^3 (MJ/kg)
Average annual Heating Value is calculated for every town;
Cef – carbon emission factor, ktCO_2/TJ;
B_{ri} – amount of fuel consumed by a boiler-house in the reported year, ths m^3 or tons;

[$_r$] index – related to the reporting year

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

1	Fuel consumption at boiler houses: (B^b)	Every Boiler house			Every day	100%	Registered in the journal (paper (initial) and electronic (later))	Fuel consum-ption at boiler houses is the main data which allows to calculate GHG emissions in the report year
1.1	Natural Gas		ths m^3	m				
1.2	Coal		ton	m				
1.3	Heavy oil		ton	m				
2	Average annual Heating Value of a fuel calculated by Lower Heating Value (LHV_b)	Fuel Supplier or Chemical Analysis Lab		m	Once per month	100%	Registered in the journal (paper (initial) and electronic (later))	
2.1	Natural Gas		MJ/m^3	c				
2.2	Coal		MJ/kg	c				
2.3	Heavy oil		MJ/kg	c				
3	Daily outside temperature in the heating season ($T_{out\ r}$) and ($T_{out\ b}$)	Meteorological Service	^0C (K)	m	Every day over the heating season	100%	Meteorological Service Report (paper and electronic)	Auxiliary data which allows correcting the dynamic baseline

4	Average inside temperature in the heating season.($T_{in\ r}$) and ($T_{in\ b}$)	3 Typical Buildings for all boiler houses	^0C (K)	m	Once per week	100%	Paper and electronic	Auxiliary data which allows correcting the dynamic baseline
5	Number of Customers (n_r and n_b)	Each heat supplying enterprise		Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
6	Heating area (F_b and F_r)	Each heat supplying enterprise	m^2	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
7	Heat transfer factor of buildings (k_b and k_r)	Each heat supplying enterprise	W/m^2*K	c	Once per year		Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
8	Heating area of buildings with heat insulation improvement (F_i)	Each heat supplying enterprise	m^2	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline

9	Heat transfer factor of buildings with new thermal insulation (k_i)	Each heat supplying enterprise	W/m^2*K	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
10	Heating period duration (N_r and N_b)	Each heat supplying enterprise	Hours	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
11	Duration of period of hot water supply service, (N_w)	Each heat supplying enterprise	Hours	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline

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

$E_i^b = E_{1i}^b$

where:
E_i^b – baseline emissions, t CO_2

For the case when in the base year the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is:
$E_1^b = LHV_b*Cef_b*[B_b*a_b*K_1*K_h + B_b*(1-a_b)*K_1*K_w]$,
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 year the hot water supply service was absent at all ($(1-a_b) = 0$), and in the reported year this service was provided (due to improvement of heat supply service quality for population), the formulae for E_1^b is:
$E_1^b = LHV_b*Cef_b*[B_b*a_b*K_1*K_h + B_r*(1-a_r)*K_1*K_{w0}]$.

where:
LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, KtCO_2/TJ;
B_b – amount of fuel consumed by a boiler-house in the base year, ths m^3 or tons;
K_1, $K_h = K_2 * K_3 * K_4$; $K_w = K_5 * K_6 * K_7$ – adjustment factors;
a_b – portion of fuel (heat), consumed for heating purposes in the base year;
$(1-a_b)$ – portion of fuel (heat), consumed for hot water supply services in the base year;
a_r – portion of fuel (heat), consumed for heating purposes in the reported year.

$a_b = L_h^b*q*N_h^b / (L_h^b*g*N_h^b + L_w^b*N_w^b)$;

where:
L_h^b – maximum connected load required for heating in the base year, MW;
L_w^b – connected load required for hot water supply service in the base year, MW;
g – recalculating factor for average load during heating period (usually 0,5-0,8);

N_h^b – duration of heating period in the base year , hours
N_w^b – duration of hot water supply service in the base year, hours

$a_r = L_h^r * q * N_h^r / (L_h^r * g * N_h^r + L_w^r * N_w^r)$

where:
L_h^r – maximum connected load required for heating in the reported year, MW;
L_w^r – connected load required for hot water supply service in the reported year, MW;
g – recalculating factor for average load during heating period (usually 0,5-0,8);
N_h^r – duration of heating period in the reported year, hours,
N_w^r – duration of hot water supply service in the reported year, hours.

$K_1 = LHV_b / LHV_r$;

where:
LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg);
LHV_r – Average annual lower heating value in the reported year, MJ/m^3 (MJ/kg)

$K_2 = (T_{in\ r} - T_{out\ r}) / (T_{in\ b} - T_{out\ b})$;

where:
$T_{in\ r}$ – average inside temperature for the heating period in the reported year, K (or ^{0}C);
$T_{in\ b}$ – average inside temperature for the heating period in the base year, K (or ^{0}C);
$T_{out\ r}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C);
$T_{out\ b}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C)

$K_3 = [(F_{h\ r} – F_{h\ t\ r} – F_{h\ n\ r})*k_{h\ b} + (F_{h\ n\ r} + F_{h\ t\ r})*k_{h\ n}] / F_{h\ b}*k_{h\ b}$;

where:
$F_{h\ b}$ – heating area in the base year, m^2;
$F_{h\ r}$ – heating area in the reported year, m^2;

$F_{h\,n\,r}$ – heating area of new buildings connected to DH system (assumed with the new (improved) thermal insulation) in the reported year, m^2;
$F_{h\,t\,r}$ – heating area of buildings (previously existed in the base year) in reported year with the renewed (improved) thermal insulation, m^2;
$k_{h\,b}$ – average heat transfer factor of heated buildings in the base year, 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.

$K_4=N_{hr}/N_{hb}$;

where:
N_{hb},– duration of heating period in the base year, hours
N_{hr} – duration of heating period in the reported year, hours

$K_5=n_{wr} / n_{wb}$;
where:
N_{wb},– number of customers in the base year;
N_{wr} – number of customers in the reported year

$K_6 = v_{w\,r} / v_{w\,b}$;

where:
$v_{w\,r}$ – standard specific discharge of hot water per personal account in the reported year, (in heat units, kWh/h);
$v_{w\,b}$ – standard specific discharge of hot water per personal account in the base year, (in heat units, kWh/h).

$K_7 = N_{wr}/ N_{wb}$;

where:
N_{wr}– duration of hot water supply service in the reported year, hours.
N_{wb} – duration of hot water supply service in the base year, hours.

[$_b$] index – related to the base year;
[$_r$] index – related to the reporting year.

The Methodology for "District Heating" projects in Ukrainian conditions was developed for application in different Regions of Ukraine. In some Regions the consumers receive less than necessary amount of heat, in result of which the temperature inside the buildings is much lower than normative one (18 ^{0}C), and hot water supply is insufficient or absent. Therefore this Methodology allows to take into account improving of the heat supply quality for the consumers and excludes deliberate reduction of heat delivery, and, in such a way, of fuel consumption with the purpose of increasing of generation of GHG emissions reduction units (ERUs) at the project activity.

Delivery of the less than necessary amount of heat and hot water really took place previously in cities and regions of Ukraine (and takes place even now in some cities and regions where situation business-as-usual is continued), and is reflected for example in JI Projects "Rehabilitation of the District Heating System in Donetsk Region", "Rehabilitation of the District Heating System of Chernihiv Region", etc.
According to "Rules of rendering of heat and hot water supply service to population" № 1497 from 30.12.1997, the heat supply enterprises must make the return payments to population for delivery less than necessary for providing normative heating level amount of heat. The normative inside temperature should be not lower than 18 ^{o}C.
Amount of such return payment is the following:
– 5% from normative payment for every degree from 18 to 12 ^{o}C;
– 10% from normative payment for every degree from 12 to 5 ^{o}C;
– when inside temperature is lower than 5 ^{o}C the payment is to be returned completely.

Average inside temperature during the heating season is calculated from the sum of returned payments caused by insufficient heating (in case of normative level (18 ^{0}C) is not satisfied).
Above 18 ^{0}C – is treated as 18 ^{0}C (according to the conservatism principle) and as meeting the normative.
Below 18 ^{0}C – is treated as not meeting the normative, and is calculated as below.

The average inside temperature is calculated by formulae:

If R = 0 (according to conservatism principle for the baseline assume R < 0.05):
$\mathbf{T_{in\,b}} = 18\ ^oC$.

If $0.05 < R \leq 0.3$ NP:
$\mathbf{T_{in\,b}} = 18 - (R/5)\ [^oC]$

If 0.3 NP < R < NP:
$\mathbf{T_{in\,b}} = 12 - [(R - 0.3\ NP)/10]\ [^oC]$

where:
R - % of return payment from NP;

NP – amount of normative payment.

Thus if the inside temperature will be 18 °C or higher we will accept it as 18 °C according to conservatism principle, if it will be lower than 18 °C it will be calculated from return payments by the methodology presented before.

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

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

There are no data to be collected in order to monitor emission reductions from the project, because emission reductions will be calculate by means of formulae presented in paragraph **D.1.2.2.**

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):

Amount of the Emission Reduction Units (ERUs), t CO_2e:
ERUs = $\sum[E_i^b - E_i^r]$;

The sum is taken over all boiler-houses which are included into the project.
$E_i^b = E_{1i}^b$
$E_i^r = E_{1i}^r$

where:

E_{1i}^b and E_{1i}^r – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base year and reported year, t CO_2e;

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

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

Any occasional leakage emissions (for example, caused by pipes' leakages, etc.) should be eliminated as soon as possible.

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.

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):

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

ERUs = $E_b - E_r$.

where:
ERUs – emission reduction units, t CO_2;
E_r – project emissions, t CO_2
E_b – baseline emissions, t CO_2

Baseline emissions

1) Baseline emissions from heat generating sources operated by the Supplier:
$E_{heat} = \sum (B_{b(i)} * LHV_{b(i)} * Cef_i)$,

Where:
$B_{b(i)}$ – fuel consumption in baseline scenario (for every fuel), 1000 m^3 (t);

1) Emissions from heat generating sources operated by an Applicant:
$E_{heat} = \sum (B_{b(i)} * LHV_{b(i)} * Cef_i)$,
$LHV_{r(i)}$ – Lower Heating Value for each fuel, MJ/m^3 (MJ/kg);
Cef_{i-} – Carbon Emission Factors for each fuel, Kt CO_2/TJ.

Project emissions

Project scenario emissions from boiler-houses are a sum of actual fuel amounts to be used in any report year (starting from 2008) multiplied by corresponding conversion factors (CF). Actual – means with subtracted fuel saving due to improving of the network efficiency:

$E_r = \sum ([B_{r(i)} - V_{(i)}] * LHV_{r(i)} * Cef_i)$,

where:
E_r – project emissions in any reported year, t CO_2
$B_{r(i)}$ – fuel consumption in the project scenario (for each fuel), ths m^3 (t);
$V_{(i)}$ –fuel saving due to network rehabilitation for each fuel, ths m^3 (t);
$LHV_{r(i)}$ – Lower Heating Value for each fuel, MJ/m^3 (MJ/kg);
Cef_{i}- – Carbon Emission Factors for each fuel, Kt CO_2/TJ.

$B_{r(i)} = [B_{b(i)} * LHV_{b(i)} * (\text{Baseline Boilers Efficiency})_i] / [LHV_{r(i)} * (\text{Project Boilers Efficiency})_i]$,

$V_{(i)} = B_{b(i)} - B_{b(i)} * (100-L_b) / (100-L_r)$,
where:
$B_{b(i)}$ – fuel consumption in the baseline scenario (for each fuel), ths m^3 (t);
L_b – heat losses in the network in the baseline scenario, %;
L_r – heat losses in the network in the project scenario, %.

For more detailed information see **Appendix 1, 2 (Boilers), Appendix 3 (Networks).**

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:

According to the State Building Norms of Ukraine A.2.2-1-2003, information on the environmental impact assessment of the project objects is collected and archived in paper form.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Quantity of natural gas consumed by boiler houses. Amount of fuel oil consumed by boiler houses. Amount of coal consumed by boiler houses.	Low for gas. Low for fuel oil Low for coal	Measuring instruments must be calibrated according to national regulations (usually every year)
Outside temperature.	Low	Outside temperature data from two boiler houses located in the same town should be similar.
Inside temperature.	Low	Each boiler house operator who uses services of the boiler house he operates will be responsible for accurate data acquisition during heating season.
Fuel quality (Lower Heating Values).	Low	Even though there is no need to mistrust fuel suppliers, the Supplier will periodically check the data provided by fuel suppliers through performing chemical analyzes of supplied fuel (usually once per heating season).
Number of customers (heating area).	Low	Statistic data. No quality assurance is needed.

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

The operational structure will include operation departments (repairement and adjustment, etc.) of Supplier (JSC "Oblteplocomunenergo") and boiler house operation personnel.
The management structure will include management departments of Supplier and specialists of the project developer (Institute of Engineering Ecology).

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

The monitoring plan is determined by the Institute of Engineering Ecology (IEE), project developer and project partner, in collaboration with European Institute for safety, security, insurance and environmental techniques (SVT e.V.), project consultant, and JSC "Oblteplocomunenergo", project supplier.

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SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Project Carbon Emission Factors are assumed equal to the Baseline Carbon Emission Factors.

Calculation of Project Activity Level

Project's activity level, estimated by fuel consumption, will be reduced comparing to the baseline activity level due to fuel saving.

	Project Natural Gas Consumption after boiler-houses rehabilitation, ths Nm^3/yr	Project Natural Gas Saving due to heat networks rehabilitation, ths Nm^3/year	Project Natural Gas Consumption, ths Nm^3/yr
JSC „Oblteplocomunenergo", Chernihiv city	61674.7	8720.9	52953.8
JSC „Oblteplocomunenergo", Chernihiv Region	20841.3	2397.0	18444.3
JSC „Oblteplocomunenergo", Subtotal	**82516.1**	**11117.9**	**71398.2**
"Nizhynteplomerezhi" Ltd.	24890.9	5997.9	18893.0
ME "Prilukiteplovodopostachannya"	22359.9	2118.4	20241.5
ME "Bahmachteplomerezhi"	4412.6	77.7	4334.9
PEHN "Borznateplocomunenergo"	1560.1	22.5	1537.6
ME "Nosivski teplovi merezhi"	1509.4	406.4	1103.0
Varva filial of JSC "Volodar"	1932.4	23.4	1909.0
Other enterprises, Chernihiv Region, Subtotal	**56665.3**	**8646.3**	**48019.0**
Total	**139181.4**	**19764.2**	**119417.2**

Table 7. Project fuel consumption

Detailed information is presented in **Appendix 1, 2 (Boilers), Appendix 3 (Networks).**

Estimation of Direct Project Emissions

	Project emissions, t CO_2	Project emissions reduction due to heat network reconstruction, t CO_2	General project emissions, t CO_2
JSC „Oblteplocomunenergo", Chernihiv city	120579.3	17025.6	103553.7
JSC „Oblteplocomunenergo", Chernihiv Region	40746.5	4679.6	36066.9
JSC „Oblteplocomunenergo", Subtotal	**161325.9**	**21705.3**	**139620.6**
"Nizhynteplomerezhi"Ltd.	48594.2	11709.6	36884.6
ME "Prilukiteplovodopostachannya"	43653.0	4135.7	39517.3
ME "Bahmachteplomerezhi"	8615.4	151.7	8463.7
PEHN "Borznateplocomunenergo"	3045.6	43.9	3001.6
ME "Nosivski teplovi merezhi"	2946.0	793.4	2152.6
Varva filial of JSC "Volodar"	3771.8	45.7	3726.1
Other enterprises, Chernihiv Region, Subtotal	**110625.9**	**16880.0**	**93745.9**
Total	**271951.8**	**38585.3**	**233366.5**

Table 8. Project Emissions of CO_2 after project implementation

Project emissions are ~ **233 366.5** t CO_2

E.2. Estimated leakage:

We assume that possible leakage is negligible that is less than 1% of the total direct emissions. These indirect emissions are not under control of project developer so we do not include them in calculations**.**

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

Project Emissions + Leakages = **233 366.5** +0 = **233 366.5** т CO_2.

E.4. Estimated baseline emissions:

Baseline emissions estimation

	Baseline emissions, t CO_2
JSC „Oblteplocomunenergo", Chernihiv city	137221.6
JSC „Oblteplocomunenergo", Chernihiv Region	46404.9
JSC „Oblteplocomunenergo", Subtotal	**183626.5**
"Nizhynteplomerezhi" Ltd.	55490.1
ME "Prilukiteplovodopostachannya"	49667.1
ME "Bahmachteplomerezhi"	9815.7
PEHN "Borznateplocomunenergo"	6768.5
ME "Nosivski teplovi merezhi"	3312.0
Varva filial of JSC "Volodar"	4319.2
Other enterprises, Chernihiv Region, Subtotal	**129372.5**
Total	**312999.0**

Table 9. Baseline Emissions of CO_2

Baseline emissions ~ **312 999,0** t CO_2.
More detailed calculation of resulting annual Baseline Carbon Emissions, that would take place during typical heating season if JSC "Oblteplocomunenergo" DH system remains unchanged, see in **section B** and **Appendixes 1 - 2 (Boilers)**.

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

Project Emission Reduction = Baseline emission-(Project emission +Estimated leakage) = **312 999.0 - 233 366.5 = 79 632.5 t CO_2 / yr**.

In course of the project implementation, the different emission reduction will be achieved at the different stages of project implementation. The amounts of emission reduction are represented in Paragraph **A.4.3.1.**

Year	GHG emissions reduction, t CO_2			Total accumulative emission reduction, t CO_2
	JSC „Oblteplocomunenergo”	Other enterprizes in Chernihiv Region	Total	
2004	2566.5	3644.2	6210.7	6210.7
2005	4568.3	4754.8	9323.0	15533.8
2006	7870.0	8944.2	16814.2	32348.0
2007	10674.8	13728.3	24403.1	56751.1
Subtotal	**25679.6**	**31071.5**	**56751.1**	
2008	27083.2	21593.2	48676.4	105427.5
2009	27896.6	25931.5	53828.1	159255.6
2010	35951.2	30778.8	66730.0	225985.5
2011	44005.8	35626.0	79631.8	305617.3
2012	44005.8	35626.0	79631.8	385249.1
Subtotal	**178942.5**	**149555.5**	**328498.1**	
Total	**204622.1**	**180627.0**	**385249.1**	

Table 10.Estimated amount of CO_2e Emission Reductions

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

Year	Estimated project emissions (tones of CO_2 equivalent)	Estimated leakage (tones of CO_2 equivalent)	Estimated baseline emissions (tones of CO_2 equivalent)	Estimated emission reduction (tones of CO_2 equivalent)
2004	306788	0	312999	6211
2005	303676	0	312999	9323
2006	296185	0	312999	16814
2007	288596	0	312999	24403
Subtotal	**1195245**	**0**	**1251996**	**56751**
2008	264323	0	312999	48676
2009	259171	0	312999	53828
2010	246269	0	312999	66730
2011	233367	0	312999	79632
2012	233367	0	312999	79632
Subtotal	**1236497**	**0**	**1564995**	**328498**
2013	233367	0	312999	79632
2014	233367	0	312999	79632
2015	233367	0	312999	79632
2016	233367	0	312999	79632
2017	233367	0	312999	79632
2018	233367	0	312999	79632
2019	233367	0	312999	79632
2020	233367	0	312999	79632
2021	233367	0	312999	79632
2022	233367	0	312999	79632
2023	233367	0	312999	79632
Subtotal	**2567037**	**0**	**3442989**	**875952**
Total (tones of CO_2 equivalent)	**4998779**	**0**	**6259980**	**1261201**

Table 11. Table providing values obtained when applying formulae above

SECTION F. Environmental impacts

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

According to the Ukrainian rules, 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.

JSC "Obleteplocomunenergo" has all the necessary Environmental Impact Assessments for its activity on heating system rehabilitation according to Ukrainian legislation.

Overall, the project "District Heating System Rehabilitation of Chernihiv Region" will have a positive effect on environment. Following points will give detailed information on environmental benefits.

1. Project implementation will allow saving over 32.8 million Nm^3 of natural gas, 890 tons of heavy oil and 6358 tons of coal per year starting from 2011. Natural gas and coal are non-renewable resources and their saving is important.

2. Project implementation will reduce direct CO_2 emissions from city and regional boilers by 79 thousand tons per year starting from 2011 due to increased boilers efficiencies, achieved through installation of up-to-date boiler equipment, particularly new boilers, heat utilizers and new boiler burners, and installation of pre-insulated network pipes (197 km) instead of existing regular network pipes.

3. Due to fuel saving and the new environmentally friendlier technologies of fuel combustion, project implementation will reduce emissions of SO_x, NO_x, CO and particulate matter (co-products of combustion).

4. It is expected that due to a better DH service Chernihiv region population will reduce electricity consumption from electric heaters thus reducing power plants emissions of CO_2, SO_x, NO_x, CO and particulate matter.

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:

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 JSC "Oblteplocomunenergo" 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 medium air

The project implementation will have positive effect on air medium:

- Reduction of NO_x, SO_x, CO and PM due to application of cleaner technologies at boiler houses;
- Reduction of electricity consumption results in lower emissions of the same air pollutants;
- Heat stress on the atmosphere (due to lower temperatures of flue gases);
- 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.

Positive effect on the environment is recycling of old equipment is a positive effect by the definition.

SECTION G. Stakeholders' comments

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

The authorities in Chernihiv Region have expressed the strong support for the project.

The project is already approved by local authorities, namely Chernihiv Regional State Administration, and Ukrainian government representatives, namely Ministry for Environmental Protection of Ukraine and Ministry of Construction, Architecture, Housing and Municipal Economy of Ukraine.

According to Ukrainian rules, all projects for new building, reconstruction and technical re-equipment of industrial and civil objects that require EIA, also requires information of population about it through the local administration [State Building Norms of Ukraine A.2.2-1-2003, p.1.6].

In line with this, information on each sub-project on rehabilitation of the each object included in the Project was published in a local newspaper. According to information from JSC "Oblteplocomunenergo", no local stakeholder comments were received.

In addition, the Project was presented at the XIV (Sevastopol, June 14-17, 2004), XV (Sevastopol, June 13-16, 2005), XVI (Sevastopol, June 6-10, 2006), XVII (Yalta, June 5-9, 2007) and XVIII (Yalta, June 10-14, 2008) International Conferences "Problems of Ecology and Exploitation of Energy Objects", where it was comprehensively discussed with representatives of governmental and District heating organisations.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

See Section B for the Baseline information.

Annex 3

MONITORING PLAN

1. DISTRICT HEATING SYSTEM REHABILITATION OF CHERNIHIV REGION

This monitoring plan describes the methodology that will be used to calculate the ongoing amount of greenhouse gas emission reduction units (ERUs) resulting from installation and commissioning of the JI project in Chernihiv Region. Upgrades to the district heating system are expected to result in improved system performance. Each component of the JI project is expected to result in a reduction in greenhouse gas emissions. The reduction in greenhouse gas emissions will be quantified using the methodology presented in this Monitoring Plan.

2. PROJECT DESCRIPTION

The total number of boiler-houses which are involved in the project is 189 with 681 boilers (435 of which are for reconstruction and replacement within this project) and 352 km heat distribution networks (198 of which are for reconstruction and replacement within this project). This is approximately 80% of Chernihiv regional DH system, and project may be expanded by including the other DH objects in the region.

Measures that will be used to improve the efficiency of Chernihiv DH utility are the follows:

- Obsolete boilers will be replaced by new highly efficient ones that will result in efficiency increase from 55-70% up to 91-93%.
- Obsolete coal-fired and fuel oil-fired boilers will be partially switched to or replaced by gas-fired ones.
- Upgrading of boilers' burners will increase the efficiency by 3-5% due to improved combustion with excess air coefficient decreasing and reducing CO and NO_x emissions.
- Rehabilitation of obsolete but able to work boilers with using various technologies, including developed by the Institute of Engineering Ecology (project partner), will lead to 6-9% increase in efficiency. Particularly, existing burners will be replaced by modernized ones, intensity of furnace heat exchange and heat transfer will be raised due to increasing of the radiant component, excess air inflows will be diminished due to improving of the gas impermeability of boilers, etc.
- Contact and surface heat-recovery gas-cleaning apparatuses (utilizers), including developed by the Institute of Engineering Ecology, will be installed in order to utilize and recover the exhaust gases heat as well as the additional heat of steam condensation, occurring when the temperature of exhaust gases fall below dew point. The implementation of this technology will result in increasing the fuel consumption efficiency by 7-9%.
- The efficiency of distribution networks system will be considerably increased by:
  - decreasing pipelines length (moving heat generating source closer to consumer);
  - 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;

- improving of pipes insulation (JSC “Oblteplocomunenergo” has already mastered serial production of modern insulating parts).

3. MONITORING METHODOLOGY

Relevant monitoring methodologies

In course of development of the project **“District Heating System Rehabilitation of Chernihiv Region”,** the **own-developed methodology** was used that is partly similar to “Baseline and monitoring methodology AM0044”. The project “District Heating System Rehabilitation of Chernihiv Region” has some differences from applicability conditions of this methodology.
The main cause of impossibility of using the methodology AM0044 for baseline calculation is absence of data for heat energy output, because of heat energy meters absence at the majority of boiler houses included in the project. That’s why “SVT e.V.” (Germany) and Institute of Engineering Ecology (Ukraine) have developed the project specific methodology, which takes into account all activity involved in the project and its peculiarities.

The main complication for implementation of the JI projects on district heating in Ukraine is the practical absence of direct monitoring devices for heat and heat-carrier expenditure in the municipal boiler-houses. Only such main characteristic as fuel consumption is registered on a regular basis. It makes practically impossible the application of AM0044 methodology, which basic moment is monitoring of the value $EG_{PJ, i, y}$ – the thermal energy output of project boiler i in year y (pages 9, 13 of Methodology AM0044), that 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").

Besides, in section "Scope of Application" it is mentioned, that the scope of application of the Methodology AM0044 is limited only to the increase of boilers’ efficiency by means of their replacement or modernization, and it does not apply to the fuel type switch. At the same time our project includes also such kind of modernization as well as some others such as the replacement of burner equipment, installation of cogeneration units, etc.

The developed project specific "Methodology" is based on the permanent monitoring of fuel consumption and on the account of various other factors, such as connection or disconnection of the consumers, change of fuel heating value, weather conditions change, ratio of the heat consumption for heating and for hot water supply, consumption for own needs, etc.

The developed "Methodology" 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 municipal 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.

Approved Consolidated Methodology ACM0009 "Consolidated baseline methodology for fuel switching from coal or petroleum fuel to natural gas" proposes the dependences for baseline and reporting year emissions quantity definition (see pages 4 and 5), that contain determination of Energy efficiency $\varepsilon_{project,i,y}$ and $\varepsilon_{baseline,i}$ for equipment. In the chapter "Baseline emissions" on the page 6 there is an explanation that:

Efficiencies for the project activity ($\varepsilon_{project,i,y}$) should be measured monthly throughout the crediting period, and annual averages should be used for emission calculations. Efficiencies for the baseline scenario ($\varepsilon_{baseline,i}$) should be measured monthly during 6 months before project implementation, and the 6 months average should be used for emission calculations. These requirements are confirmed by tables for monitoring on the pages 13-15.

However, as it was mentioned before in this report, 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.

For this reason, the own project specific methodology was developed, that 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.

In additional, the proposition in ACM0009 to take (by conservatism principle) the baseline efficiency of equipment equal to 100 % is unacceptable in “District Heating“ type projects, because not only fuel switch, but mainly namely increasing of equipment (boilers) efficiency are implemented in these projects. Accepting of such calculated baseline would lead to essential underestimation of results of implemented measures. And, anyway, as it was shown before, this would not solve the problem with impossibility of monthly measurements for getting energy efficiency $\varepsilon_{project,i,y.}$

As it was already mentioned before, the majority of the heat supply enterprises and heat customers in Ukraine are not equipped with heat meters or devices for heat-carrier output (hot water for heating and hot water service) determination. Just for this reason, the methodology was developed that is based on the permanent measuring of the fuel consumption and corrections for possible changes of parameters in reporting year comparing to the baseline. The changeable parameters may be the lower heating value of fuels, quality of heating service (providing of normative temperature value inside apartments), weather features, number of customers, etc. As it was mentioned before, this approach eliminates any possibility of reduction of fuel consumption and correspondingly GHG emission due to incomplete delivery of heat to consumers.

In view of the above mentioned, in contrast to the methodologies AM0044 and ACM0009 our Methodology, developed for “District Heating” projects in Ukrainian conditions and used in JI Projects “District Heating System Rehabilitation in Kharkiv City, “Rehabilitation of the District Heating System in Donetsk Region”, “Rehabilitation of the District Heating System in Crimea” and others, is the most appropriate, precise, corresponding to the principle of conservatism, and in the most closely manner reflects the aims, goals and spirit of Kyoto Protocol.

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

Monitoring methodology developed for “District Heating” projects in Ukrainian conditions

The monitoring methodology developed for “District Heating” projects in Ukrainian conditions consists in the following:

For any project year, the baseline scenario may be different due to the influence of external factors such as weather conditions, possible changes of the lower heating value of fuel(s), number of customers, heating area, etc. The Baseline and the amount of ERUs for each project year should be corrected with taking into account these and some other factors.

The following methodology is proposed to be used.

Amount of the Emission Reduction Units (ERUs), t CO_2e:

$$ERUs = \sum[E_i^b - E_i^r]$$

The sum is taken over all boiler-houses (i) which are included into the project.

$$E_i^b = E_{1i}^b + E_{gen\ i}^b + E_{cons\ i}^b,$$
$$E_i^r = E_{1i}^r + E_{gen\ i}^r + E_{cons\ i}^r,$$

where:
E_{1i}^b and E_{1i}^r – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base year and in the reported year, respectively, t CO_2e;

$E_{gen\ i}^{b}$ and $E_{gen\ i}^{r}$ – CO_2 emissions due to electric power generation associated to the project for an i boiler-house in the base year (consumed from greed, amount to be substituted in the reported year), and generated by included into the project objects in the reported year, respectively, t CO_2e;
$E_{cons\ i}^{b}$ and $E_{cons\ i}^{r}$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the base year and in the reported year, respectively, t CO_2e.

For each i boiler-house:

$E_1^b = LHV_b*Cef_b*B_b$

$E_1^r = LHV_r*Cef_r*B_r$

$E_{gen}^b = W_b*CEF_g + Q_b*f_b/1000*LHV_r*Cef$

$E_{gen}^r = (W_b - W_r)*CEF_g + [(Q_b-Q_r)*f_b/1000 + B_g]*LHV_r*Cef$

$E_{cons}^b = P_b*CEF_c$

$E_{cons}^r = P_r*CEF_c$

where:

LHV – lower heating value, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, kt CO_2/TJ;
B – amount of fuel consumed by a boiler-house, ths m^3 or tons;
W_b – scheduled electric power production by the new CHP units at a boiler-house, MWh;
W_r – electric power production by the installed new CHP units, MWh;
CEF_g – Carbon Emission factor for electricity generation in Ukraine, tCO_2e/MWh;
P_b – electric power consumption by a boiler-house where energy saving measures are scheduled to be implemented, MWh;
P_r – electric power consumption by a boiler-house with energy saving measures implemented, MWh;
CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh;

Q_b – scheduled heat energy production by the new CHP units at a boiler-house, MWh;
Q_r – heat energy production by the installed new CHP units at a boiler-house in reported year, MWh;
f_b – specific natural gas consumption by a boiler-house, where CHP units are scheduled to be installed, m^3/MW;
B_g – amount of fuel (gas) consumed by the installed CHP units for heat and power generation, ths m^3;
[$_b$] index – related to the base year;
[$_r$] index – related to the reported year.

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:
$E_{1i}^b = E_{hi}^b, + E_{wi}^b$;
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 year the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is:
$E_1^b = LHV_b*Cef_b*[B_b*a_b*K_1*K_h + B_b*(1-a_b)*K_1*K_w]$,

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

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

$E_1^r = LHV_r*Cef_r*B_r$

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

$a_b = L_h^b*g*N_h^b / (L_h^b*g*N_h^b+L_w^b*N_w^b)$;
$a_r = L_h^r*g*N_h^r / (L_h^r*g*N_h^r+L_w^r*N_w^r)$,

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 year, hours.

Adjustment factors:

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

$K_1 = LHV_b / LHV_r$

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:

$B_h = B*a = Q_h / LHV*\eta$,

where η is overall heating system efficiency.

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

$Q_{h\,br} = Q_{h\,b}*K_h = Q_{h\,r}$

where:

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

From this equation it is possible to determine the averaged adjustment factor:
$K_h = Q_{h\,r} / Q_{h\,b}$.

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"[2], is determined by [ibid, equation 2.17]:

$Q_h = F_h * k_h * (T_{in} - T_{out}) * N_h$,

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 year, hours.

Then:
$K_h = (F_{h\,r} * k_{h\,r}) * (T_{in\,r} - T_{out\,r}) * N_{h\,r} / F_{h\,b} * k_{h\,b} * (T_{in\,b} - T_{out\,b}) * N_{h\,b}$
2.1. K_2 (temperature change factor):

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

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

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

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

2.4. K_4 (heating period duration change factor):

$K_4 = N_{h\,r} / N_{h\,b}$

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2 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.

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

Thus,

$K_h = K_2 * K_3 * K_4$

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:

$B_w = B*(1\text{-}a) = Q_w / LHV*\eta$,

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 year for correct comparison should be reduced to real conditions (external to the project) in the reported year:

$Q_{w\,br} = Q_{w\,b} * K_w = Q_{w\,r}$

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 reported year,
$Q_{w\,b}$ – required heat for hot water supply service in the base year,
K_w – averaged adjustment factor for hot water supply service.

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

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

$Q_w = n_w * v_w * N_w$,

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 year, hours.

Then:
$K_w = n_{w\,r} * v_{w\,r} * N_{w\,r} / n_{w\,b} * v_{w\,b} * N_{w\,b}$

3.1. K_5 (number of customers change factor):

$K_5 = n_{w\,r} / n_{w\,b}$

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

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):

$K_7 = N_{w\,r} / N_{w\,b}$

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

Thus,

$K_w = K_5 * K_6 * K_7$.

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

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

$K_5 = K_6 = K_7 = 1$.

Thus

$K_{w0} = 1$.

Formulae for monitoring

Formulae used for computing project emissions, baseline emissions and the total emission reduction are presented in the tables below.

Total emission reduction

The total annual emission reduction is the difference between the baseline emissions (BE) and the project emissions (PE).

Formula 1 – Total emission reduction (ERUs)	
	ERUs = $\sum[E_i^b - E_i^r]$; [t CO2-eq.]
	ERUs - Total annual emission reduction [t CO2-eq.] E^b_i - Baseline CO_2 emissions [t CO2-eq.] E^r_i - CO_2 emissions in the reported year [t CO2-eq.]
	The sum is taken over all boiler-houses (i) which are included into the project

Project emissions

Formula 2 –Emissions in the reported year **(E^r)**	
	$E_i^r = E_{1i}^r$; [tCO2-eq.]
	E_{1i}^r – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the reported year, t CO_2e;

Formula 3 – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the reported year, (E_{1i}^r)	
	$E_{1i}^r = LHV_r * Cef_r * B_{ri}$, [tCO2-eq.]
	LHV_{ri} – Average annual lower heating value, MJ/m^3 (MJ/kg) Average annual Heating Value is calculated for every town; Cef – carbon emission factor, $ktCO_2/TJ$; B_{ri} – amount of fuel consumed by a boiler-house in the reported year, ths m^3 or tons;

Baseline emissions

Formula 4 – Annual baseline emissions **(**E_b)	
	$E_i^b = E_{1i}^b$; [t CO2-eq.]
	E_{1i}^b – baseline CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house , t CO_2e;

Formula 5 – Baseline CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house, (E_{1i}^b)	
	For the case when in the base year the hot water supply service was provided (independent of this service duration, $(1\text{-}a_b) \neq 0$), the formulae for E_1^b is: $E_1^b = LHV_b*Cef_b*[B_b*a_b*K_1*K_h + B_b*(1\text{-}a_b)*K_1*K_w]$, 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 year the hot water supply service was absent at all ($(1\text{-}a_b) = 0$), and in the reported year this service was provided (due to improvement of heat supply service quality for population), the formulae for E_1^b is: $E_1^b = LHV_b*Cef_b*[B_b*a_b*K_1*K_h + B_r*(1\text{-}a_r)*K_1*K_{w0}]$.
	LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg); Cef – carbon emission factor, $KtCO_2/TJ$; B_b – amount of fuel consumed by a boiler-house in the base year, ths m^3 or tons; K_1, $K_h = K_2* K_3* K_4$; $K_w = K_5 * K_6 * K_7$ – adjustment factors; a_b – portion of fuel (heat), consumed for heating purposes in the base year; $(1\text{-}a_b)$ – portion of fuel (heat), consumed for hot water supply services in the base year; a_r – portion of fuel (heat), consumed for heating purposes in the reported year.

Formula 6 – Portion of fuel (heat), consumed for heating purposes in the base year (a_b)	
	$a_b = L_h^b*q*N_h^b / (L_h^b*g*N_h^b + L_w^b*N_w^b)$;
	L_h^b – maximum connected load required for heating in the base year , MW; L_w^b – connected load required for hot water supply service in the base year , MW; g – recalculating factor for average load during heating period (usually 0,5-0,8); N_h^b – duration of heating period in the base year , hours N_w^b – duration of hot water supply service in the base year, hours.

Formula 7 – Portion of fuel (heat), consumed for heating purposes in the reported year (a_r)	
	$a_r = L_h^r * q * N_h^r / (L_h^r * g * N_h^r + L_w^r * N_w^r)$
	L_h^r – maximum connected load required for heating in the reported year , MW; L_w^r – connected load required for hot water supply service in the reported year , MW; g – recalculating factor for average load during heating period (usually 0,5-0,8); N_h^r – duration of heating period in the reported year, hours N_w^r – duration of hot water supply service in the reported year, hours.

Formula 8 – Change in the lower heating value (K_1)	
	$K_1 = LHV_b / LHV_r$
	LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg); LHV_r – Average annual lower heating value in the reported year, MJ/m^3 (MJ/kg)

Formula 9 – Temperature change factor (K_2)	
	$K_2 = (T_{in\ r} - T_{out\ r}) / (T_{in\ b} - T_{out\ b})$
	$T_{in\ r}$ – average inside temperature for the heating period in the reported year, K (or ^{0}C); $T_{in\ b}$ – average inside temperature for the heating period in the base year, K (or ^{0}C); $T_{out\ r}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C); $T_{out\ b}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C)

Formula 10 – Heating area and building thermal insulation change factor (K_3)	
	$K_3 = [(F_{h\ r} – F_{h\ t\ r} – F_{h\ n\ r})*k_{h\ b} + (F_{h\ n\ r} + F_{h\ t\ r})*k_{h\ n}] / F_{h\ b}*k_{h\ b}$,
	$F_{h\ b}$ – heating area in the base year, m^2; $F_{h\ r}$ – heating area in the reported year, m^2; $F_{h\ n\ r}$ – heating area of new buildings connected to DH system (assumed with the new (improved) thermal insulation) in the reported year, m^2; $F_{h\ t\ r}$ – heating area of buildings (previously existed in the base year) in reported year with the renewed (improved) thermal insulation, m^2; $k_{h\ b}$ – average heat transfer factor of heated buildings in the base year, (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).

Formula 11 – Heating period duration change factor (K_4)	
	$K_4 = N_{hr} / N_{hb}$
	N_{hb},– duration of heating period in the base year, hours N_{hr} – duration of heating period in the reported year, hours

Formula 12 – Number of customers change factor (K_5)	
	$K_5 = n_{wr} / n_{wb}$
	N_{wb},– number of customers in base year; N_{wr} – number of customers in the reported year

Formula 13 – Standard specific discharge of hot water per personal account change factor (K_6)	
	$K_6 = v_{w\,r} / v_{w\,b}$
	$v_{w\,r}$ – standard specific discharge of hot water per personal account in the reported year, (in heat units, kWh/h); $v_{w\,b}$ – standard specific discharge of hot water per personal account in the base year, (in heat units, kWh/h).

Formula 14 – Hot water supply period duration change factor (K_6)	
	$K_7 = N_{wr} / N_{wb}$
	N_{wr}– duration of hot water supply service in the reported year, hours. N_{wb} – duration of hot water supply service in the base year, hours.

4. MONITORING OF BASELINE AND PROJECT EMISSIONS

Parameters to be monitored

Monitoring methodology identifies and takes into account the parameters that are need to be measured or monitored at regular intervals. These parameters will then be input into a project Tracking Database, which will be an Excel based spreadsheet that will track GHG emission reductions annually.
List of parameters to be monitored are in the table below.

	Symbol	Data variable	Data unit	Measured (m), calculated (c), estimated (e)
1	(B_b) and (B_r)	Fuel consumption at boiler houses		m
1.1		Natural Gas	1000 m^3	
1.2		Coal	ton	
1.3		Heavy oil	ton	
2	(LHV_b) and (LHV_r)	Average annual Heating Value of a fuel calculated by Lower Heating Value		m, c
2.1		Natural Gas	MJ/m^3	
2.2		Coal	MJ/kg	
2.3		Heavy oil	MJ/kg	
3	($T_{out\ r}$) and ($T_{out\ b}$)	Average daily outside temperature during the heating season	^{0}C (K)	m, c
4	($T_{in\ r}$) and ($T_{in\ b}$)	Average inside temperature during the heating season	^{0}C (K)	m, c
5	(n_{wb} and (n_{wr})	Number of Customers		Statistics
6	($F_{h\ b}$ and ($F_{h\ r}$)	Heating area (total)	m^2	Statistics
7	(k_{hb})	Average heat transfer factor of heated buildings in the base year	W/m^2*K	c
8	($F_{h\ t\ r}$)	Heating area of buildings (previously existed in the base year) with the renewed (improved) thermal insulation in the reported year	m^2	Statistics
9	($F_{h\ n\ r}$)	Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reported year	m^2	Statistics
10	($k_{h\ n}$)	Heat transfer factor of buildings with the new thermal insulation	W/m^2*K	Statistics
11	($N_{h\ r}$) and ($N_{h\ b}$)	Duration of the heating period	Hours	Statistics
12	($N_{w\ r}$) and ($N_{w\ b}$)	Duration of the hot water supply period	Hours	Statistics

13	**(L_h^b)** and **(L_h^r)**	Maximum connected load to the boiler-house, that is required for heating	MW	Statistics
14	**(L_w^b)** and **(L_w^r)**	Connected load to the boiler-house, that is required for hot water supply service	MW	Statistics
15	**($v_{w\,r}$)** and **($v_{w\,b}$)**	Standard specific discharge of hot water per personal account	kWh/h	Statistics
16	**(Cef_r)** and **(Cef_b)**	Carbon emission factor		Statistics
16.1		Natural Gas	kt CO_2/TJ	
16.2		Coal	kt CO_2/TJ	
16.3		Heavy oil	kt CO_2/TJ	
17	**g**	Recalculating factor for average load during heating period		Statistics

Data to be monitored

Parameter number and name	**1.1** Natural gas consumption at boiler houses
Description	Natural gas consumption at boiler houses. Consumption of fuel is the main parameter affecting greenhouse gas emissions. The most objective and accurate indicator of project performance will therefore be the changes in fuel consumption. Changes in fuel consumption in result of the project implementation, when compared to baseline fuel consumption, will integrate all other relevant indicators such as improvement of boiler efficiency, reduction of network losses, etc.
Monitoring method	Gas flow meters
Recording frequency	Every day
Background data	Instrument readings are registered in the paper journals at every boiler-house.
Calculation method	n.a.

Parameter number and name	**1.2** Coal consumption at boiler houses
Description	Coal consumption at boiler houses
Monitoring method	Purchasing of coal is realized in accordance with invoices. Consumption of coal is measured by wheelbarrows and pails then recalculated to weight
Recording frequency	Every day
Background data	Coal consumption is registered in the paper journals at every boiler-house. Invoices are filed in special journals.
Calculation method	n.a.

Parameter number and name	**1.3** Heavy oil consumption at boiler houses
Description	Heavy oil is consumed only by Chernihiv region enterprisers
Monitoring method	Purchasing of Heavy oil is realized in accordance with invoices. Consumption of Heavy oil is measured by measured tare – torque tanks with rod
Recording frequency	Every day
Background data	Heavy oil consumption is registered in the paper journal Invoices are filed in special journals.
Calculation method	n.a.

Parameter number and name	**2.1** Average annual Heating Value of Natural Gas
Description	Average annual Heating Value of Natural Gas calculated by Lower Heating Value for every town
Monitoring method	Accepted in accordance with reference or telephone message from natural gas supplier or independent chemical lab analysis report. Independent chemical lab analysis is used in questionable cases. It is used rarely.
Recording frequency	Data is provided by natural gas suppliers usually 3 times per month
Background data	Registered in the paper journal
Calculation method	Weighted average value

Parameter number and name	**2.2** Average annual Heating Value of Coal
Description	Average annual Heating Value of Coal calculated by Lower Heating Value for every town
Monitoring method	Accepted in accordance with quality certificate from coal supplier's or independent chemical lab analysis report. Independent chemical lab analysis is used in contentious cases. It is used rarely.
Recording frequency	Quality certificate is given by coal supplier's for every consignment
Background data	Certificates are filed in special journals
Calculation method	Weighted average value

Parameter number and name	**2.3** Average annual Heating Value of Heavy oil
Description	Average annual Heating Value of Heavy oil calculated by Lower

	Heating Value for every town.
Monitoring method	Accepted in accordance with quality certificate from heavy oil supplier's or independent chemical lab analysis report. Independent chemical lab analysis is used in contentious cases. It is used rarely
Recording frequency	Quality certificate is given by heavy oil supplier for every consignment
Background data	Certificates are filed in special journals
Calculation method	Weighted average value

Parameter number and name	**3.** Average outside temperature during the heating season
Description	Average daily outside temperature during the heating season for every town
Monitoring method	Daily outside temperature is taken by dispatcher of JSC „Oblteplocomunenergo" from Chernihiv Meteorological Centre from 10 to 11 a.m. every day of heating season.
Recording frequency	Every day of heating season
Background data	Meteorological Centre sends the Report every decade or month for every day of heating season. Reports are filed in special journals
Calculation method	Average value

Parameter number and name	**4.** Average inside temperature during the heating season
Description	Average inside temperature during the heating season is calculated from the sum of returned payments caused by insufficient heating (in case of normative level (18 ^{0}C) is not satisfied) Above 18 ^{0}C – is treated as 18 ^{0}C (according to the conservatism principle) and as meeting the normative. Below 18 ^{0}C – is treated as not meeting the normative, and is calculated as below.
Monitoring method	Sum of returned payments
Recording frequency	Once per heating season
Background data	Sums of return payment
Calculation method	According to "Rules of rendering of heat and hot water supply service to population" № 1497 from 30.12.1997, the enterprises must make the return payments to population for delivery less than necessary amount of heat. The normative inside temperature should be not lower than 18 ^{o}C. Amount of the return payment is: – 5% from normative payment for every degree from 18 to 12 ^{o}C; – 10% from normative payment for every degree from 12 to 5 ^{o}C; – when inside temperature is lower than 5 ^{o}C the payment is to be returned completely.

	Therefore the inside temperature will be calculated by formulae: If R = 0 (according to conservatism principle for the baseline assume R < 0.05): $T_{in\ b}$ = 18 °C. If 0.05 < R ≤ 0.3 NP: $T_{in\ b}$ = 18 – (R/5) [°C] If 0.3 NP < R < NP: $T_{in\ b}$ = 12 – [(R – 0.3 NP)/10] [°C] where: R - % of return payment from NP; NP – amount of normative payment. Thus if the inside temperature will be 18 °C or higher we will accept it as 18 °C according to conservatism principle, if it will be lower than 18 °C it will be calculated from return payments by the methodology presented before.

Parameter number and name	**5.** Number of Customers for hot water supply service
Description	Number of Customers for hot water supply service for every boiler houses
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Contracts with population, organizations and legal entities are concludes directly with JSC „Oblteplocomunenergo" and Chernihiv region enterprises. They are updated once per year.
Background data	The information is collected in special electronic journals "Registration of income from population" (for inhabitants). For organizations and legal entities such information is taken from contracts concluded with them
Calculation method	

Parameter number and name	**6.** Heating area (Total)
Description	Heating area for every boiler houses
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	The revise is made in case of new contracts with Customers or in case of contracts break.
Background data	The information is collected at the sale departments of JSC „Oblteplocomunenergo" and Chernihiv region enterprises by the certificates of owners in accordance with technical passport of building. Total area with balconies and stairs and Heating area are displayed in the special journal

Calculation method	The data is taken for January, 01 for every year

Parameter number and name	**7.** Heat transfer factor of buildings
Description	Heat transfer factor of buildings for every boiler-house
Monitoring method	Statistics JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Heat transfer factor is recorded ones per year at recording of connection or disconnection of any heating area to boiler-houses included in project.
Background data	
Calculation method	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.

Parameter number and name	**8.** Heating area of buildings (previously existed in the base year) with the renewed (improved) thermal insulation in the reported year
Description	Heating area of reconstructed buildings with application of new insulations for walls
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises.
Recording frequency	Once per year
Background data	
Calculation method	

Parameter number and name	**9.** Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reported year
Description	Heating area of newly connected buildings with application of the new insulation for walls
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises.
Recording frequency	Once per year
Background data	
Calculation method	

Parameter number and name)	**10.** Heat transfer factor of new buildings and buildings with new thermal insulation
Description	Heat transfer factor of buildings with new thermal insulation

Monitoring method	According to State Buildings Norms (B.2.6-31:2006)
Recording frequency	
Background data	
Calculation method	
Parameter number and name	**11.** Heating period duration
Description	Heating period duration in every town
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Once per year
Background data	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. According to SNiP 2.01.01-84 (Climatology in heating engineering) the duration of heating period for project development is to be taken as 183 days, and usually it is from October,15, till April 15.
Calculation method	

Parameter number and name	**12.** Duration of the hot water supply period
Description	Duration of the period of hot water supply service for every boiler house.
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Once per day
Background data	Hot water supply service is realized by hot water delivery schedule for every town.
Calculation method	

Parameter number and name	**13.** Maximum connected load to the boiler-house, that is required for heating
Description	Maximum connected load to the boiler-house, that is required for heating.
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Once per year .
Background data	Maximum connected load to the boiler-house, that is required for heating, is calculated by JSC „Oblteplocomunenergo" and Chernihiv region enterprises for every heating season. It is calculated according to heat demand at outside temperature -23 ^{o}C.

Calculation method	

Parameter number and name	**14.** Connected load to the boiler-house, that is required for hot water supply service
Description	Connected load to the boiler-house, that is required for providing the hot water supply service
Monitoring method	Statistics of JSC „Oblteplocomunenergo" and Chernihiv region enterprises
Recording frequency	Once per year .
Background data	Connected load to the boiler-house, that is required for hot water supply service, is calculated by JSC „Oblteplocomunenergo" and Chernihiv region enterprises every year according to contracts with consumers.
Calculation method	

Parameter number and name	**15.** Standard specific discharge of hot water per personal account
Description	Standard specific discharge of hot water per personal account
Monitoring method	Normative documents
Recording frequency	Once per year
Background data	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.
Calculation method	

Parameter number and name	**16.** Carbon emission factor
Description	Carbon emission factor for different fuels
Monitoring method	Normative documents
Recording frequency	Once per year
Background data	For all fuels we used CO_2 emission factors from the data table provided in Annex C of the Operational Guidelines for Project Design Documents of Joint Implementation Projects [Volume 1: General guidelines; Version 2.2]. Cef (natural gas) = 0.0561 $ktCO_2/TJ$; Cef (mazut) = 0.0774 $ktCO_2/TJ$; (taken as "Residual fuel oil"). Cef (coal) = 0.0946 $ktCO_2/TJ$; (taken as "Other bituminous coal").
Calculation method	

Parameter number and name	**17.** Recalculating factor for average load during heating period
Description	Recalculating factor for determination of the average load during

	heating period
Monitoring method	Statistics
Recording frequency	Once per year
Background data	Recalculating factor for average load during heating period is determined for each boiler-house on historical base, usually it is in the range (0,4 – 0,8)
Calculation method	$g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$ 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).

Scheme of monitoring system

The control and monitoring system comes to fuel consumption measurement. Other parameters are defined by calculations or taken from statistic data. Fuel consumption measurement is realized at the Gas distributing units of the boiler-houses. Gas registration is carring out in volume units reduced to standard conditions by means of automatic correction for temperature and pressure. The scheme of typical Gas distribution unit is shown at the Fig. 1.

The typical Gas distributing system usually consists of the following equipment:

- Gas filter;
- Control and measuring devices for gas operation pressure measurement and control of pressure difference at the gas filter;
- Gas flow meter;
- stop valve;
- bypass facility.

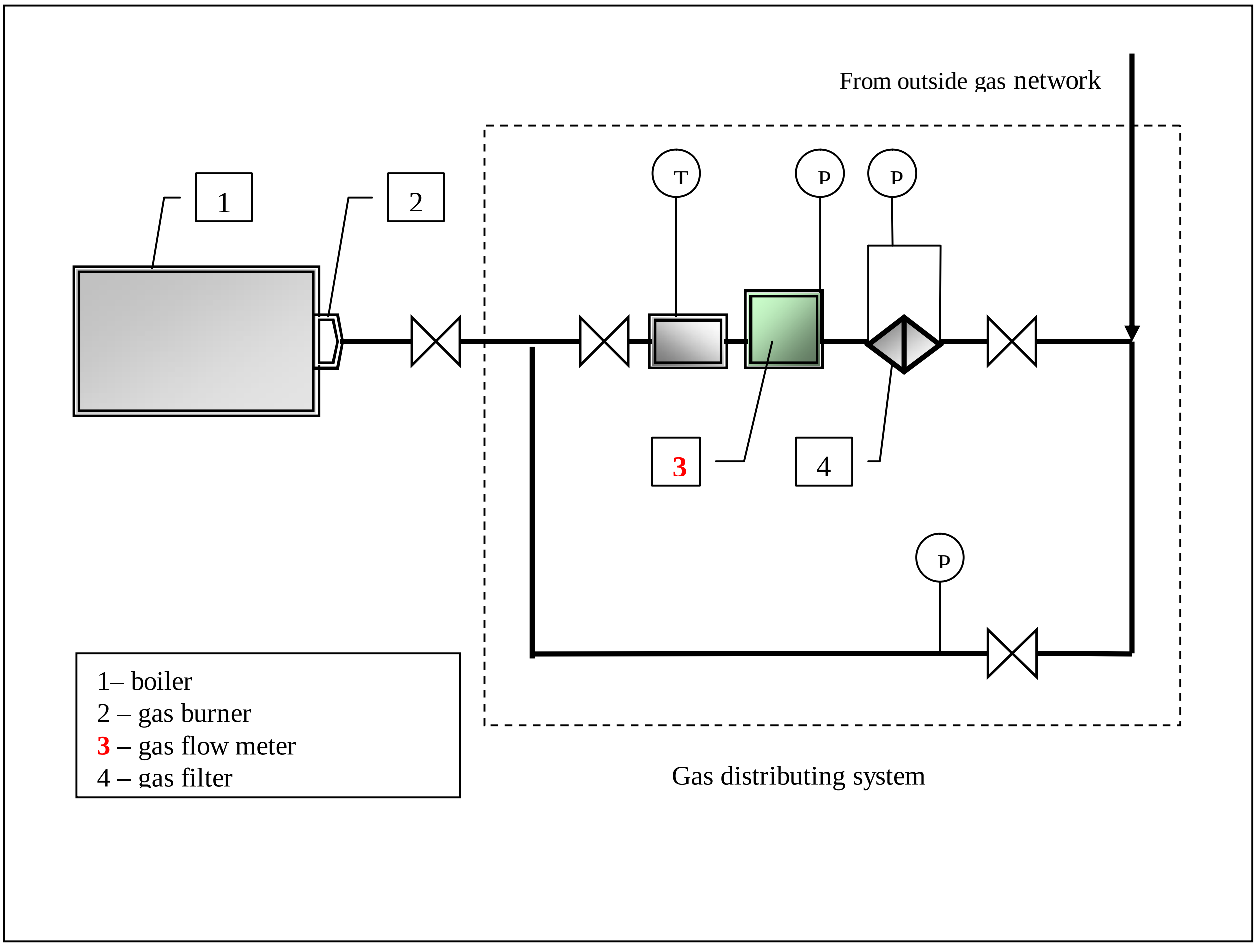

Fig. 1. Scheme of the Gas distribution system

Monitoring equipment

The equipment to be used by the project executor for monitoring of the relevant parameters are summarized in Table 1. The table also provides information on equipment type, calibration and procedures to follow in case of equipment failure.

ID number and data variable	Equipment	Accuracy	Calibration	Frequency	Procedure in case of failure
1.1 Natural Gas consumption	Gas flow meters	+/- (0.5…2)% Usually 1%	JSC “Oblteplocomunenergo” has its own heat technical laboratory that is authorized to calibrate the measurement devices for own needs and for other enterprises, JSC “Chernihivgas service center”, JSC “Chernihiv State center of standardization, metrology and certification”, “Derzhspozhivstandart” of Ukraine.	Once per from 1 to 5 years, usually two years	Failure should be firstly reported to the Project manager or Chief Engineer. If failure is not removed within 48 hrs, the equipment supplier should be ordered for repair. If repair is not possible, equipment should be replaced by equivalent item. Failure events will be recorded in the site events log book.

Table 1. Monitoring equipment

Level of uncertainty and errors

Possible uncertainties and errors for such type project may arise from two main reasons: measurement and stipulation. Measurement error is due to metering equipment inaccuracies. Stipulation occurs when some values are required to complete calculations, but these values cannot be measured directly. In these cases estimates are used in place of actual measurements, and therefore error may be introduced. The stipulation error itself may be estimated based on the expected accuracy of the stipulated values.

The project error can be calculated from the two error components described above. The total project error (Standard Error, SE) can be calculated by taking the square root of the sum of the squares of the individual error components, as below:
$SE = \sqrt{[(\text{measurement error})^2 + (\text{stipulation error})^2]}$

The monitoring plan developed for this project does not rely on any estimates and is therefore free of any stipulation errors.

Thus, $SE = \sqrt{[(\text{measurement error})^2 + (0)^2]} = (\text{measurement error})$

Although the project has 17 monitoring parameters, only one of them (volume of natural gas consumption) is measured directly. The remaining monitoring parameters used in calculation of the baseline and project line emissions are taken as statistic data. Furthermore, they are used for adjustment factors calculation. Calculations of adjustment factors are based on reported and base year parameters ratio. For example, temperature change factor is calculated as ratio of inside and outside temperature differences in reported and base years: $K_2 = (T_{in\ r} - T_{out\ r}) / (T_{in\ b} - T_{out\ b})$. Therefore any error in statistic data will be cancelled.

The volume of natural gas consumption measurement errors which impact the Standard Error and their level of accuracy are: ± 1.0 % (usual value for the majority of meters).

5. MONITORING OF ENVIRONMENTAL IMPACTS

As the project involves rehabilitation of an existing district heating network leading to an improvement of energy efficiency and therefore better environmental performance of the system, and is not a new build project, no negative environmental impacts are expected, and therefore no formal environmental impact assessment is required by the relevant Ukrainian authorities.
There is therefore no need to monitor specified environmental impact indicators during implementation and operation of the project activities.

6. PROJECT MANAGEMENT PLANNING

The overall responsibility for the project management and implementation is carried out by the director of JSC "Oblteplocomunenergo", Mr. Yuriy Barbarov, and appointed responsible persons leaded by Mr. Mr. Victor Olejnik , Head of production department of JSC "Oblteplocomunenergo". The stuff of PTD is responsible for project activity.

Compliance of the project activity with the operational requirements is constantly controlled by responsible stuff of a boiler-house, and according to their reports – by PTD.
Possible bottlenecks and mistakes in project implementation should be identified and solved by responsible stuff of PTD.

Responsibilities for data collection

The chairman of JSC "Oblteplocomunenergo", Mr. Yuriy Barbarov, appointed a responsible person, Mr. Victor Olejnik, for the implementation and management of the monitoring process at the JSC "Oblteplocomunenergo", "Nizhynteplomerezhi" Ltd, ME "Prilukiteplovodopostachannya", ME "Bahmachteplomerezhi", PEHN "Borznateplocomunenergo", ME "Nosivski teplovi merezhi". Mr. Victor Olejnik is responsible for supervising data collection, measurements, calibration, data recording and storage.
Dr. Vladimir Gomon, Managing Engineer of European Institute for safety, security, insurance and environmental techniques, is responsible for baseline and monitoring methodology development.
Dr. Dmitri Paderno, vice director of Institute of Engineering Ecology, is responsible for baseline and monitoring methodology development.
Ms. Tetiana Grechko, senior engineer of Institute of Engineering Ecology, is responsible for baseline and monitoring methodology development and data processing.

Data collection for fuel consumption is providing in the following way:

1. Every 2 hours operator of a boiler house read the values of inside air temperature, temperature of the natural gas and gas pressure at the entrance to the boiler-house. Natural gas consumption is measured by gas flow meters, installed at the every boiler-house. Every day operator of a boiler house make registration of daily gas consumption in the special paper journal.
2. Instrument readings were summarized daily and transferred to JSC „Oblteplocomunenergo" calculating center.
3. Every decade calculating center transferred data to gas supplying company

Scheme of data collection for Monitoring Report is shown at the Fig. 2.

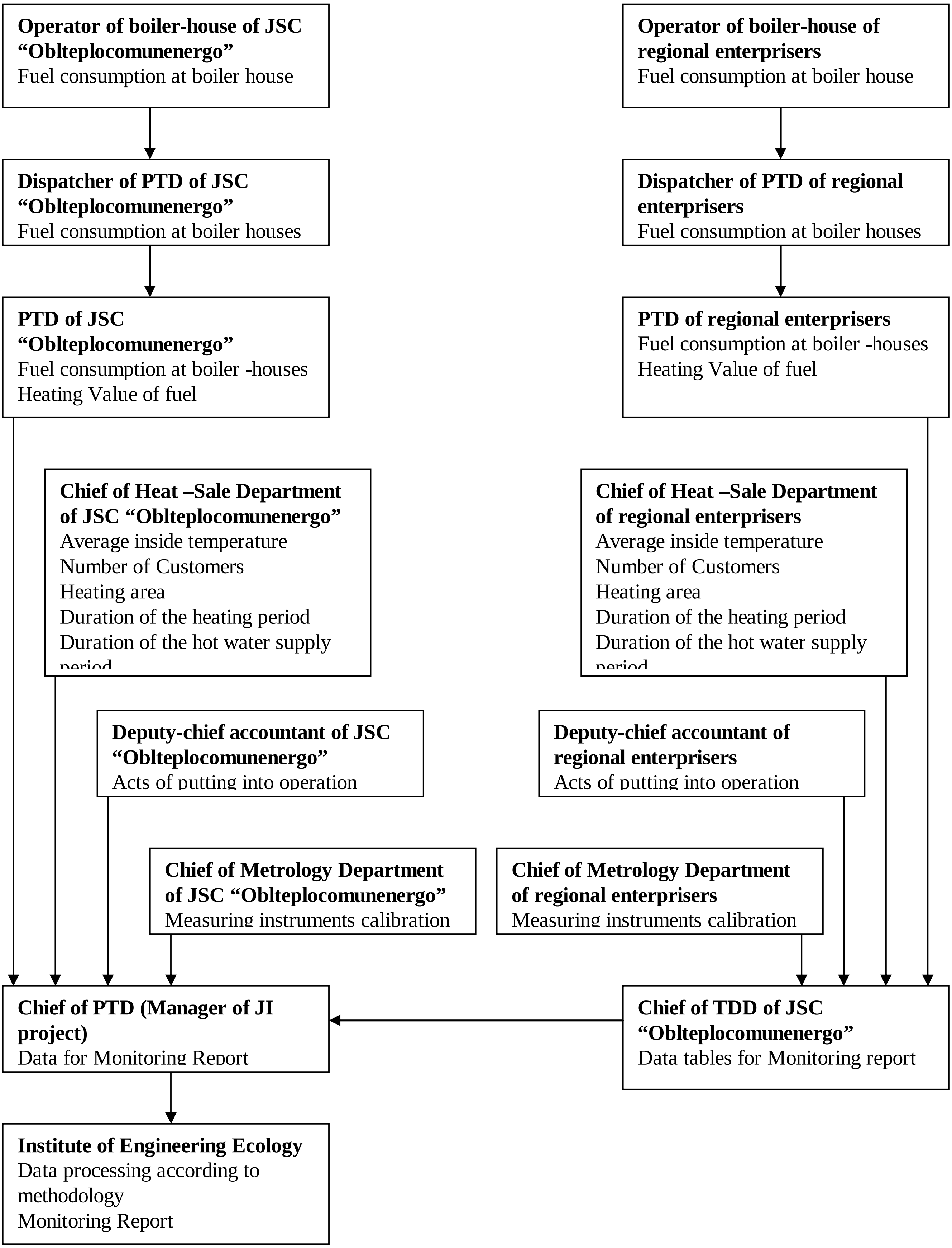

Fig.2. Scheme of data collection for Monitoring Report

Trainings

As far as the main activity of of JSC "Oblteplocomunenergo" and other regional enterprises 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 implmentation of the project activity and maintenance of the usual equipment.

JSC "Oblteplocomunenergo" provides personnel retraining according to protection of labour norms. The enterprise has the Labour protection department, which is responsible for raising the level of personnel skills and trainings.

In course of the JI project development, specialists of Institute of Engineering Ecology and then also of the European Institute for safety, security, insurance and environmental technics carried out a comprehensive consultations and trainings for involved representatives of JSC "Oblteplocomunenergo" and other regional enterprises on the necessary data collection according to Monitoring plan for the project.
The special training is scheduled to be held before the development of the Monitoring report.

The responcible stuff of PTD of JSC "Oblteplocomunenergo" and other regional enterprises will be involved in this process.

Responsibilities for data management

All collected data will be transferred to Andriy Repin, who will be responsible for data storage and archiving, entry of the data into the monitoring spreadsheets. Tetiana Grechko will be responsible for the data processing according to methodology and for development of Monitoring Report. Support in co-ordination of verification process will be undertaken by Dmitry Paderno. Responsibilities for data management are presented in Table 2.

Activity	Responsible person	
	Name	Position and department
Data storage and archiving, filling up the spreadsheets for Monitoring Report	Mr. Oleksiy Teterya	Head of technical development department of JSC "Oblteplocomunenergo"
Data storage and archiving, filling up the spreadsheets for Monitoring Report Data monitoring and reporting, coordination of verification process	Mr. Victor Olejnik	Head of production department of JSC "Oblteplocomunenergo"
Data processing according to methodology, development of Monitoring Report	Mrs. Tetiana Grechko	Senior engineer of Institute of Engineering Ecology, Ltd
Monitoring methodology assessment	Dr. Vladimir Gomon	Managing Engineer of European Institute for safety, security, insurance and environmental techniques
Support in coordination of verification process	Dr. Dmitri Paderno	Vice Director of Institute of Engineering Ecology, Ltd

Table 2: Responsibilities for data management