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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

"Rehabilitation of the Heat and Water Supply Systems in Lutsk city"

Sectoral scopes:

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

PDD Version: 04, dated September 21, 2012.

A.2. Description of the project:

Project objective is to reduce greenhouse gas emissions due to fuel, in particular natural gas (which is imported to Ukraine), consumption reduction, as well as power consumption reduction, by means of rehabilitation of the heat and water supply systems in Lutsk city, including boiler-houses, step-up (UPS) and sewage (SPS) pumping stations, and heat and water distribution network equipment replacement, modernization and rehabilitation. The purpose of the project is sustainable development of the Lutsk city through implementation of energy saving technologies.

Project is realized by following heat and water supplying enterprises in Lutsk city:

1. Public Joint Stock Company "Oblteplocomunenergo" (further mentioned as PJSC "Oblteplocomunenergo").
2. State Municipal Enterprise "Lutskteplo" (further mentioned as SME "Lutskteplo");
3. Municipal Enterprise "Lutskvodokanal" (further mentioned as ME "Lutskvodokanal");

PJSC "Oblteplocomunenergo" represents the interests of all participants of project activity as an Applicant and Supplier of GHG emission reduction units.

SME "Lutskteplo" generate and supply heat energy in forms of heat, hot water and steam. Generated heat is totally sold to local consumers, namely householders, municipal consumers and state-owned organizations. ME "Lutskvodokanal" render all complex of centralized water supply and sewage removal services for Lutsk city. The market for heat and water is stable during years.

Project includes 63 boiler-houses with 191 installed boilers and heat supply stations (HSS) related to them, and 164 km in the 2-pipe calculation of heat distribution networks, 7 step-up (UPS) and 20 sewage (SPS) pumping stations, 301 km of water supply network, 194 km of sewerage pipes, and 3 water intakes, see Appendixes 1 – 5.

a) Situation existing prior to the starting date of the project:

The common practice for the district heating and water supplying enterprises in Ukraine including enterprises that implement the project is to fulfill annual minimal repairing of the heat and water supply system to keep them working. In fact, mainly repairing of network's parts and boilers which might cause accidents are commonly executed.

b) Baseline scenario:

For Baseline scenario, the economically feasible and realistic scenario with very slow rehabilitation activities was chosen. Tariffs for heat and water do not include the resources for prospective rehabilitation of the heat and water supply systems, only the resources for probable necessary repairing after possible accidents. Minimal annual repairing doesn't lead to reduction of baseline emissions, because along with degradation of the whole systems with efficiency droop at other objects, the overall actual emissions of Supplier would stay at approximately the same level. This scenario is not environmentally favorable for the near future, since GHGs emissions of Supplier will continue to be kept at the same level or even higher, but economically such scenario is attractive.

c) Project scenario

The project employs the increase of fuel and energy resources (FER) consumption efficiency to reduce greenhouse gas emissions relative to current practice. The following activities will ensure fuel and energy resources saving:

- liquidation of low efficient boiler-houses with switching load to the high efficient boiler-houses;
- replacement of obsolete boilers with high efficient ones;
- rehabilitation of boilers with replacement and preventive maintenance measures for boilers burners, heated surfaces, etc.:
- optimization of heat load allocation and operational mode of equipment;
- optimization of heat supply network organization and network rehabilitation;
- consecutive switching of heat supply networks to preliminary insulated pipes;
- improvement of hot water supply service;
- optimization of water load allocation;
- replacement of pipes of water supply and sewage networks;
- technical re-equipment of heat supply stations with highly effective heat exchangers;
- implementation of heat recovery equipment;
- installation of frequency controllers at electric drives of pumps, blow fans and smoke exhausters;
- replacement / rehabilitation of pumps;
- improvement of the feeding water quality by optimization of operational mode of water preparation system;
- implementation of control and monitoring systems.

Implementation of the project will provide substantial economic, environmental, and social benefits to the Lutsk city. Social impact of the project is positive since after project implementation the heat and water supply services will be improved.

The brief history (the main milestones) of the project (including its JI component):

The project was initiated in 2005.

March, 2004 - Institute of Engineering Ecology suggested State Municipal Enterprise “Lutskteplo” and Municipal Enterprise “Lutskvodokanal” to develop Joint Implementation Project on Green House Gas Emission Reduction.

November, 2004 – Order on creation of the Technical Working Group on the possible participation of the ME “Lutskvodokanal” in Joint Implementation Project in frames of Kyoto protocol and starting of preparation to realization of project since 01/01/2005 was issued (# 224 dated 18/11/2004).

December, 2004 – Order on creation of the Technical Working Group on the possible participation of the SME “Lutskteplo” in Joint Implementation Project in frames of Kyoto protocol and starting of preparation to realization of project since 01/01/2005 was issued (dated 09/12/2004).

April, 2012 – Agreement on Joint Activity for realization of the JI project on GHG emission reduction was signed between the OJSC “Oblteplocomunenergo”, SME “Lutskteplo” and ME “Lutskvodokanal” (dated 18/04/2012).

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)	PJSC "Oblteplocomunenergo"	No
Estonia	OÜ "Biotehnoloogia"	No

Table A-1. Project participants

- ***PJSC "Oblteplocomunenergo":*** organization acting as Project Applicant and Supplier of GHG emission reductions on behalf of all participants of the Agreement on Joint Activity dated 18.04.2012) It represents the interests of participants of the Agreement and is responsible for the organizational aspects of the JI project.

Historical details[1]:

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 had started its work on January 1st, 1969. Since 1982 the enterprise became 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 became State Municipal Enterprise (SME)"Oblteplocomunenergo".

In 1995 the privatization of enterprise objects was hold. On 31/07/95 the SME "Oblteplocomunenergo" was re-named to the Open Joint Stock Company "Oblteplocomunenergo". On April 20, 2012 the Open Joint Stock Company "Oblteplocomunenergo" was reorganized to the Public Joint Stock Company "Oblteplocomunenergo"

Today the PJSC "Oblteplocomunenergo" is the powerful heat supply complex. It has 12 boiler-houses and 2 heat supply stations, automobile division, repairing-mechanical division, pre-insulated pipes manufacture division, measuring devices repairing and testing division, metrological lab, etc. The heat energy is also produced by 107 rented boiler-houses. 18 operation divisions in the region belong to the enterprise as well. The enterprise supplies heat energy to over 270 thousand of consumers (population, housing and administrative buildings) in 22 settlements in Chernihiv Region. The installed heating load is nearly 288 Gcal/hour, hot water supply load – nearly 92 Gcal/hour. The part of the housing (populated) heated area is about 81%, of legal persons – 19%.

- ***OÜ "Biotehnoloogia":*** is the purchaser of the emission reduction units generated from this Project.

Historical details[2]:

OÜ Biotehnoloogia has been investing into Joint Implementation projects since February of 2011. At this moment OÜ Biotehnoloogia is involved in five different JI projects.

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1 *http://teplo.cn.ua/*

2 *http://www.biotehnoloogia.eu/index.php?id=10*

A.4. Technical description of the project:

A.4.1. Location of the project:

The Project is located in Lutsk city in the north-western part of Ukraine (Fig. A-1).

Fig. A-1. The map of Ukraine with administrative division

A.4.1.1. Host Party(ies):

The project is located in Ukraine.

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

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

The project is located in Volyn region of Ukraine.

Volyn region is located in the north-western part of Ukraine.

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

Lutsk city [3] - is the regional administrative center of the Volyn Region, located in the north-western part of Ukraine.

It occupies the territory of 42 km^2. Number of inhabitants is 211.7 thousand (1 January 2011) [4].

The climate is temperate continental. The average January temperature is -4 °C, July +17 °C.

[3] http://www.voladm.gov.ua/index.php?option=com_k2&view=item&layout=item&id=6&Itemid=42

[4] http://www.lutsk.ua

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

Location of the Lutsk city: 50°44'52 N 25°19'28 E.

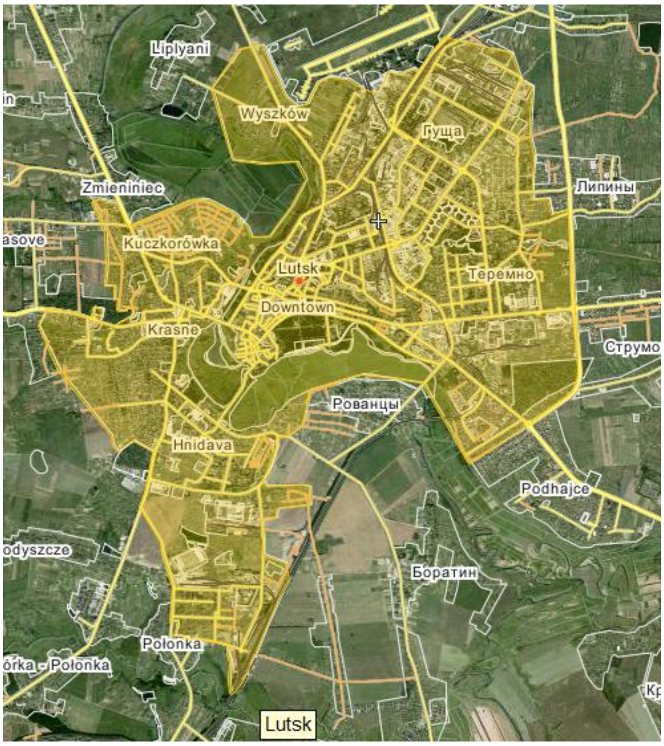

Fig. A-2. Map of the Lutsk city

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

The main measures planned to be implemented by the project for improving the efficiency of enterprises that implement the project are the following:

- Replacement of old operating boilers with low efficiency by the new highly efficient ones, that will result in efficiency increasing up to 90-92%. Technical characteristics of new boilers scheduled to be installed are presented at the producer's websites that are listed in Table A-2 below.

Type of boiler	Website of boiler producer
Kolvi	*http://kolvi.com/*
Riello	*www.riello.su*
Protherm	*http://www.protherm.ua/*

Table A-2. Boilers producer's web sites

- Rehabilitation and modernization of obsolete but able to work boilers with using various technologies, including replacement and preventive maintenance measures for boilers burners, boilers heated surfaces (replacement and cleaning of screen tubes of combusting chambers, convective surfaces), implementation of technology for the exhaust gases heat recovery, etc., will lead to 5 - 25% increase in efficiency.
- Liquidation of low efficient boiler-houses with switching of load to highly efficient boiler-houses.

- The efficiency of heat distribution networks system will be considerably increased by:
  - optimization of network organization: decreasing pipelines length (moving heat generating source closer to consumer, etc.), with replacement of 4-pipe lines by 2-pipe ones with simultaneous installation of heat exchangers directly at the consumers, etc.;
  - gradual shift of heat supply networks to preliminary insulated pipes, including produced by "Transprogres" Ltd. (http://www.transprogress.com.ua/products.htm) and "Polimerteplo-Ukraine" Ltd. (http://polymerteplo.com.ua/). These pipes are presented at the Fig. A-3;
  - decreasing of losses in pipelines (renovation of heat insulation, packing of controlling and locking elements, etc.).

Fig. A-3. Pre-insulated pipes.

- Improvement of hot water supply service with increasing of hot water delivery term from 15 hours per day to 20 hours per day.
- Replacement of old heat exchangers by the high efficient plate-type ones. This will enable to reduce electric power consumption and heat losses. Technical characteristics of new heat exchangers (Fig. A-4) are presented at the producer's website http://teploenergo.com.ua.

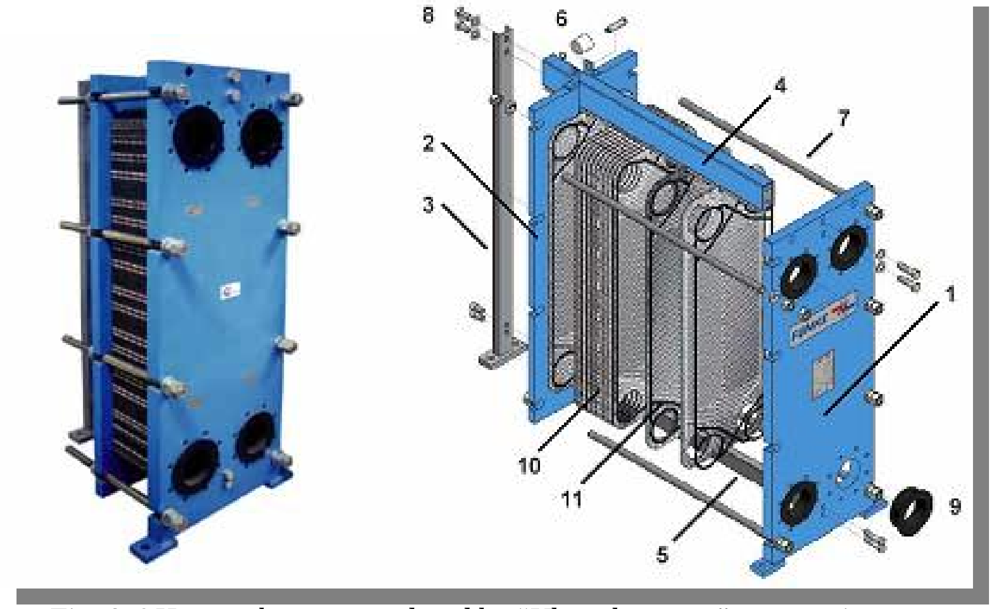

Fig. A-4.Heat exchangers produced by "Ukrteploenergo" corporation

- Rehabilitation and optimization of water supply and sewage removal networks with replacement of pipes and decreasing of losses in pipelines will allow delivering the necessary volume of water with pumping the less amount of raw water and thus considerably reducing electricity consumption;

- Installation of frequency controllers at pump motors' electric drives will result in electricity saving. Such regulators enable to change the actual capacity of the motors in dependence on connected load, both during a day when water consumption is changed, and during a year.

  Installation of frequency controllers at blow fans' and smoke exhausters' electric drives will result in considerable electricity saving in dependence on a boiler operation mode.

  Technical characteristics of frequency converters are presented at the website of "Danfoss" company: www.danfoss.com.

- Replacement / rehabilitation of old pumps transporting raw and hot water by the new ones will enable to considerably reduce power consumption. Technical characteristics of new pumps are presented at the websites of manufacturers, "Wilo" company - http://www.wilo.de/cps/rde/xchg/ua-ru/layout.xsl/2882.htm, and others.
- Optimization of load allocation, in particular during intermediary period, will enable to considerably reduce fuel consumption for supplying required heat to consumers;
- Improvement of the feeding water quality by optimization of operational mode of water preparation system will allow increasing efficiency of boilers;
- Implementation of modern control and monitoring systems and automatics will allow increasing efficiency of a whole heat and water supply systems.

More detailed information is provided in Appendixes 1 – 5:

Appendix 1 - Rehabilitation of boiler equipment of the heat supply system.
Appendix 2 - Rehabilitation of networks of the heat supply system.
Appendix 3 - Rehabilitation of pumping equipment of the water supply system.
Appendix 4 – Installation of frequency controllers at equipment of the water supply system.
Appendix 5 – Rehabilitation of networks of the water supply system.

The generalized planned schedule of the above measures implementation is the following:

#	Project stage	Period
1	Rehabilitation of boilers with replacement and preventive maintenance measures for boilers burners, heated surfaces, etc.	2005 – 2012
2	Optimization of heat load allocation and operational mode of equipment	2005 – 2012
3	Optimization of heat supply network organization and network rehabilitation	2005 – 2012
4	Rehabilitation / optimization of water supply and sewage removal networks	2005 – 2012
5	Technical re-equipment of heat supply stations with highly effective heat exchangers	2005 – 2012
6	Replacement / rehabilitation of pump equipment in boiler-houses and pumping stations	2005 – 2012
7	Installation of frequency controllers at electric drives of pumps, blow fans and smoke exhausters	2005 – 2012
8	Improvement of the feeding water quality by optimization of operational mode of water preparation system	2005 – 2012
9	Implementation of control and monitoring systems	2005 – 2012
10	Improvement of hot water supply service	2007 – 2012
11	Liquidation of low efficient boiler-houses	2009 – 2011
12	Replacement of obsolete boilers with high efficient ones	2011 – 2012

Table A-3. Schedule of the Project implementation

At the beginning of the project, specialists of the Institute of Engineering Ecology (project developer) had analyzed the current state of the heat and water supply systems of the enterprises that implement the project. Based on experience of developing and implementing the JI projects for rehabilitation of the heat supply systems in Ukrainian conditions (“District Heating System Rehabilitation of Chernihiv Region”, “Rehabilitation of the District Heating System in Kharkiv City”, “Rehabilitation of the District Heating System in Donetsk Region”, “Rehabilitation of the District Heating System of Crimea”, etc.), a set of recommendations to implement the low-cost, mainly organizational and operational measures, were issued by the Institute and were implemented at objects of enterprises involved in the project.

Such measures, in particular, include:

- technical servicing and operational adjustment of boiler equipment (additional extraordinary);
- optimization of operational mode of the equipment:
    - providing of the correspondence of the quantity of heat supplied to consumers to that is determined by need to satisfy normative requirements in specific conditions depending on outside temperature, day time, etc., i. e. avoiding of the so-called “excess heating”,
    - providing of the operational mode of the equipment at maximum efficiency according to the regime cards or specifications of equipment;
- reduction of operational time of boiler and pumping equipment (pumps, smoke exhausters, fans, etc.) at idle running;
- identifying and removing of the small leakages of heat-carrying agent (nonhermeticity) and heat (heat insulation defects) in heat distribution networks;
- identifying and removing of the small leakages of raw water and sewage in water distribution and sewage removal networks, including leakages in controlling and locking valves;
- mechanical and / or chemical cleaning of heating surfaces of boilers;
- adjustment of automatic control devices at the heat supply stations (HSS) to the economic mode, which also favors to reduce “excess heating”;
- improving the quality of water for feeding of boilers by optimizing of water treatment systems operation.

In addition, in connection with participation in the JI project, during the process of project implementation at enterprises that implement the project the responsibility of each employee for the optimal consumption of energy resources is set, under which the unscheduled on-site monitoring of all key parameters of system as a whole are conducted.

These measures have provided achieving of the average fuel saving up to 15% and of electricity saving up to 7%, depending on capacity and conditions of facilities. Sometimes the energy saving due to implementing of organizational and operational measures achieves up to 30% or more.

Estimated prognostic effects of implementation of the above technologies and measures on efficiency improving are provided in the **Appendices 1 – 5.**

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

These technologies are the most up-to-date thus it is ensured that there is no risk that they will be substituted by any other technologies during at least the first commitment period up to 2012, and most probably in near future during the upcoming second commitment period. As to the last one, the project activity can be extended with further implementation of the abovementioned measures and technologies at the objects included in the project. Detailed information about types and amounts of project activity will be included in the periodic monitoring reports.

As far as the main activity of enterprises that implement the project will not be changed in course of the JI project implementation, the special technical trainings for personnel are not necessary. The technical personnel of the enterprises have sufficient knowledge and experience for implementation of the project activity and maintenance of the usual equipment.

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

Enterprises that implement the project provide personnel retraining according to the labour protection norms. The enterprises have the Labour protection department, which is responsible for raising the level of personnel skills and trainings.

The special training on the data collection according to Monitoring plan for this project was hold by the Institute of Engineering Ecology (IEE), and the special group that consisted of representatives of heat and water supplying enterprises and IEE was organized.

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 replacement, modernization and rehabilitation of equipment of boiler-houses, step-up and sewage pumping stations and heat and water distribution networks will increase energy efficiency of the heat and water supply systems in Lutsk city, thus enabling them to produce the same amount of heat energy and supply the same amount of water to customers with less fuel and energy resources consumption. Reduced fuel and energy resources consumption will lead to reduction of GHG emissions.

In the absence of the proposed project, all equipment, including the old low efficient but still workable for a long life period one, will operate in as-usual mode, and any emission reductions will 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 and for 2009-2014 confirmed by the Law of Ukraine dated 24/06/2004 No. 1869-IV[5] with changes according to the Law of Ukraine dated 11/06/2009 No. 1511-VI[6], and in the Law of Ukraine "On energy saving" dated 01/07/1994 No. 74/94-VR[7] with changes according to the Law of Ukraine dated 24/05/2012 No. 4845-VI[8]. The Laws of Ukraine "On heat energy supply" dated 02/06/2005 No. 2633-IV[9] and "On drinking water and drinking water supply" dated 10/01/2002 No. 2918-III[10] with changes according to the Law of Ukraine dated 23/02/2012 No. 4434-VI[11] regulate all relations in the heat and water supply markets. This does not considerably change the previously existing practices at the markets, but stimulates the more rigid energy saving and implementation of energy efficient technologies.

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[5] *http://zakon1.rada.gov.ua/laws/show/1869-15*

[6] *http://zakon1.rada.gov.ua/laws/show/1511-17*

[7] *http://zakon3.rada.gov.ua/laws/show/74/94-%D0%B2%D1%80*

[8] *http://zakon3.rada.gov.ua/laws/show/4845-17*

[9] *http://zakon2.rada.gov.ua/laws/show/2633-15/page*

[10] *http://zakon2.rada.gov.ua/laws/show/2918-14/ed20120223*

[11] *http://zakon2.rada.gov.ua/laws/show/4434-17*

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

Estimated amounts of emission reductions by years over the crediting period are presented in Tables A4 - A6.:

The First Kyoto Commitment period 2008 – 2012:

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	102 793
2009	109 093
2010	111 065
2011	126 249
2012	126 249
Total estimated emission reductions over the first commitment period (tonnes of CO_2 equivalent)	575 449
Annual average of estimated emission reductions over the first commitment period (tonnes CO_2 equivalent)	115 090

Table A-4. Estimated emission reductions during the first commitment period 2008 – 2012

The Post-first commitment period 2013 – 2032:

	Years
Length of the crediting period	20
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	126 249
2014	126 249
2015	126 249
2016	126 249
2017	126 249
2018	126 249
2019	126 249
2020	126 249
2021	126 249
2022	126 249
2023	126 249
2024	126 249
2025	126 249
2026	126 249
2027	126 249
2028	126 249
2029	126 249
2030	126 249
2031	126 249
2032	126 249
Total estimated emission reduction over the post- first commitment period (tonnes of CO_2 equivalent)	2 524 980
Annual average of estimated emission reductions over the post- first commitment period (tonnes CO_2 equivalent)	126 249

Table A-5. Estimated emission reductions during the post- first commitment period 2013 –2032

Total amount of Emission Reductions over the crediting period:

	Years
Length of the crediting period	25
	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	3 100 429
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	124 017

Table A-6. Estimated emission reductions during the crediting period 2008 – 2032

A.5. Project approval by the Parties involved:

The project has been already approved by local authorities and representative of the Government of Ukraine - the State Environmental Investment Agency of Ukraine (responsible authority for the Kyoto Protocol activity in Ukraine).

Ukrainian DFP – the State Environmental Investment Agency of Ukraine has issued the Letter of Endorsement for this project (No. 2659/23/7 dated 19.09.2012).

According to the adopted procedure, the LoAs by Parties involved will be issued after the project determination.

SECTION B. Baseline

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

According to the "Guidelines for users of the JI PDD form" version 04[12], the baseline shall be established on a project-specific basis, or where applicable, project participants may opt to apply approved clean development mechanism (CDM) baseline and monitoring methodologies.

In course of development of this JI project, in accordance with paragraph 9(a) of the "Guidance on criteria for baseline setting and monitoring", the project specific approach was used, developed in accordance with appendix B "Criteria for baseline setting and monitoring" of the JI guidelines.

This project specific approach is partly similar to the Baseline and monitoring methodology AM0044 "Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors" (version 1)[13], however the AM0044 cannot be used for the JI project "Rehabilitation of the Heat and Water Supply Systems in Lutsk city" since this project has some differences from applicability conditions of this methodology.

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 heat energy output of project boiler i in year y, that should be measured every month by flow-meter (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 production per year $EG_{BL, his, i}$ (average historic heat energy output from the baseline boiler "i"), etc.

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. At the same time this project includes also some others kinds of modernization such as the replacement of burner and network equipment, etc.

In view of above mentioned, the specialists of the European Institute for safety, security, insurance and environmental technics "SVT e.V." (Germany) and of the Institute of Engineering Ecology (Ukraine) have developed the project specific approach, which takes into account all activities involved in and the peculiarities of the JI projects on rehabilitation of the district heating systems in Ukraine.

This project specific approach is based on the permanent measuring of the fuel consumption and on amendment of the baseline for possible changes of parameters in a reported year. The changeable parameters may be the Net Calorific Value of fuels, quality of heating service, weather conditions, number of consumers, etc. Taking into account only equipment efficiency change does not eliminate the possibilities of undersupply of heat to consumers (worsening of heat supply service), and possible weather warming in reported year, change in fuel quality, disconnection of some consumers and other factors could lead to artificial overestimation of emission reductions amount. The developed project specific approach eliminates any possibility to depreciate fuel consumption and correspondingly to underestimate GHG emissions due to underdelivery of heat to consumers.

This developed project specific approach has two important advantages (at least for Ukrainian conditions):

- It takes into account the quality of heat supply (heating and hot water supply). Almost every year 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

[12] http://ji.unfccc.int/Ref/Documents/Guidelines.pdf

[13] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5

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 excess reduction of heat consumption, and, in such a way, of fuel consumption with the purpose of excess increasing of generation of emission reductions 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.

Thus, in contrast to the methodology AM0044, this project specific approach, developed for "District Heating" projects in Ukrainian conditions and used in JI Projects "District Heating System Rehabilitation of Chernihiv Region", "Rehabilitation of the District Heating System in Kharkiv City", "Rehabilitation of the District Heating System in Donetsk Region", "Rehabilitation of the District Heating System of Crimea", "Rehabilitation of the District Heating System in Luhansk city", etc. as well, is the most appropriate, precise, corresponding to the conservative approach, and in the most closely manner reflects the aims, goals and spirit of Kyoto Protocol.

For baseline setting and monitoring associated with water supply system rehabilitation, the elements of approved methodology AM0020 "Baseline methodology for water pumping efficiency improvements" and "Monitoring methodology for water pumping efficiency improvements" (version 02)[14] are also used.

The baseline study will be fulfilled every year of the emission reduction, to correct adjustment factors which have an influence at the baseline.
This project specific approach is presented in **Section D.**

Construction of the Baseline Scenario

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

The first version of Baseline scenario was a business-as-usual scenario with minimum rehabilitation works balanced by overall degradation of the systems. 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 it represents the common practice in Ukraine.

The second version of Baseline scenario was to make rehabilitation 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 and water supply equipment in order to improve its efficiency is not a common practice in Ukraine.

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

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[14] http://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf#AM0020

Thus, the first version was chosen for Baseline scenario.

Operation of heat and water supply systems in Lutsk city results in continuous deterioration of the heat-generating and heat and water distribution equipment, followed by continuous slight efficiency decreasing. Such decreasing is estimated in normative documents[15,16] for conditions of the proper operative maintenance of the equipment, and makes from 0.19 to 0.44 % per year for boilers, with lower values for larger capacity. The similar situation is for the main heat networks, and even worse for the heat distribution networks. Actually the operative maintenance of the heat equipment in Ukraine is usually not provided at the proper level, and such deterioration is obviously larger and in overall may be estimated as 1 % per year and more. According to conservative approach, the Baseline is constructed with taking into account the average deterioration of only the main heat generating and distributing equipment (boilers and distribution networks) at the level of 0.5 % per year.

For calculation of Baseline emissions, the 2004 was taken as the base year. This year is one of the typical years concerning conditions of production and consumption of the heat and water.

Status of the heat and water supply systems in the base year

In the base year the heat supply by DH systems in Lutsk city was primarily based on Ukrainian and Russian made gas fired boilers, including: Strelya–1, GM-50-14, DE-10-14GM, DE-25-14GP, DEV 16-14 GM, DKVR-10-13, DKVR-20-13, DKVR-4-13, DKVR-6,5-13, E-1/9-1G, ELGA-G, KBNG-2,5, KV-G-4-150, KV-G-6,5-150, KVGM-100, KVS-GM-0,8, KSV-3,15, MINSK-1, NIISTU-5, Rivneterm–96, TVG-4R, TVG-8M, Universal-5P. Detailed information is presented in **Appendix 1**. Efficiencies of those boilers were in the range of 56-87%.

The heat distribution networks were characterized by heat losses up to 38%. Detailed information is presented in **Appendix 2.**

The water supply system in Lutsk city was primarily based on Ukrainian and Russian industrial pumps with overestimated capacity and non-regulated engine, such as: FG2400-75, FG 450-22.5, CM250-200-400, FG 800-33, FG 216-24, 200D/90, 300D/90, EMU NY911N, etc. Detailed information is presented in **Appendix 3.**

The raw water distribution networks were characterized by aversage losses up to 29%. Detailed information is presented in **Appendix 5.**

The following GHG emissions are included in the baseline scenario:

1) emissions due to fuel consumption by the heat supply system;
2) emissions due to electricity production that is consumed by the heat supply system;
3) emissions due to fuel consumption by the water supply system ;
4) emissions due to heat production that is consumed by the water supply system;
5) emissions due to electricity production that is consumed by the water supply system.

The total baseline amounts of fuel and energy resources consumption by involved enterprises are summarized in Table B-1.

	Baseline natural gas consumption, ths. m^3	Baseline electricity consumption, MWh	Baseline heat energy consumption, Gcal
SME “Lutskteplo”;	117298	31025	0
ME “Lutskvodokanal”	300	26893	1483
Total	**117598**	**57918**	**1483**

Table B-1. Baseline fuel and energy resources consumption

[15] http://www.janko.front.ru/KTM_204_UKR_246_99.zip

[16] http://budstandart.ua/read/document_body/id/3091126

Detailed information is presented in **Appendices 6, 7** and **9.**

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

Data / Parameter	B_H^b
Data unit	ths. m^3
Description	Fuel (natural gas) consumption by a boiler house in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	SME “Lutskteplo”
Value of data applied (for ex ante calculations/determinations)	See Appendix 6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurements are taken by gas meters at each boiler-house
QA/QC procedures (to be) applied	Equipment is inspected and calibrated according to the State Standard of Ukraine No.2708:2006 “Metrology. Calibration of measuring equipment. The organization and procedure”[17].
Any comment	Information shall be archived in paper and electronic form.

Data / Parameter	P_H^b
Data unit	MWh
Description	Electricity consumption by a boiler house in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	SME “Lutskteplo”
Value of data applied (for ex ante calculations/determinations)	See Appendix 7
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by electricity meters
QA/QC procedures (to be) applied	Equipment is inspected and calibrated according to the State Standard of Ukraine No.2708:2006 “Metrology. Calibration of measuring equipment. The organization and procedure”.
Any comment	Information shall be archived in paper and electronic form.

[17] http://oscill.com/files/27082006.pdf

Data / Parameter	**NCV^b**
Data unit	MJ/m^3
Description	Averaged net calorific value of fuel (natural gas) in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	Enterprises that implement the project
Value of data applied (for ex ante calculations/determinations)	33.7
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Fuel Supplier's Report
QA/QC procedures (to be) applied	N/A
Any comment	Information shall be archived in paper and electronic form.

Data / Parameter	**B_W^b**
Data unit	ths. m^3
Description	Fuel (natural gas) consumption by water supply system in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	ME “Lutskvodokanal”
Value of data applied (for ex ante calculations/determinations)	300
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurements are taken by gas meters at boiler-houses of the water supply enterprise
QA/QC procedures (to be) applied	Equipment is inspected and calibrated according to the State Standard of Ukraine No.2708:2006 “Metrology. Calibration of measuring equipment. The organization and procedure”[18].
Any comment	Information shall be archived in paper and electronic form.

Data / Parameter	**Q_W^b**
Data unit	Gcal
Description	Heat consumption by water supply system in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	ME “Lutskvodokanal”
Value of data applied (for ex ante calculations/determinations)	1483
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Amount of heat consumed by ME “Lutskvodokanal” is determined from bills for heating from the heat supplying enterprises
QA/QC procedures (to be) applied	N/A
Any comment	Information shall be archived in paper and electronic form.

[18] http://oscill.com/files/27082006.pdf

Data / Parameter	P_W^b
Data unit	MWh
Description	Electricity consumption by water supply system in the base year
Time of determination/monitoring	Once after the end of the base year
Source of data (to be) used	ME "Lutskvodokanal"
Value of data applied (for ex ante calculations/determinations)	26893
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement by electricity meters
QA/QC procedures (to be) applied	Equipment is inspected and calibrated according to the State Standard of Ukraine № 2708:2006 "Metrology. Calibration of measuring equipment. The organization and procedure".
Any comment	Information shall be archived in paper and electronic form.

Data / Parameter	Cef
Data unit	t CO_2/GJ
Description	Carbon emission factor for natural gas
Time of determination/monitoring	Once per year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	The following Cef values are used in calculations in PDD: Year — t C/TJ — Cef, t CO_2e/ GJ 2004 — 15.18 — 0.0557 2008 — 15.17 — 0.0556 2009 — 15.20 — 0.0557 2010-2012 — 15.17 — 0.0556
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data for 2004-2012 were taken according to the data from the National inventory report of Ukraine for 1990 – 2010, Table P2.8[19]
QA/QC procedures (to be) applied	N/A
Any comment	In course of development of the Monitoring reports for this project, the valid values for corresponding period will be used.

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

Data / Parameter	**CEF_c**
Data unit	t CO_2e/MWh
Description	Carbon emission factor for electricity consumption
Time of determination/monitoring	Once per year
Source of data (to be) used	Normative documents
Value of data applied (for ex ante calculations/determinations)	The following CEF_c values are used in calculations in PDD: Year — CEF_c, t CO_2e/MWh 2004 — 0.916 2008 — 1.219 2009 — 1.237 2010 — 1.225 2011-2012 — 1.227
Justification of the choice of data or description of measurement methods and procedures (to be) applied	For 2004: Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines. Version 2.3. Ministry of Economic Affairs of the Netherlands, 2004[20]; For 2008-2012: Orders of the National Environmental Investment Agency of Ukraine: # 62 dated 15/04/2011[21]; # 63 dated 15/04/2011[22]; # 43 dated 28/03/2011[23]; # 75 dated 12/05/2011[24].
QA/QC procedures (to be) applied	N/A
Any comment	All included electricity consuming objects are the 2 class customers. In course of development of the Monitoring reports for this project, the valid values for corresponding period will be used.

[20] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/GuidVol2.doc

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

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

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

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

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 in the project scenario will be reduced due to comprehensive rehabilitation of the heat and water supply systems with application of the technologies proposed in the project activities and described in **paragraph A.4.2.**

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 with baseline, which is the function of the stage of project implementation (Fig. B-1).

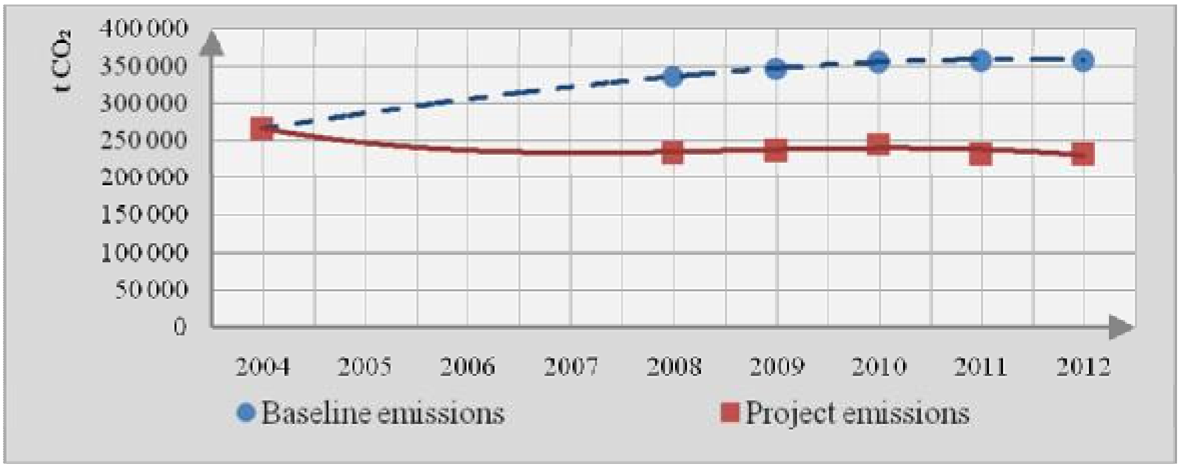

Fig. B-1. Baseline and project GHG emissions

Additionality of the project

The additionality of the project activity is demonstrated and assessed below with using the "Tool for the demonstration and assessment of additionality" (Version 6.0.0)[25] (see Fig. B-2). This tool was originally developed for CDM projects but may be applied to JI projects as well.

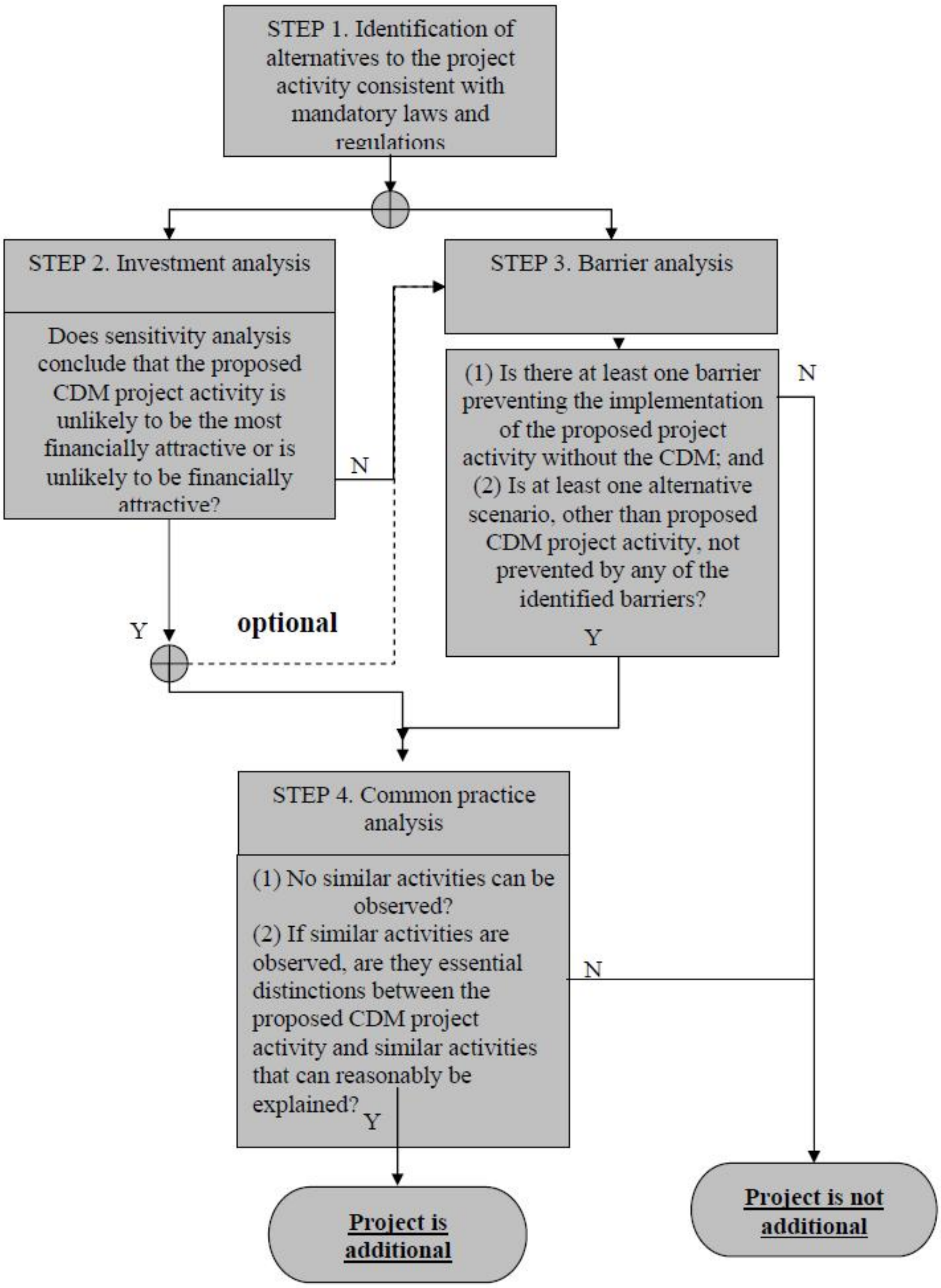

Fig.B-2. Steps for demonstration of additionality

[25] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf

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 alternatives to this project (as was already discussed in section **B1**).

1. The first alternative is continuation of the current situation (no project activity or other alternatives undertaken), i.e. business-as-usual scenario with minimum rehabilitation works, approximately balanced by overall degradation of the heat and water supply systems.

It should be noted that, for example, there is no local legislation regarding the time of boilers replacement and maximum lifetime permitted for boilers. It is common practice in Ukraine to exploit boilers which were installed in 70^{th} and even in $50\text{-}60^{th}$ and earlier, if they pass the technical examination by the authorized body ("Derzhnagliadohoronpratsi").

2. The second alternative is to make rehabilitation works (the proposed project activity) 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, etc., from the project.

Outcome of Step 1a: Three realistic and credible alternative scenarios to the project activity are identified.

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

According to the Laws of Ukraine dated 01/06/2000 No. 1775-III "On licensing of certain types of activities"[26], dated 02/06/2005 No. 2633-IV "On heat energy supply" and dated 10/01/2002 No. 2918-III "On drinking water and drinking water supply"; as well as according to the Decree of the Cabinet of Ministers of Ukraine dated 14/11/2000 No. 1698 "On approval of the list of licensing bodies"[27], execution of economic activity in fields of heat energy production, distribution and supply, and also district water supply and sewage removal requires licenses that are issued by the National Commission, which performs state regulation of municipal services.

Municipal enterprises that implement the project have such licenses.

The Project has been prepared according to the Law of Ukraine dated 01/07/1994 No. 74/94-VR "On energy saving".

Outcome of Step 1b: The alternatives, which are: to continue business-as-usual scenario, to make rehabilitation works without JI mechanism and to implement shortened project activity without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.

Hence, the Step 1 is satisfied.

According to the "Tool for the demonstration and assessment of additionality" (Version 6.0), for further additionality analysis it is possible to follow the Step 2 or Step 3 (or both).

Step 2. Investment analysis.

Sub-step 2a: Determine appropriate analysis method

The appropriate analysis method is to be chosen in dependence of generating of financial or economic benefits by the project. If project activity generates no financial or economic benefits other than JI related income, then the simple cost analysis (Option I) may be applied, otherwise the investment comparison analysis (Option II) or the benchmark analysis (Option III) should be used.

The main source of income of the district heating and water supplying enterprises in Ukraine are

[26] *http://zakon2.rada.gov.ua/laws/show/1775-14*

[27] *http://zakon2.rada.gov.ua/laws/show/1698-2000-п*

payments from customers according to the tariffs that are regulated by the "Procedure of setting tariffs for heat energy, it production, transportation and supplying and for centralized heating and hot water supply services" and the "Procedure of setting tariffs for centralized water supply and sewage removal services" approved by Decree of the Cabinet of Ministries of Ukraine No.869 dated 01/06/2011[28].

According to these Procedures, tariffs are to be set on the base of the scheduled prime cost and don't allow to obtain benefit from reduction of fuel, power, raw materials, etc. consumption. Any reduction of expenses for these raw inputs should result in decrease of tariffs for the end consumers and corresponding decrease of an enterprise's revenue, thereby the enterprises don't obtain additional revenue.

Thus, the simple cost analysis (Option I) may be applied.

Sub-step 2b: Option I. Apply simple cost analysis

Implementation of the project activity will require substantial additional investments – about **15** million EUR only for the main equipment installation / rehabilitation. The required investments for implementation of the project include the costs of the main equipment installation / rehabilitation, as well as the auxiliary costs such as personnel training, maintenance control, systematic data collection and archiving, etc.

For more detailed information see **Financing plan of JI project.**

Estimated costs for implementation of the defined above alternatives to the project activity:

1. For the first alternative (continuation of the current situation, business-as-usual scenario) no additional investments are required.

2. For the second alternative (the proposed project activity without JI mechanism) the required additional investments are the same as for the project activity.

3. For the third alternative (shortened project activity) the required additional investments are less then the ones required for the project activity.

Outcome of Step 2: There is at least one alternative which is less costly than the project activity.

Hence, the Step 2 is satisfied.

Step 3: Barrier analysis

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

Investment barriers

The general situation in heat and water supply sectors 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 cannot 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:

[28] http://zakon2.rada.gov.ua/laws/show/869-2011-%D0%BF

Market Potential for District Heating Projects in the Ukraine and their Modernization with Austrian Technology, Vienna, 2004, p.3][29]

“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 modernization. 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[30].

“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][31].

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[32].].

Moreover, no bank gives credits without the proper guarantees. Municipal enterprises that implement the project are communal ownership enterprises, and all their main funds belong to territorial population. For this reason the property of enterprises cannot be a credit mortgage. 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].

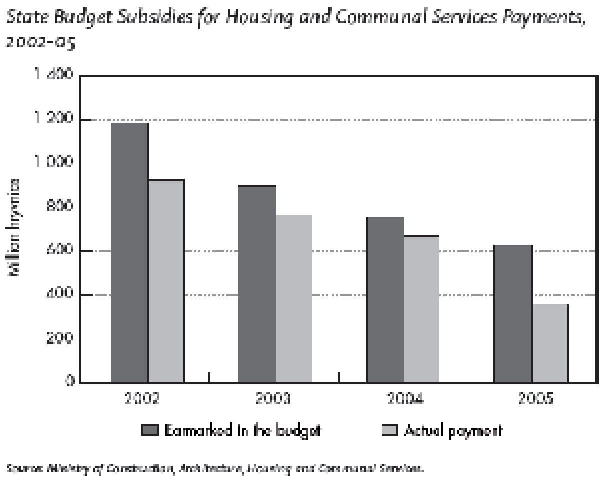

Fig. B-3. Diagram of the real State budget subsidies for Housing and communal services payments

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[29] http://www.energyagency.at/(publ)/themen/elektrizitaet_index.htm

[30] http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1819

[31] www.case-ukraine.com.ua

[32] www.case-ukraine.com.ua

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 shifting the priorities of budget financing, thus decreasing the investment barrier. The evidence for this, in particular for the very similar JI project on rehabilitation of the heat supply system of Chernihiv region, is available in the letter from the local authority – the Chernihiv Regional State Administration No. 01.04-05/1554 from 03/06/2008.

For this project, also the fact of signing of the external economic contract with purchaser of the Emission reduction units provides the priority for distribution of funds from the state and local budgets to the rehabilitation of the heat and water supply systems in Lutsk city, thus to provide fulfillment of international liabilities on the joint implementation project.

Technological barriers

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

Most of heat and water supply enterprisers in Ukraine fulfill annual minimal repairing of these systems to keep them working. Particularly they execute repairing of network's parts and boilers that might cause accidents. The most economically feasible and realistic scenario without carbon credits sales is a very slow rehabilitation activity, instead of making a major overhaul.

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

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 since Ukraine is dependent on Russian natural gas delivery. Ukrainian Government makes attempts to reduce this dependence.

Organizational barriers

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

Outcome of Step 3a: Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make rehabilitation works without JI mechanism and to realize shortened project activity, without any of the non-key type of project activity.

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 heat and water supply systems in Lutsk city, there is no impediment for enterprises that implement the project to operate the heat and water supply systems at their present level.

Outcome of Step 3b: The identified barriers would not prevent the implementation of at least one of the alternatives – the business-as-usual scenario.

Hence, the Step 3 is satisfied.

Step 4: Common practice analysis

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

The common practice for heat and water supply enterprises in Ukraine without JI mechanism is only a necessary repair of the old equipment, mainly in emergency cases, and not the renewal. Only with the JI component it is possible to obtain the necessary additional funds for real rehabilitation of the heat and water supply systems.
This is confirmed by the present situation that the real comprehensive rehabilitation of the heat and water supply systems in Ukraine is performed only by the enterprises participating in JI projects. There are at least 9 district heating rehabilitation projects with JI mechanism in Ukraine at advanced stages beside this project: for DH systems in Chernihiv region, Donetsk region, AR Crimea, Kharkiv city, Rivne region, Dnipropetrovsk Region, Luhansk city, Zaporizhzhia City, Cities Makiivka, Mariupol, Artemivsk of Donetsk region, and at least 4 JI projects on rehabilitation of water supply systems, such as "Modernization of water supply and drainage system "Luganskvoda Ltd."", "Development and improvement of water supply system, drainage system and wastewater treatment of "Infox Ltd." branch "Infoxvodokanal"", "Development and Upgrade of District Water Supply and Disposal System in Zaporizhzhia City", "Development and improvement of water supply system, drainage system and wastewater treatment of City Communal Enterprise "Mykolayivvodokanal"". But JI project activities are not to be included in Common practice analysis.

Outcome of Step 4a: Since the similar projects (being implemented without JI mechanism, since the projects implemented with JI mechanism are not to be taken into account) are not observed in the region, there is no basis for analysis of similar activities.

Sub-step 4b. Discuss any similar Options that are occurring

All projects on rehabilitation of heat and water supply systems in Ukraine are being implemented only within the framework of the Kyoto Protocol JI mechanism. In the absence of additional financing (such as grants, other non-commercial finance terms, carbon credits, etc.) implementation of these projects would be impossible. Application of the JI mechanism is the only incentive to implement such projects.

Outcome of Step 4b: Based on the available facts, the following conclusion may be made: Activities similar to this Project are not widespread in the housing and utilities sector in Ukraine and are not a common practice.

Thus, the Project activities do not fall under the category of *common practice.*

Hence, the Step 4 is satisfied.

Conclusion

The results of the above assessment lead 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:

Boundaries for **Baseline scenario** are represented by dotted line at the graphical representation (Fig. B-4).

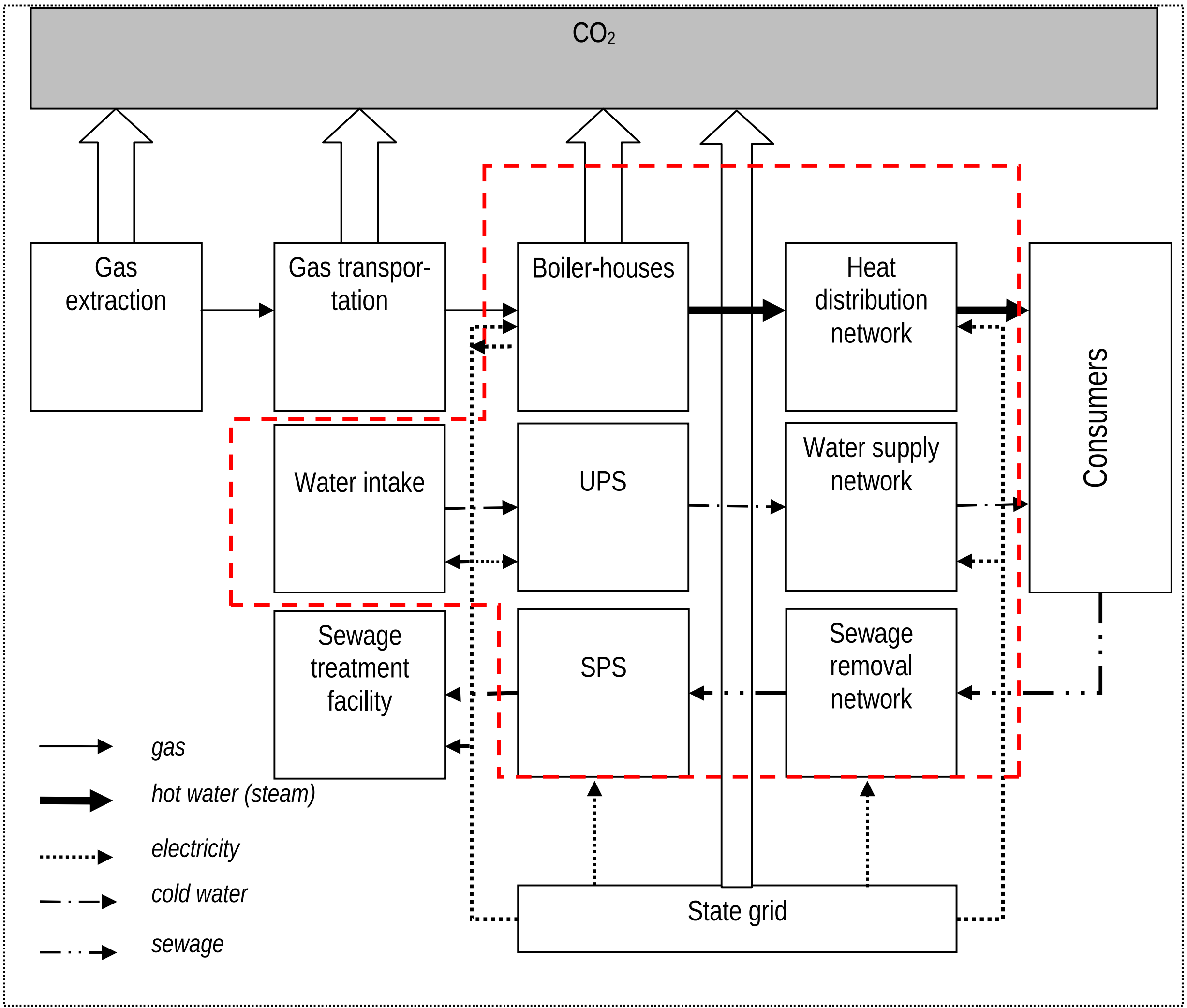

Fig. B-4. Boundaries for Baseline scenario

Project boundaries for **Project scenario** are represented by dotted line at the graphical representation (Fig. B-5).

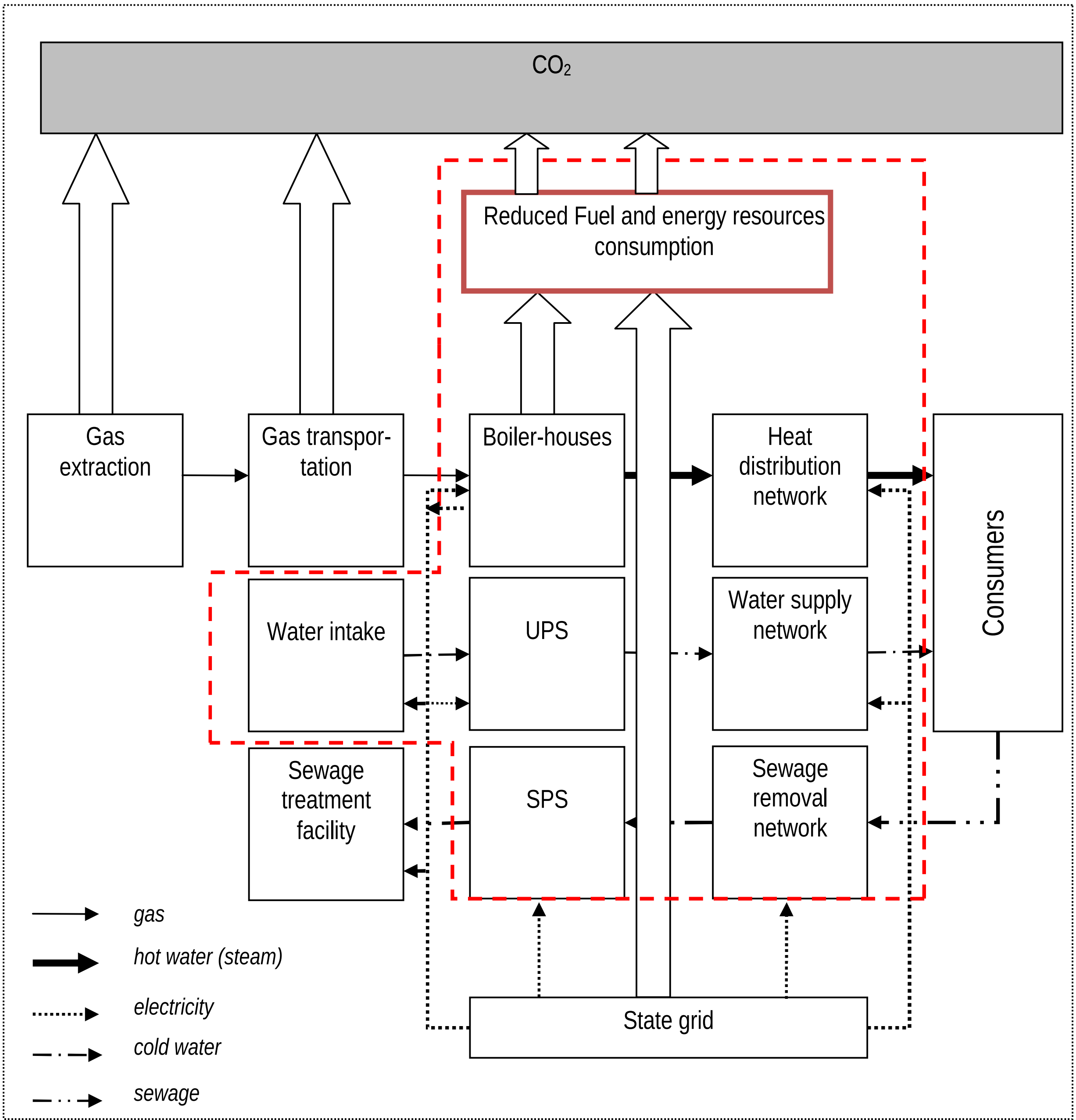

Fig. B-5. Project boundaries for Project scenario

Direct and Indirect Emissions

Direct on-site emissions: CO_2 as well as NO_x and CO emissions from natural gas combustion in boilers, including additional such emissions from natural gas combustion in boilers at the boiler-houses due to the too large (exceeding normative) heat losses in the distribution networks.

CH_4 and N_2O emissions from fuel combustion are negligible minor sources, and are excluded from considerations for simplification.

Direct off-site emissions: GHG emissions from power station(s) due to electricity production to the grid that is consumed by heat and water supply systems.

GHG emissions from power plants due to electricity production to the grid that is consumed for heating of consumers of Lutsk city. 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.

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	Included or excluded
CO_2 emissions from fuel (natural gas) combustion in boilers	Reduced CO_2 emissions from fuel (natural gas) combustion in boilers due to increased overall efficiency and fuel saving of the heat supply system as a whole	Direct	Included
NO_x and CO emission from fuel combustion in boilers	Reduced NO_x and CO emissions from fuel combustion after boilers replacement / rehabilitation	Direct	Excluded. NO_x and CO are not GHGs
Off-site emissions			
Current situation	Project	Direct or indirect	Included or excluded
CO_2 emissions from power plant(s) due to electricity production to the grid, that is consumed by heat and water supply systems	Reduced CO_2 emissions from power plant(s) due to reduction of electricity consumption by heat and water supply systems due to implementation of energy saving measurements	Direct	Included
CO_2 emissions from power plant(s) due to electricity consumption used for heating by consumers of Lutsk city. 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.	Reduced CO_2 emissions from power plant(s) due to reduction of electricity consumption for heating by consumers of Lutsk city. This will take place after project implementation when heat supply service will become more efficient. Exploitation of electric heaters will be decreased substantially	Direct	Excluded, not under control of project developer
CO_2 emissions from fuel extraction and transportation	Reduced CO_2 emissions from fuel extraction and transportation due to fuel saving	Indirect	Excluded, not under control of project developer

Table B-6. On-site and off-site emissions

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: 04/07/2012.

The baseline is determined by the Institute of Engineering Ecology, Ltd., the project developer (is not the project participant), and PJSC "Oblteplocomunenergo", project participant and project supplier.

Institute of Engineering Ecology, Ltd.:
Kyiv, Ukraine.
Dmytro Paderno,
Deputy director, PhD.
Phone: +38 044 453 28 62
Fax: +38 044 456 92 62
e-mail: engeco@kw.ua

PJSC "Oblteplocomunenergo":
Chernihiv, Ukraine.
Ivan Lusta,
Head of the Board.
Phone: +38 0462 77 43 24
Fax: +38 0462 77 43 24
e-mail: otke@teplo.cn.ua

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The starting date of the project is: 01/01/2005.

The date 01/01/2005 was accepted as the project's starting date according to the Orders on creation of the Technical Working Group and starting of preparation to realization of Joint Implementation project of the State Municipal Enterprise "Lutskteplo" and Municipal Enterprise "Lutskvodokanal".

C.2. Expected operational lifetime of the project:

In accordance to conservative approach the expected operational lifetime of the project is 28 years (336 months), from 01/01/2005 till 31/12/2032 on conditions of the proper equipment maintenance.

C.3. Length of the crediting period:

The starting date of the crediting period is accepted as the date of the Kyoto Protocol first commitment period start that is January 1, 2008 and will not exceed the project operation period.

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

The status of emissions reduction or enhancement of net removals generated by the JI projects after ending of the first commitment period within Kyoto Protocol (continuation of the crediting period after 2012) may be defined as per relevant agreements and procedures within the framework of UNFCCC and Host country.

Thus the length of the crediting period is 25 years (300 months), from 01/01/2008 till 31/12/2032.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

In accordance with paragraph 9(a) of the "Guidance on criteria for baseline setting and monitoring"[33], the project specific approach regarding monitoring was used, developed in accordance with appendix B "Criteria for baseline setting and monitoring"[34] of the JI guidelines.

For monitoring associated with water supply system rehabilitation, the elements of the approved methodology AM0020 "Baseline methodology for water pumping efficiency improvements" and "Monitoring methodology for water pumping efficiency improvements"[35] were used.

Detailed theoretical description of the approach chosen regarding monitoring is provided below.

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 gives a clear picture of whether emission reductions really took place – is *fuel and energy resources consumption reduction*. It can be identified as a difference between baseline consumption and consumption after project implementation. For example, if boilers consume fuel at the projected level, than all other relevant indicators such as efficiencies of new boilers, burners and heat utilizers, as well as heat losses in network are adequate.

Monitoring of project performance indicators

Enterprises that implement the project collect data on fuel and energy resources purchasing and consumption for heat and water supply activity in form of fuel, heat and electricity bills as well as input meters records. Information on actual fuel and energy resources consumption will be used in course of preparation of monitoring reports, with all relevant grounding documentation and historical information.

Monitoring of Emissions and Baseline Scenario

The project specific approach developed for monitoring of this JI project is based on the project specific approach, developed previously for JI projects on rehabilitation of the District Heating systems in Ukrainian conditions and already determined by two AIEs and used in several similar JI Projects, with additional using of the elements of AM0020 for water pumping focused activity.

The achieved emission reductions result from the difference between the baseline and project scenarios.

In frames of the baseline scenario chosen, for any year of project activity the baseline would be different due to the influence of external factors such as weather

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

[34] *http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=2*

[35] *http://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf#AM0020*

conditions, possible changes of the net calorific value of fuel(s), number of customers, etc. The Baseline for each project year should be calculated with taking into account these and some other factors (the Dynamic Baseline).

The tables of parameters included in the process of monitoring and verification of emission reductions (ERs) calculation and corresponding formulas are represented in the Sections **D.1.1.1 – D.1.1.4.** 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 ERs will be calculated.

If expected monitored data for an object of the project activity in any reported period are unavailable:

- for statistical data unavailable, the default values from IPCC reports will be taken;
- for non-statistical data unavailable, the calculations for this object in this reported period will not be made, in according to conservative approach the estimated emission reductions for this object in this reported period will be assumed equal to 0.

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 (natural gas) consumption by a boiler house ($\mathbf{B_H^r}$)	Every boiler house	ths. m^3	m	Every day	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
2	Electricity consumption by a boiler house ($\mathbf{P_H^r}$)	Every boiler house and heat supply stations related to it	MWh	m	Once per month	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
3	Averaged net calorific value of fuel (natural gas) ($\mathbf{NCV^r}$)	Fuel Supplier's Report or Chem. Lab Analysis Report	MJ/m^3	m, c	Once per year (reported period)	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
4	Fuel (natural gas) consumption by the water supply system ($\mathbf{B_W^r}$)	Water supplying enterprise	ths. m^3	m	Once per month	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
5	Heat energy consumption by the water supply system ($\mathbf{Q_W^r}$)	Water supplying enterprise	Gcal	c	Once per month	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3

6	Electricity consumption by the water supply system (**$P_W{}^r$**)	Water supplying enterprise	MWh	m	Once per month	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
7	Carbon emission factor for:	Normative documents		c	Once per year (reported period)	100%		
7.1	Natural gas (**Cef**)		kt CO_2/TJ					Detailed description is provided in Annex 3
7.2	Electricity consumption (**CEF_c**)		t CO_2e/MWh					Detailed description is provided in Annex 3

All the data above are monitored throughout the crediting period.

According to valid legislation[36], all measuring equipment in Ukraine should meet the specified requirements of corresponding standards and is subject to the periodical calibration.

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.

[36] http://oscill.com/files/27082006.pdf

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

GHG emissions in the reported year for the project scenario consist of following components:

$E^r = E_{Hfuel}^r + E_{Hcons}^r + E_{Wfuel}^r + E_{Wheat}^r + E_{Wcons}^r$; (D.1.1.2-1)

where:
E_{Hfuel}^r – emissions due to fuel consumption by the heat supply system in the reported year, t CO_2e;
E_{Hcons}^r – emissions due to electricity production that is consumed by the heat supply system in the reported year, t CO_2e.
E_{Wfuel}^r – emissions due to fuel consumption by the water supply system in the reported year, t CO_2e;
E_{Wheat}^r – emissions due to heat consumption by the water supply system in the reported year, t CO_2e;
E_{Wcons}^r – emissions due to electricity production that is consumed by the water supply system in the reported year, t CO_2e.

GHG emissions due to fuel and electricity consumption by the heat supply system in the reported year for the project scenario are sums taken over all boiler-houses (i) which are included into the project.

For each boiler-house:

$E_{Hfuel}^r = B_H^r * NCV^r * Cef$; (D.1.1.2-2)

where:
B_H^r – fuel (natural gas) consumption by a boiler-house in the reported year, ths. m^3;
NCV^r – averaged net calorific value of a fuel (natural gas) in the reported year, GJ/ ths. m^3;
Cef – carbon emission factor for a fuel (natural gas), t CO_2/GJ.

$E_{Hcons}^r = P_H^r * CEF_c$; (D.1.1.2-3)

where:
P_H^r – electricity consumption by a boiler-house and heat supply stations related to it in the reported year, MWh;
CEF_c – carbon emission factor for electricity consumption, t CO_2e/MWh.

GHG emissions due to fuel, heat and electricity consumption by the water supply system in the reported year:

$E_{Wfuel}^r = B_W^r * NCV^r * Cef$, (D.1.1.2-4)

where:
B_W^r – fuel (natural gas) consumption by the water supply system in the reported year, ths. m^3;

NCV^r – averaged calorific value of a fuel (natural gas) in the reported year, GJ/ ths. m^3;
Cef – carbon emission factor for a fuel (natural gas), t CO_2/GJ.

$E_{Wheat}{}^r = Q_W{}^r / \varphi * Cef$; (D.1.1.2-5)

where:
$Q_W{}^r$ – heat energy consumption by the water supply system in the reported year, GJ;
φ – efficiency of heat energy production. Adopted equal to 0.9 (see section B.1 above);
Cef – carbon emission factor for natural gas, t CO_2/GJ.

$E_{Wcons}{}^r = P_W{}^r * CEF_c$, (D.1.1.2-6)

where:
$P_W{}^r$ – electricity consumption by the water supply system in the reported year, MWh;
CEF_c – carbon emission factor for electricity consumption, t CO_2e/MWh.

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

ID number *(Please use numbers to ease 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 (natural gas) consumption by a boiler house (**B_H^b**)	Every boiler-house	ths. m^3	m	Once after the end of the base year	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
2	Electricity consumption by a boiler house (**P_H^b**)	Every boiler house and heat supply stations related to it	MWh	m	Once after the end of the base year	100%	Data journal, (paper and electronic file)	Detailed description is provided in Annex 3
3	Averaged net calorific value of fuel (natural gas) (**NCV^b** and **NCV^r**)	Fuel Supplier's Report or Chem. Lab Analysis Report	MJ/m^3	m, c	Once per year (reported period)	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
4	Fuel (natural gas) consumption by the water supply system (**B_W^b**)	Water supplying enterprise	ths. m^3	m	Once after the end of the base year	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
5	Heat energy consumption by the water supply system (**Q_W^b**)	Water supplying enterprise	GJ	c	Once after the end of the base year	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3

6	Electricity consumption by the water supply system ($\mathbf{P_W^b}$)	Water supplying enterprise	MWh	m	Once after the end of the base year	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
7	Carbon emission factor for:	Normative documents		c	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
7.1	Natural Gas **(Cef)**		kt CO_2/TJ					
7.2	Electricity consumption **($\mathbf{CEF_c}$)**		t CO_2e/MWh					
8	Average outside temperature during the heating period ($\mathbf{T_{out}^b}$ and $\mathbf{T_{out}^r}$)	Meteorological Service	^{0}C	m, c	Once per heating period. Daily temperature is registered every day	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
9	Average inside temperature during the heating period ($\mathbf{T_{in}^b}$ and $\mathbf{T_{in}^r}$)	Heat supplying enterprise	^{0}C	m, c	Once per heating period	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3
10	Number of consumers of hot water supply service ($\mathbf{n_w^b}$ and $\mathbf{n_w^r}$)	Heat supplying enterprise	unit	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
11	Heated area (total) ($\mathbf{F_h^b}$ and $\mathbf{F_h^r}$)	Heat supplying enterprise	m^2	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3

12	Averaged heat transfer factor of buildings in the base year (**k_h^b**)	Heat supplying enterprise	W/(m²*K)	Statistics	Once after the end of the base year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
13	Heated area of buildings (previously existed in the base year) with the renewed (improved) heat insulation in the reported year (**$F_{h\,t}^r$**)	Heat supplying enterprise	m^2	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
14	Heated area of newly connected buildings (assumed with the new (improved) heat insulation) in the reported year (**$F_{h\,n}^r$**)	Heat supplying enterprise	m^2	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
15	Heat transfer factor of buildings with new heat insulation (**$k_{h\,n}$**)	Heat supplying enterprise	W/(m²*K)	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
16	Heating period duration (**N_h^b** and **N_h^r**)	Heat supplying enterprise	Hours	m	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3

17	Duration of period of hot water supply service ($\mathbf{N_w}^{\mathbf{b}}$ and $\mathbf{N_w}^{\mathbf{r}}$)	Heat supplying enterprise	Hours	m	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
18	Maximum connected load to a boiler-house, that is required for heating ($\mathbf{L_h}^{\mathbf{b}}$ and $\mathbf{L_h}^{\mathbf{r}}$)	Heat supplying enterprise	Gcal/h	c	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
19	Connected load to a boiler-house, that is required for hot water supply service ($\mathbf{L_w}^{\mathbf{b}}$ and $\mathbf{L_w}^{\mathbf{r}}$)	Heat supplying enterprise	Gcal/h	c	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
20	Standard specific discharge of hot water per personal account ($\mathbf{v_w}^{\mathbf{b}}$ and $\mathbf{v_w}^{\mathbf{r}}$)	Normative documents	kWh/h	Statistics	Once per year	100%	Special Reports (paper and/or electronic)	Detailed description is provided in Annex 3
21	Total volume of water supplied to consumers ($\mathbf{W}^{\mathbf{r}}$ and $\mathbf{W}^{\mathbf{b}}$)	Water supplying enterprise	ths. m^3	m	Once per year	100%	Registered in the journal (paper and/or electronic)	Detailed description is provided in Annex 3

For the base year (2004) all parameters (with [^{b}] index) presented above excluding parameters 13-15 are not monitored throughout the crediting period, are determined only once after the end of the base year and thus remain fixed throughout the crediting period. These data are available already at the stage of determination.

For any reported year (2008-2012 and later) all parameters (with [r] index) presented above excluding parameters 1, 2, 4, 5, 6 and 12 are monitored throughout the crediting period.

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

GHG emissions in the reported year for the dynamic baseline scenario consist of the following components:

$E^b = E_{Hfuel}^b + E_{Hcons}^b + E_{Wfuel}^b + E_{Wheat}^b + E_{Wcons}^b$; (D.1.1.4-1)

where:
E_{Hfuel}^b – emissions due to fuel consumption by the heat supply system that would be in the base year in terms of the reported year, t CO_2e;
E_{Hcons}^b – emissions due to electricity production that is consumed by the heat supply system that would be in the base year in terms of the reported year, t CO_2e.
E_{Wfuel}^b – emissions due to fuel consumption by the water supply system that would be in the base year in terms of the reported year, t CO_2e;
E_{Wheat}^b – emissions due to heat consumption by the water supply system that would be in the base year in terms of the reported year, t CO_2e;
E_{Wcons}^b– emissions due to electricity production that is consumed by the water supply system that would be in the base year in terms of the reported year, t CO_2e.

GHG emissions due to fuel and electricity consumption by the heat supply systems in the reported year for the dynamic baseline scenario are sums taken over all boiler-houses (i) which are included into the project.

For each boiler-house:

For the case when in the base year the hot water supply service was provided (irrespective of this service duration, $(1-a^b) \neq 0$), the formulae for E_{Hfuel}^b is:

$E_{Hfuel}^b = NCV^b*Cef*[B_H^b *a^b*K_1*K_h + B_H^b *(1-a^b)*K_1*K_w] *(1 + K_d * \tau)$, (D.1.1.4-2)

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:

$E_{Hfuel}^b = NCV^b*Cef*[B_H^b *a^b*K_1*K_h + B_H^r *(1-a^r)*K_1*K_{w0}] *(1 + K_d * \tau)$. (D.1.1.4-3)

where:
B_H^b – fuel (natural gas) consumption by a boiler-house in the base year, ths. m^3;
B_H^r – fuel (natural gas) consumption by a boiler-house in the reported year, ths. m^3;
NCV^b – averaged net calorific value of a fuel (natural gas) in the base year, GJ/ ths. m^3;
Cef – carbon emission factor for a fuel (natural gas), t CO_2/GJ;
K_1, $K_h = K_2* K_3* K_4$; $K_w = K_5 * K_6 * K_7$, K_{w0} – 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 service in the base year;
a^r – portion of fuel (heat), consumed for heating purposes in the reported year;
$(1- a^r)$ – portion of fuel (heat), consumed for hot water supply service purposes in the reported year;
K_d – deterioration factor, year^{-1};
τ – operation term after the base year, years.

$$a^b= L_h^b*g^b*N_h^b/ (L_h^b*g^b*N_h^b+L_w^b*N_w^b); \quad (D.1.1.4-4)$$

where:
L_h^b– maximum connected load to a boiler-house , that is required for heating in the base year, MW;
L_w^b– connected load to a boiler-house , that is required for hot water supply service in the base year, MW;
g^b – recalculation factor for average heat load during heating period in the base year;
N_h^b– heating period duration in the base year, hours;
N_w^b – duration of period of hot water supply service in the base year, hours.

$$a^r= L_h^r*g^r*N_h^r/ (L_h^r*g^r*N_h^r+L_w^r*N_w^r) \quad (D.1.1.4-5)$$

where:
L_h^r– maximum connected load to a boiler-house , that is required for heating in the reported year, MW;
L_w^r– connected load to a boiler-house , that is required for hot water supply service in the reported year, MW;
g^r – recalculation factor for average heat load during heating period in the reported year;
N_h^r – heating period duration in the reported year, hours,
N_w^r – duration of period of hot water supply service in the reported year, hours.

$$g^{b, r} = (T_{in}^{b, r} - T_{out}^{b, r}) / (T_{in}^{b, r} - T_{out\ min}) \quad (D.1.1.4-6)$$

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

$$K_1=NCV^b/NCV^r; \quad (D.1.1.4-7)$$

where:
K_1 – net calorific value of a fuel change factor;
NCV^b – averaged net calorific value of a fuel (natural gas) in the base year, GJ/ ths. m^3;
NCV^r – averaged net calorific value of a fuel (natural gas) in the reported year, GJ/ ths. m^3.

$$K_2 = (T_{in}^r - T_{out}^r) / (T_{in}^b - T_{out}^b); \quad (D.1.1.4-8)$$

where:
K_2 – temperature change factor;
T_{in}^{r} – average inside temperature during the heating period in the reported year, K (or ^{0}C);
T_{in}^{b} – average inside temperature during the heating period in the base year, K (or ^{0}C);
T_{out}^{r}– average outside temperature during the heating period in the reported year, K (or ^{0}C);
T_{out}^{b}– average outside temperature during the heating period in the reported year, K (or ^{0}C)

$K_3 = [(F_h^{r} – F_{h\,t}^{r} – F_{h\,n}^{r})*k_h^{b} + (F_{h\,n}^{r} + F_{h\,t}^{r})*k_{h\,n}] / F_h^{b}*k_h^{b}$; (D.1.1.4-9)

where:
K_3 – heated area and building heat insulation change factor;
F_h^{b} – heated area in the base year, m^2;
F_h^{r} – heated area in the reported year, m^2;
$F_{h\,n}^{r}$ – heated area of newly connected buildings (assumed with the new (improved) heat insulation) in the reported year, m^2;
$F_{h\,t}^{r}$ – heated area of buildings (previously existed in the base year) with the renewed (improved) heat insulation in reported year, m^2;
k_h^{b} – averaged heat transfer factor of heated buildings in the base year, kW/(m^2*K);
$k_{h\,n}$ – heat transfer factor of heated buildings with the new heat insulation, kW/(m^2*K).

$K_4=N_h^{r} / N_h^{b}$; (D.1.1.4-10)

where:
K_4 – heating period duration change factor;
N_h^{b} – heating period duration in the base year, hours;
N_h^{r} – heating period duration in the reported year, hours.

$K_5 =n_w^{r} / n_w^{b}$; (D.1.1.4-11)

where:
K_5 – number of consumers of hot water supply service change factor;
n_w^{b},– number of consumers of hot water supply service in the base year;
n_w^{r} – number of consumers of hot water supply service in the reported year.

$K_6 = v_w^{r} / v_w^{b}$; (D.1.1.4-12)

where:
K_6 – standard specific discharge of hot water per personal account change factor;
v_w^{r} – standard specific discharge of hot water per personal account in the reported year, kWh/h (or heat units);
v_w^{b} – standard specific discharge of hot water per personal account in the base year, kWh/h (or heat units).

$K_7 = N_w^r / N_w^b$; (D.1.1.4-13)

where:
K_7 – duration of period of hot water supply service change factor;
N_w^r – duration of period of hot water supply service in the reported year, hours;
N_w^b – duration of period of hot water supply service in the base year, hours.

For the case when in the base year the hot water supply service was absent at all, number of consumers, standard specific discharge of hot water per personal account and duration of period of hot water supply service for baseline are assumed equal to these values in the reported year, and then:

$K_5 = K_6 = K_7 = 1$.

Thus
$K_{w0} = 1$.

$K_d = 0.005$ year^{-1}.

As it was described in Section B1, the baseline GHG emissions due to fuel consumption by the heat supply system are determined with taking into account the average deterioration of the main heat generating and distributing equipment. The deterioration factor K_d is adopted at the level of 0.5 % per year ($K_d = 0.005$ year^{-1}).

$E_{Hcons}^b = [P_H^b * a^b * K_h + P_H^b * (1-a^b) * K_w] * CEF_c$, (D.1.1.4-14)

where:
P_H^b – electricity consumption by a boiler-house and heat supply stations related to it in the base year, MWh;
K_h, K_w – 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 service in the base year;
CEF_c – carbon emission factor for electricity consumption, t CO_2e/MWh.

The Specific project approach for JI projects on District Heating systems rehabilitation 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 (18^0C), and hot water supply is insufficient or absent. Therefore this Specific project approach allows taking into account improving of the heat supply quality for the consumers, and excludes deliberate excess reduction of heat delivery, and, in such a way, of fuel consumption with the purpose of excess increasing of generation of GHG emissions reductions at the project activity.

Delivery of the less than necessary amount of heat and hot water really took place previously in a number of cities and regions in 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” confirmed by the Order of Cabinet of Ministries of Ukraine No. 1497 dated 30.12.1997[37] (valid till 21.07.2005, but the below recalculation algorithm was valid till 17.02.2010), 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 period 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 conservative approach) 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 the following algorithm:

If R = 0 (according to conservative approach, R < 0.05 is assumed for the baseline):
$\mathbf{T_{in\ b}}$ = 18 ^{o}C.
If $0.05 < R \leq 0.3$:
$\mathbf{T_{in\ b}} = 18 - (R/0.05)$ [^{o}C];
If $0.3 < R < 1$:
$\mathbf{T_{in\ b}} = 12 - [(R - 0.3)/0.1]$ [^{o}C]

where:
R **-** portion of returned payment from the amount of normative payment.

Since 17.02.2010, the new “Order for recalculation of payment for rendering the centralized heating, cold and hot water supply services in cases of their non-rendering or non-full rendering, quality decrease” confirmed by the Order of Cabinet of Ministries of Ukraine No. 151 dated 17.02.2010[38], is valid, according to which the amount of such return payment is the following:
– 5% from normative payment for every degree from 18 to 12 ^{o}C;

[37] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1497-97-%EF

[38] http://zakon2.rada.gov.ua/laws/show/151-2010-%D0%BF

– when inside temperature is lower than 12 ^oC, the payment is to be returned completely.

Thus, the average inside temperature since 17.02.2010 is calculated by the following algorithm:

If R = 0 (according to conservative approach, R < 0.05 is assumed for the baseline):
$\mathbf{T_{in\ b}}$ = 18 ^oC.
If 0.05 < R ≤ 0.3:
$\mathbf{T_{in\ b}}$ = 18 – (R/0.05) [^oC];
If 0.3 < R < 1:
$\mathbf{T_{in\ b}}$ = 12 ^oC is accepted,

Thus if the inside temperature will be 18 ^oC or higher, it will be accepted as 18 ^oC according to conservative approach, and if it will be lower than 18 ^oC it will be calculated from return payments by the methodology presented above.

GHG emissions due to heat and electricity consumption by the water supply system in the reported year for the dynamic baseline scenario:

$E_{Wfuel}^b = B_W^b * NCV^r * Cef * W^r / W^b$, (D.1.1.4-15)
where:
B_W^b – fuel (natural gas) consumption by the water supply system in the base year, ths. m^3;
NCV^r – averaged net calorific value of a fuel (natural gas) in the reported year, GJ/ ths. m^3;
Cef – carbon emission factor for a fuel (natural gas), t CO_2/GJ;
W^r - total volume of water supplied to consumers in the reported year, m^3;
W^b - total volume of water supplied to consumers in the base year, m^3.

$E_{Wheat}^b = Q_W^b * Cef * W^r / (\varphi * W^b)$; (D.1.1.4-16)

where:
Q_W^b – heat energy consumption by the water supply system in the base year, GJ;
φ – efficiency of heat energy production (adopted equal to 0.9, see section B1 above);
Cef – carbon emission factor for fuel (natural gas), t CO_2/GJ;
W^r - total volume of water supplied to consumers in the reported year, m^3;
W^b - total volume of water supplied to consumers in the base year, m^3.

$E_{Wcons}{}^{b} = P_{W}{}^{b} * CEF_{c} * W^{r} / W^{b}$, (D.1.1.4-17)

where:
$P_{W}{}^{b}$ – electricity consumption by the water supply system in the base year, MWh;
CEF_{c} – carbon emission factor for electricity consumption, t CO_2e/MWh;
W^{r} - total volume of water supplied to consumers in the reported year, m^3;
W^{b} - total volume of water supplied to consumers in the base year, m^3.

In all formulae:
[^{b}] – index related to the base year;
[^{r}] – index related to the reported year.

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

This section is left blank for purpose. Option 1 is chosen.

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

This section is left blank for purpose. Option 1 is chosen.

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):

Estimated emission reductions for the project activity in a reported year:

$$ERs = \sum[E_{(i)}^{b} - E_{(i)}^{r}] \qquad (D.1.4\text{-}1)$$

where:
$E_{(i)}^{b}$ - baseline emissions for an (i) boiler-house (water supply system) in a reported year, t CO_2e;
$E_{(i)}^{r}$ - project emissions for an (i) boiler-house (water supply system) in a reported year, t CO_2e.

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

Formulae presented in sections D.1.1 - D.1.4 are used for estimation of emission reductions in PDD for years when values of all parameters are already available, that is for the past years.

The same formulae will be used for monitoring of the project activity results and achieved actual emission reductions in course of development of Monitoring reports during the project crediting period.

The baseline is dynamic and depends on actual conditions in every reported year. Therefore it is impossible to predict in PDD the actual values of emission reductions for future years because there are no data on some necessary parameters (net calorific value of fuel, etc.) available yet.

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 common Ukrainian practice for such type projects, the environmental impact of the project will be estimated by fuel consumption and combustion.

- Law of Ukraine No. 1264-XII "On environmental protection" dated 25/06/1991[39];
- Law of Ukraine No. 2707-XII "On atmospheric air protection" dated 16/10/1992[40];
- Valid rules on emissions limitation: "Norms of limit admissible emissions of pollution agents from stationary sources" – adopted by Ministry for Environmental Protection of Ukraine on 27/06/2006, No.309 and registered by Ministry of Justice of Ukraine on 01/09/2006, No. 912/12786[41].

[39] *http://zakon2.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1264-12*

[40] *http://zakon2.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2707-12*

[41] *http://zakon2.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0912-06*

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.
D.1.1.1; D.1.1.3 **1**. Fuel (natural gas) consumption by a boiler house **(B_H)**	Low	Measuring instruments must be calibrated according to national regulations
D.1.1.1; D.1.1.3 **2**. Electricity consumption by a boiler house **(P_H)**	Low	Measuring instruments must be calibrated according to national regulations
D.1.1.1; D.1.1.3 **3**. Averaged net calorific value of fuel (natural gas) **(NCV)**	Low	Even though there is no need to mistrust fuel suppliers, the Supplier may periodically check the data provided by fuel suppliers through performing chemical analysis of supplied fuel
D.1.1.1; D.1.1.3 **4**. Fuel (natural gas) consumption by the water supply system **(B_W)**	Low	Measuring instruments must be calibrated according to national regulations
D.1.1.1; D.1.1.3 **5**. Heat energy consumption by the water supply system **(Q_W)**	Low	Calculated data (data are calculated with taking into account heat load, that is required for heating objects of water supply system, by methodology of normative documents). No QA/QC procedures are necessary

D.1.1.1; D.1.1.3 **6**. Electricity consumption by the water supply system **(P_W)**	Low	Measuring instruments must be calibrated according to national regulations
D.1.1.1; D.1.1.3 **7**. Carbon emission factors **(Cef, CEF_c)**	Low	Normative documents data. No QA/QC procedures are necessary
D.1.1.3 **8**. Average outside temperature during the heating period **(T_{out})**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **9**. Average inside temperature during the heating period **(T_{in})**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **10**. Number of Consumers of hot water supply service **(n_w)**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **11**. Heated area (total) **(F_h)**	Low	Statistic data. No QA/QC procedures are necessary

D.1.1.3 **12**. Averaged heat transfer factor of buildings in the base year **(k_h)**	Low	Normative documents data. No QA/QC procedures are necessary
D.1.1.3 **13**. Heated area of buildings (previously existed in the base year) with the renewed (improved) heat insulation in the reported year **($F_{h\ t}$)**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **14**. Heated area of newly connected buildings (assumed with the new (improved) heat insulation) in the reported year **($F_{h\ n}$)**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **15**. Heat transfer factor of buildings with new heat insulation **($k_{h\ n}$)**	Low	Normative documents data. No QA/QC procedures are necessary

D.1.1.3 **16**. Heating period duration **(N_h)**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **17**. Duration of period of hot water supply service **(N_w)**	Low	Statistic data. No QA/QC procedures are necessary
D.1.1.3 **18**. Maximum connected load to a boiler-house, that is required for heating **(L_h^b)**	Low	Calculated data (data are calculated with taking into account connected heated area, by methodology of normative documents). No QA/QC procedures are necessary
D.1.1.3 **19**. Connected load to a boiler-house , that is required for hot water supply service **(L_w)**	Low	Calculated data (data are calculated with taking into account number of connected consumers of hot water supply service, by methodology of normative documents). No QA/QC procedures are necessary
D.1.1.3 **20**. Standard specific discharge of hot water per personal account **(v_w)**	Low	Normative documents data. No QA/QC procedures are necessary

D.1.1.3 **21**. Total volume of water supplied to consumers **(W)**	Low	Measuring instruments must be calibrated according to national regulations

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

The scheme describing the operational and management structure that the project operator will apply in implementing the monitoring plan and identifying the responsibilities and the authority regarding the monitoring activity as to the parameters to be monitored is presented in **Annex 3**.

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

The monitoring plan is determined by the Institute of Engineering Ecology, Ltd., the project developer (is not the project participant), and PJSC "Oblteplocomunenergo", project participant and project supplier.

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SECTION E. Estimation of greenhouse gas emission reductions

Estimation (calculation) of GHG emission reductions for years when values of all parameters are already available, that is for the past years from 2008 to 2011, is based on the actual data according to the monitoring plan with using the formulae presented in sections D.1.1 - D.1.4.

The emission reductions in 2012 are conservatively estimated as equal to the actual data for the 2011.

Results of the corresponding calculations made with using of these formulae as well as prognostic estimations are provided in **Appendices 6, 7** and **9.** Every Appendix contains calculations of GHG emission reductions that correspond to specified emission components. Auxiliary data for calculations (average inside temperature) are provided in **Appendix 8.** Total emission reductions are provided in **Appendix 10,** which contains links with all **Appendices 6, 7** and **9:**

Appendix 6 – GHG emissions due to fuel consumption by the heat supply system.
Appendix 7 – GHG emissions due to electricity consumption by the heat supply system.
Appendix 8 – Calculation of average inside temperature during the heating period.
Appendix 9 – GHG emissions due to FER consumption by the water supply system.
Appendix 10 – Total.

E.1. Estimated project emissions:

The following GHG emissions are included in the project scenario:

1) emissions due to fuel consumption by the heat supply system (E_{Hfuel}^r);
2) emissions due to electricity production that is consumed by the heat supply system (E_{Hcons}^r);
3) emissions due to fuel consumption by the water supply system (E_{Wfuel}^r);
4) emissions due to heat production that is consumed by the water supply system (E_{Wheat}^r);
5) emissions due to electricity production that is consumed by the water supply system (E_{Wcons}^r).

Project Emissions by the components of GHG emissions are shown in Table E-1.

Year	Emissions due to fuel consumption by the heat supply system in the reported year, t CO_2e	Emissions due to electricity production that is consumed by the heat supply system in the reported year, t CO_2e	Emissions due to fuel consumption by the water supply system in the reported year, t CO_2e	Emissions due to heat production that is consumed by the water supply system in the reported year, t CO_2e	Emissions due to electricity production that is consumed by the water supply system in the reported year, t CO_2e	**Project emissions, t CO_2e**
	E_{Hfuel}^r	E_{Hcons}^r	E_{Wfuel}^r	E_{Wheat}^r	E_{Wcons}^r	E^r
2008	175 156	35 005	298	129	23 962	**234 550**
2009	181 765	34 836	370	39	21 761	**238 771**
2010	191 365	32 971	350	38	21 011	**245 735**
2011	180 230	32 275	245	18	20 198	**232 966**
2012	180 230	32 275	245	18	20 198	**232 966**
Subtotal 2008 - 2012	**908 746**	**167 362**	**1 508**	**242**	**107 130**	**1 184 988**
2013	180 230	32 275	245	18	20 198	**232 966**
2014	180 230	32 275	245	18	20 198	**232 966**
2015	180 230	32 275	245	18	20 198	**232 966**

2016	180 230	32 275	245	18	20 198	**232 966**
2017	180 230	32 275	245	18	20 198	**232 966**
2018	180 230	32 275	245	18	20 198	**232 966**
2019	180 230	32 275	245	18	20 198	**232 966**
2020	180 230	32 275	245	18	20 198	**232 966**
2021	180 230	32 275	245	18	20 198	**232 966**
2022	180 230	32 275	245	18	20 198	**232 966**
2023	180 230	32 275	245	18	20 198	**232 966**
2024	180 230	32 275	245	18	20 198	**232 966**
2025	180 230	32 275	245	18	20 198	**232 966**
2026	180 230	32 275	245	18	20 198	**232 966**
2027	180 230	32 275	245	18	20 198	**232 966**
2028	180 230	32 275	245	18	20 198	**232 966**
2029	180 230	32 275	245	18	20 198	**232 966**
2030	180 230	32 275	245	18	20 198	**232 966**
2031	180 230	32 275	245	18	20 198	**232 966**
2032	180 230	32 275	245	18	20 198	**232 966**
Subtotal 2013 - 2032	**3 604 600**	**645 500**	**4 900**	**360**	**403 960**	**4 659 320**
Total 2008 - 2032	**4 513 346**	**812 862**	**6 408**	**602**	**511 090**	**5 844 308**

Table E-1. Project Emissions

Project emissions after complete project implementation for every year of the crediting period after 2012 (2013 – 2032) are estimated as equal to project emissions for 2012, that is as **232 966** t CO_2e

For detailed information see sections **D.1.1. - D.1.3** and **Appendixes 6 - 10**.

E.2. Estimated leakage:

No leakage is expected in proposed project activity.

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

Project Emissions + Leakages = 232 966+ 0 = 232 966 t CO_2e.

E.4. Estimated baseline emissions:

Estimation of Baseline Emissions

The following GHG emissions are included in the baseline scenario:

1) emissions due to fuel consumption by the heat supply system (E_{Hfuel}^b);
2) emissions due to electricity production that is consumed by the heat supply system (E_{Hcons}^b);
3) emissions due to fuel consumption by the water supply system (E_{Wfuel}^b);
4) emissions due to heat production that is consumed by the water supply system (E_{Wheat}^b);
5) emissions due to electricity production that is consumed by the water supply system (E_{Wcons}^b).

Baseline emissions by the components of GHG emission are presented in Table E-2.

Year	Emissions due to fuel consumption by the heat supply system that would be in the base year in terms of the reported year, t CO_2e	Emissions due to electricity production that is consumed by the heat supply system that would be in the base year in terms of the reported year, t CO_2e	Emissions due to fuel consumption by the water supply system that would be in the base year in terms of the reported year, t CO_2e	Emissions due to heat production that is consumed by the water supply system that would be in the base year in terms of the reported year, t CO_2e	Emissions due to electricity production that is consumed by the water supply system that would be in the base year in terms of the reported year, t CO_2e	**Baseline emissions, t CO_2e**
	$\mathbf{E_{Hfuel}^{b}}$	$\mathbf{E_{Hcons}^{b}}$	$\mathbf{E_{Wfuel}^{b}}$	$\mathbf{E_{Wheat}^{b}}$	$\mathbf{E_{Wcons}^{b}}$	$\mathbf{E^{b}}$
2008	262 496	45 065	496	331	28 955	**337 343**
2009	273 363	47 454	445	297	26 305	**347 864**
2010	282 004	48 481	437	291	25 587	**356 800**
2011	284 728	49 207	419	280	24 581	**359 215**
2012	284 728	49 207	419	280	24 581	**359 215**
Subtotal 2008 - 2012	**1 387 319**	**239 414**	**2 216**	**1 479**	**130 009**	**1 760 437**
2013	284 728	49 207	419	280	24 581	**359 215**
2014	284 728	49 207	419	280	24 581	**359 215**
2015	284 728	49 207	419	280	24 581	**359 215**
2016	284 728	49 207	419	280	24 581	**359 215**
2017	284 728	49 207	419	280	24 581	**359 215**
2018	284 728	49 207	419	280	24 581	**359 215**
2019	284 728	49 207	419	280	24 581	**359 215**
2020	284 728	49 207	419	280	24 581	**359 215**
2021	284 728	49 207	419	280	24 581	**359 215**
2022	284 728	49 207	419	280	24 581	**359 215**
2023	284 728	49 207	419	280	24 581	**359 215**
2024	284 728	49 207	419	280	24 581	**359 215**
2025	284 728	49 207	419	280	24 581	**359 215**
2026	284 728	49 207	419	280	24 581	**359 215**
2027	284 728	49 207	419	280	24 581	**359 215**
2028	284 728	49 207	419	280	24 581	**359 215**
2029	284 728	49 207	419	280	24 581	**359 215**
2030	284 728	49 207	419	280	24 581	**359 215**
2031	284 728	49 207	419	280	24 581	**359 215**
2032	284 728	49 207	419	280	24 581	**359 215**
Subtotal 2013 - 2032	**5 694 560**	**984 140**	**8 380**	**5 600**	**491 620**	**7 184 300**
Total 2008 - 2032	**7 081 879**	**1 223 554**	**10 596**	**7 079**	**621 629**	**8 944 737**

Table E-2. Baseline Emissions for the period from 01/01/2008 till 31/12/2032

Baseline emissions after complete project implementation for every year of the crediting period after 2012 (2013 – 2032) are estimated as equal to baseline emissions for 2012, that is as **359 215** t CO_2e.

For detailed information see sections **D.1.1. - D.1.3** and **Appendixes 6 - 10**.

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

Project Emission Reduction = Baseline emissions - (Project emissions +Estimated leakage) =
= 359 215– (232 966 + 0) = 126 249 t CO_2e / year.

In course of the project implementation, the different emission reductions are (will be) achieved at the different stages of project implementation. The amounts of emission reductions are represented in the **Tables A4 – A6,** Paragraph **A.4.3.1.**

Project Emission Reductions by the components of project activity are presented in the Table E-3.

Year	Emission reductions due to decrease of fuel consumption by the heat supply system, t CO_2e	Emission reductions due to decrease of electricity consumption by the heat supply system, t CO_2e	Emission reductions due to decrease of fuel consumption by the water supply system, t CO_2e	Emission reductions due to decrease of heat consumption by the water supply system, t CO_2e	Emission reductions due to decrease of electricity consumption by the water supply system, t CO_2e	**Total emission reductions, t CO_2e**
2008	87 340	10 060	198	202	4 993	**102 793**
2009	91 598	12 618	75	258	4 544	**109 093**
2010	90 639	15 510	87	253	4 576	**111 065**
2011	104 498	16 932	174	262	4 383	**126 249**
2012	104 498	16 932	174	262	4 383	**126 249**
Subtotal 2008-2012	**478 573**	**72 052**	**708**	**1 237**	**22 879**	**575 449**
2013	104 498	16 932	174	262	4 383	**126 249**
2014	104 498	16 932	174	262	4 383	**126 249**
2015	104 498	16 932	174	262	4 383	**126 249**
2016	104 498	16 932	174	262	4 383	**126 249**
2017	104 498	16 932	174	262	4 383	**126 249**
2018	104 498	16 932	174	262	4 383	**126 249**
2019	104 498	16 932	174	262	4 383	**126 249**
2020	104 498	16 932	174	262	4 383	**126 249**
2021	104 498	16 932	174	262	4 383	**126 249**
2022	104 498	16 932	174	262	4 383	**126 249**
2023	104 498	16 932	174	262	4 383	**126 249**
2024	104 498	16 932	174	262	4 383	**126 249**
2025	104 498	16 932	174	262	4 383	**126 249**
2026	104 498	16 932	174	262	4 383	**126 249**
2027	104 498	16 932	174	262	4 383	**126 249**
2028	104 498	16 932	174	262	4 383	**126 249**
2029	104 498	16 932	174	262	4 383	**126 249**
2030	104 498	16 932	174	262	4 383	**126 249**

2031	104 498	16 932	174	262	4 383	**126 249**
2032	104 498	16 932	174	262	4 383	**126 249**
Subtotal 2013 - 2032	**2 089 960**	**338 640**	**3 480**	**5 240**	**87 660**	**2 524 980**
Total 2008 - 2032	**2 568 533**	**410 692**	**4 188**	**6 477**	**110 539**	**3 100 429**

Table E-3. Estimated Project Emission Reductions

See **Appendices 6 – 10**.

Project Emission Reductions by the enterprises that implement the project are presented in the Table E-4.

Year	Emission reductions at SME "Lutskteplo", t CO_2e	Emission reductions at ME "Lutskvodokanal", t CO_2e	**Total emission reductions, t CO_2e**
2008	97 400	5 393	**102 793**
2009	104 216	4 877	**109 093**
2010	106 149	4 916	**111 065**
2011	121 430	4 819	**126 249**
2012	121 430	4 819	**126 249**
Subtotal 2008-2012	**550 625**	**24 824**	**575 449**
2013	121 430	4 819	**126 249**
2014	121 430	4 819	**126 249**
2015	121 430	4 819	**126 249**
2016	121 430	4 819	**126 249**
2017	121 430	4 819	**126 249**
2018	121 430	4 819	**126 249**
2019	121 430	4 819	**126 249**
2020	121 430	4 819	**126 249**
2021	121 430	4 819	**126 249**
2022	121 430	4 819	**126 249**
2023	121 430	4 819	**126 249**
2024	121 430	4 819	**126 249**
2025	121 430	4 819	**126 249**
2026	121 430	4 819	**126 249**
2027	121 430	4 819	**126 249**
2028	121 430	4 819	**126 249**
2029	121 430	4 819	**126 249**
2030	121 430	4 819	**126 249**
2031	121 430	4 819	**126 249**
2032	121 430	4 819	**126 249**
Subtotal 2013 - 2032	**2 428 600**	**96 380**	**2 524 980**
Total 2008 - 2032	**2 979 225**	**121 204**	**3 100 429**

Table E-4. Estimated Emission Reductions by enterprises that implement the project

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	234 550	0	337 343	102 793
2009	238 771	0	347 864	109 093
2010	245 735	0	356 800	111 065
2011	232 966	0	359 215	126 249
2012	232 966	0	359 215	126 249
Total 2008 – 2012 (tonnes of CO_2 equivalent)	1 184 988	0	1 760 437	575 449

Table E-5. Estimated Emissions for the period 2008 – 2012

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2013	232 966	0	359 215	126 249
2014	232 966	0	359 215	126 249
2015	232 966	0	359 215	126 249
2016	232 966	0	359 215	126 249
2017	232 966	0	359 215	126 249
2018	232 966	0	359 215	126 249
2019	232 966	0	359 215	126 249
2020	232 966	0	359 215	126 249
2021	232 966	0	359 215	126 249
2022	232 966	0	359 215	126 249
2023	232 966	0	359 215	126 249
2024	232 966	0	359 215	126 249
2025	232 966	0	359 215	126 249
2026	232 966	0	359 215	126 249
2027	232 966	0	359 215	126 249
2028	232 966	0	359 215	126 249
2029	232 966	0	359 215	126 249
2030	232 966	0	359 215	126 249
2031	232 966	0	359 215	126 249
2032	232 966	0	359 215	126 249
Total 2013 – 2032 (tonnes of CO_2 equivalent)	4 659 320	0	7 184 300	2 524 980

Table E-6. Estimated Emissions for the period 2013 – 2032

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
Total 2008 - 2032 (tonnes of CO_2 equivalent)	5 844 308	0	8 944 737	3 100 429

Table E7. Estimated Emissions for the period 2008 – 2032

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 regulations, the design documentation for the new building, reconstruction and major technical re-equipment of industrial and civil objects may include the environmental impact assessment.

Environmental Impact Assessment (EIA) is directed on determination of scales and levels of the project activity impact on an environment, on development of measures for prevention or reduction of this impact, on estimation of acceptability of project decisions from the ecological point of view.

The legislative requirements to EIA materials content are enshrined in the Article 36 of the Law of Ukraine «On ecological expertise»[42]. Requirements to the structure, composition and content of the EIA sections are enshrined in the State Building Norms of Ukraine DBN A.2.2-1-2003 "Composition and content of the Environmental Impact Assessment (EIA) materials at designing and construction of enterprises, buildings and premises"[43].

Annex E of DBN A.2.2-1-2003 contains a list of activities and objects that generate a risk of negative environmental impacts. For such projects the execution of complete EIA is necessary, and Ministry of Ecology and Natural Resources of Ukraine is responsible for control of these EIAs. This list does not contain such type of activity as energy saving measures for improving the efficiency of municipal enterprises, thus the EIAs for such activity are not obligatory.

Overall, this JI project will have a positive effect on environment. The following points will give detailed information on environmental benefits.

1. Project implementation will reduce GHG emissions in Lutsk city by 126 249 t CO_2e per year after project complete implementation due to increased efficiency of the heat and water supply systems. This will be achieved through installation of up-to-date boiler-houses and pumping equipment, particularly new boilers, burners, heat exchangers, pumps, and using of pre-insulated network pipes instead of existing regular network pipes, etc.

2. Due to fuel saving and new environmentally friendlier technologies for fuel combustion, project implementation will reduce also emissions of NO_x and CO (co-products of natural gas combustion).

3. Due to electricity saving, project implementation will reduce also emissions of CO_2, SO_x, NO_x, CO and particulate matter by power plants.

4. Due to scheduled better heat supply service, population of Lutsk city is expected to reduce electricity consumption by electric heaters thus also reducing emissions of CO_2, SO_x, NO_x, CO and particulate matter by power plants.

DBN A.2.2-1-2003 does not contain the requirement as to the obligatory analysis of the transboundary impact, and in accordance with this the EIAs usually do not contain such special analysis. However, for this project transboundary impact is not considered, taking into account the insignificant emissions and that these emissions are localized not far away from the source sites.

[42] *http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=45%2F95-%E2%F0*

[43] *http://www.budinfo.com.ua/dbn/8.htm*

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 ambient air

The project implementation will have positive effect on ambient air:

1) Reduction of NO_x and CO due to application of cleaner combustion technologies at boiler houses;
2) Reduction of electricity consumption results in lower emissions of the NO_x, SO_x, CO and PM by grid power stations;
3) Heat impact on the atmosphere (due to lower temperatures of flue gases) will be decreased;
4) Lower emissions per unit of delivered heat at the same load on boiler house.

Impact on the water medium

Impact on water resources will be the same as in baseline scenario. The existing technology exploited at the objects of municipal enterprises that implement the project foresees discharging of waste water to the sewage network with obligatory chemical control in accordance to Water Code of Ukraine[44], SanPiN 4630-88 "Sanitary rules and norms of protection of surface waters from pollution"[45] on determining maximum concentration limits for internal water bodies. Discharge of waste water to the open water bodies will not take place.

Project implementation will have positive water environmental effect. It will allow to decrease the water consumption and as a result – to decrease the amount of waste water.

Impact on the land use

Impact on the land is not present.

Relevant regulation in the sphere of land use is presented by the Land Code of Ukraine[46].

Impact on the biodiversity

Impact on biodiversity is not present.

Waste generation, treatment and disposal

In the process of project implementation the generation of waste will occur after disassembling of physically and morally obsolete equipment, burners, pipes, etc. Also some construction waste will occur due to destruction of boiler settling, boiler house foundations, etc.

Possible recycling of the old equipment will by definition have a positive effect on the environment.

According to the "Law on waste products" [47] (article 17) "Obligations of economical activity subjects in sphere of waste treatment":

- enterprises must apply statistic reports on waste creating, gathering, transporting, keeping, treating, utilizing, decontaminating and excreting.

- provide complete gathering, appropriate keeping and non-admission waste destruction and spoilage, for utilization of which there is an appropriate technology in Ukraine.

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44 http://zakon.nau.ua/doc/?uid=1011.17.21&nobreak=1

45 http://www.gosthelp.ru/text/SanPiN463088Sanitarnyepra.html

46 http://zakon2.rada.gov.ua/laws/show/2768-14

47 http://zakon2.rada.gov.ua/laws/show/187/98-%D0%B2%D1%80

In view of the aforesaid, municipal enterprises that implement the project deliver old equipment to metal recycling.

Reporting on statistic supervision on environmental protection

The municipal enterprises that implement the project regularly fill all forms of statistic supervision reporting required for their activity according to the valid Ukrainian legislation, that are:

- Form #1–ecological expenses "Report about expenses for environmental protection and ecological payments";
- Form #1–danger waste "Report about generation, handling and treatment of waste of the I-III classes of danger";
- Form #2-tp(air) - report about amount of potential environmental polluting emissions to atmosphere.

SECTION G. Stakeholders' comments

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

As project activity won't provide negative influence on environment and negative social effect, special public discussion was not hold.

This project was presented at the XXII International Conference "Problems of Ecology and Exploitation of Energy Objects" (Crimea, 2012), where it was comprehensively discussed with representatives of governmental and district heating organizations.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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URL:	
Represented by:	
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Salutation:	Mr.
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Annex 2

BASELINE INFORMATION

The key elements of the baseline (including variables, parameters and data sources) are presented in table below.

	Symbol	Data variable	Data unit	Measured (m), calculated (c), estimated (e)
1	B_H^b	Fuel (natural gas) consumption by a boiler-house	ths.m^3	m
2	P_H^b	Electricity consumption by a boiler-house	MWh	m
3	NCV^b	Averaged net calorific value of fuel (natural gas)	MJ/m^3	m, c
4	B_W^b	Fuel (natural gas) consumption by water supply system	ths.m^3	m
5	Q_W^b	Heat consumption by water supply system	GJ	c
6	P_W^b	Electricity consumption by water supply system	MWh	m
7		Carbon emission factors for:		Normative documents:
7.1	**Cef**	Natural gas	t CO_2/GJ	The national inventory report of Ukraine for 1990 - 2010, Annex 2, section P2.5.1, Table P2.8, p.437
7.2	CEF_c	Electricity consumption	t CO_2e/ MWh	Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines Version 2.3. Ministry of Economic Affairs of the Netherlands, 2004; Orders of the National Environmental Investment Agency of Ukraine: # 62 dated 15/04/2011; # 63 dated 15/04/2011; # 43 dated 28/03/2011; # 75 dated 12/05/2011.

Table An2-1. The key elements of the baseline

Annex 3

MONITORING PLAN

This monitoring plan describes the project specific approach that will be used to calculate the ongoing amount of greenhouse gas emission reductions resulting from implementation of this JI project. Rehabilitation of the heat and water supply systems in Lutsk city is expected to result in improved systems performance. Each component of the JI project is expected to result in a reduction of greenhouse gas emissions. The reductions of GHG emissions will be quantified using the project specific approach presented in section D and this Annex 3 “Monitoring Plan”.

Relevant monitoring approach:

In course of development of the monitoring plan for the JI project **“Rehabilitation of the Heat and Water Supply Systems in Lutsk city”**, the project specific approach based on the project specific approach, developed for JI projects on rehabilitation of the District Heating systems in Ukrainian conditions with additional using of the elements of AM0020 for water pumping focused activity was used (see section B.1 and section D).

Parameters to be monitored

Monitoring project specific approach 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 spreadsheets that will track GHG emission reductions for each monitoring period.

Parameters to be monitored are presented in tabular form below.

Parameter number and name	**1.** Fuel (natural gas) consumption by a boiler house
Description	Natural gas consumption by 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	Registered every day and calculated once per year
Background data	Instrument readings are registered in the paper journals at every boiler-house.
Calculation method	N/A

Parameter number and name	**2.** Electricity consumption by a boiler house
Description	Electricity consumption by boiler-houses and heat supply stations related to them.
Monitoring method	Electricity meter
Recording frequency	Measured continuously and calculated once per year
Background data	Instrument readings are registered in the paper journals at every boiler-house.
Calculation method	N/A

Parameter number and name	**3.** Averaged net calorific value of a fuel (natural gas)
Description	Averaged net calorific value of natural gas calculated by net calorific value
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 every week and calculated once per year.
Background data	Registered in the paper journal
Calculation method	Weighted average value

Parameter number and name	**4.** Fuel (natural gas) consumption by the water supply system
Description	Natural gas consumption by boiler-house of the water supply system for heating UPS, SPS and other buildings belonged to water supplying enterprise
Monitoring method	Gas flow meters
Recording frequency	Registered every month and calculated once per year
Background data	Instrument readings are registered in the paper journals at every boiler-house.
Calculation method	N/A

Parameter number and name	**5.** Heat energy consumption by the water supply system
Description	Heat energy consumption by the water supply system for heating UPS, SPS and other buildings belonged to water supplying enterprise
Monitoring method	Accepted in accordance with bills for heating from heat supplying enterprises.
Recording frequency	Registered every month and calculated once per year
Background data	Data on Amount of consumed heat is stored in forms of bills for heating from heat supplying enterprises.
Calculation method	N/A

Parameter number and name	**6.** Electricity consumption by water supply system
Description	Electricity consumption by objects of water supply system (UPS, SPS, etc.).
Monitoring method	Electricity meters
Recording frequency	Measured continuously and calculated once per year
Background data	Instrument readings are registered in the paper journals at objects of water supply system.
Calculation method	N/A

Parameter number and name	**7.** Carbon emission factor
Description	Carbon emission factor for natural gas, for electricity consumption and generation
Monitoring method	Normative documents
Recording frequency	Once per year
Background data	For natural gas the carbon emission factor is used from the data of table P2.8 provided in The national inventory report of Ukraine for 1990-2010. The values of the carbon emission factors for JI projects on reducing electricity consumption in Ukraine were taken for relevant years according to: - Table B2 “Baseline carbon emission factors for JI projects reducing electricity consumption” of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines Version 2.3. Ministry of Economic Affairs of the Netherlands, 2004; - Orders of the National Environmental Investment Agency of Ukraine # 62 dated 15/04/2011; # 63 dated 15/04/2011; # 43 dated 28/03/2011; # 75 dated 12/05/2011. In course of development of the Monitoring reports for this project, the valid at that time Carbon emission factor’s values for corresponding period will be used.
Calculation method	N/A

Parameter number and name	**8.** Average outside temperature during the heating period
Description	Average outside temperature during the heating period
Monitoring method	Average outside temperature during the heating period is calculated by heat supply enterprise that implement the project from the values of daily outside temperature taken by dispatchers of enterprises from local Meteorological Centre every day of heating period.
Recording frequency	Average outside temperature is calculated once per year. Daily outside temperature is recorded every day of heating period
Background data	Meteorological Centre every month sends the Report for every day of heating period. Reports are filed in special journals
Calculation method	Average value

Parameter number and name	**9.** Average inside temperature during the heating period
Description	Average inside temperature during the heating period is calculated from the sum of returned payments caused by insufficient heating (in case of normative level (18 ^{0}C) is not satisfied).
Monitoring method	Sum of returned payments
Recording frequency	Once per heating period
Background data	Accounting documents
Calculation method	According to item 24 of “Rules of rendering of heat and hot water supply service to population” № 1497 from 30.12.1997[48], enterprise makes the return payment of: – 5% from payment for every degree from 18 to 12 ^{o}C; – 10% from 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 conservative approach, R < 0.05 is assumed for the baseline): $\mathbf{T_{in\,b}}$ = 18 ^{o}C. If $0.05 < R \leq 0.3$: $\mathbf{T_{in\,b}}$ = 18 – (R/0.05) [^{o}C] If $0.3 < R < 1$: $\mathbf{T_{in\,b}}$ = 12 – [(R – 0.3)/0.1] [^{o}C] where: R - portion of returned payment from amount of normative payment. According to item 5 of the “Order for recalculation of payment for rendering the centralized heating, cold and hot water supply services in cases of their non- rendering or non-full rendering, quality decrease” confirmed by the Order of Cabinet of Ministries of Ukraine No. 151 dated 17.02.2010[49], valid since 17.02.2010, enterprise makes the return payment of: – 5% from payment for every degree from 18 to 12 ^{o}C; – when inside temperature is lower than 12 ^{o}C, the payment is to be returned completely. Therefore the inside temperature since 17.02.2010 is calculated by formulae: If R = 0 (according to conservative approach, R < 0.05 is assumed for the baseline): $\mathbf{T_{in\,b}}$ = 18 ^{o}C. If $0.05 < R \leq 0.3$: $\mathbf{T_{in\,b}}$ = 18 – (R/0.05) [^{o}C]; If $0.3 < R < 1$: $\mathbf{T_{in\,b}}$ = 12 ^{o}C is accepted. Thus if the inside temperature will be 18 ^{o}C or higher, it will be accepted as 18 ^{o}C according to conservative approach, and if it will be lower than 18 ^{o}C it will be calculated from return payments by the algorithm presented above.

[48] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1497-97-%EF

[49] http://zakon2.rada.gov.ua/laws/show/151-2010-%D0%BF

Parameter number and name	**10.** Number of consumers of hot water supply service
Description	Number of consumers of hot water supply service for every boiler house
Monitoring method	Statistics of heat supply enterprise
Recording frequency	Contracts with population, organizations and legal entities are concludes directly with district heating enterprise. They are updated once per year.
Background data	The information is collected in special journals “Registration of income from population” (for inhabitants). For organizations and legal entities such information is taken from contracts concluded with them
Calculation method	The data is taken for January, 01 of the next to the reported year

Parameter number and name	**11.** Heated area (total)
Description	Heated area for every boiler house
Monitoring method	Statistics of heat supply enterprise
Recording frequency	The revise is made in case of new contracts with consumers or in case of contracts break
Background data	The information is collected at the sale departments of heat supply enterprise by the certificates of owners in accordance with technical passport of building. Total area with balconies and stairs and heated area are displayed in the special journal
Calculation method	The data is taken for January, 01 of the next to the reported year

Parameter number and name	**12.** Averaged heat transfer factor of heated buildings in the base year
Description	Averaged heat transfer factor of heated buildings existed in the base year
Monitoring method	Normative documents
Recording frequency	Once after the end of the base year
Background data	SNiP 2-3-79 (1998)[50], table 1a
Calculation method	N/A

Parameter number and name	**13.** Heated area of buildings (previously existed in the base year) with the renewed (improved) heat insulation in the reported year
Description	Heated area of reconstructed buildings with application of new heat insulation
Monitoring method	Statistics of heat supply enterprise
Recording frequency	Once per year
Background data	Documents of heat supply enterprises
Calculation method	The data is taken for January, 01 of the next to the reported year

[50] http://www.snip-info.ru/Snip_ii-3-79_%281998%29.htm

Parameter number and name	**14.** Heated area of newly connected buildings (assumed with the new (improved) heat insulation) in the reported year
Description	Heated area of newly connected buildings with application of the new heat insulation
Monitoring method	Statistics of heat supply enterprise
Recording frequency	Once per year
Background data	Documents of heat supply enterprise
Calculation method	The data is taken for January, 01 of the next to the reported year

Parameter number and name	**15.** Heat transfer factor of buildings with new heat insulation
Description	Heat transfer factor of buildings with new heat insulation
Monitoring method	Normative documents
Recording frequency	Once per year
Background data	State Buildings Norms B.2.6-31:2006[51], Table 1
Calculation method	N/A

Parameter number and name	**16.** Heating period duration
Description	Heating period duration for every boiler house
Monitoring method	Statistics of the heat supply enterprise
Recording frequency	Once per year
Background data	The nominal duration (beginning and ending) of the heating period is defined for every town separately, in accordance with item 7.9.4 of “Rules of technical exploitation of heating equipment and networks. 2007” [52]. 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. Actual duration of the heating period is to be taken for a boiler house
Calculation method	Sum of durations from the beginning of the calendar year till data of ending of the heating season, and from date of beginning of the new heating season till ending of this calendar year

Parameter number and name	**17.** Duration of period of hot water supply service
Description	Duration of the period of hot water supply service for every boiler house.
Monitoring method	Statistics of the heat supply enterprise
Recording frequency	Once per year
Background data	Hot water supply service is realized by hot water delivery schedule for every boiler-house.
Calculation method	Total duration of the hot water supply time per the calendar year

[51] http://dbn.at.ua/load/1-1-0-13

[52] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?page=6&nreg=z0197-07

Parameter number and name	**18.** Maximum connected load to a boiler-house that is required for heating
Description	Maximum connected load to a boiler-house, that is required for heating
Monitoring method	Calculated by heat supply enterprise
Recording frequency	Once per year
Background data	Maximum connected load to a boiler-house, that is required for heating, is calculated by District heating enterprises for every heating period. It is calculated according to heat demand at nominal minimal outside temperatures [KTM 204 Ukraine 244-94, Annex 1][53]
Calculation method	N/A

Parameter number and name	**19.** Connected load to a boiler-house that is required for hot water supply service
Description	Connected load to a boiler-house required for providing the hot water supply service
Monitoring method	Calculated by heat supply enterprise
Recording frequency	Once per year
Background data	Connected load to a boiler-house, that is required for hot water supply service, is calculated by heat supply enterprise every year according to contracts with consumers.
Calculation method	N/A

Parameter number and name	**20.** 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”, and no information is available on any propositions to change it
Calculation method	N/A

Parameter number and name	**21.** Total volume of water supplied to consumers
Description	Total volume of water supplied to consumers by water supply system.
Monitoring method	Flow meters
Recording frequency	Measured continuously and calculated once per year
Background data	Instrument readings are registered in the paper journals at objects of water supply system.
Calculation method	N/A

[53] http://www.twirpx.com/file/153194/

Description of monitoring system

The control and monitoring system comes to measurement of fuel and electricity consumption and water supplied to consumers. Other parameters are defined by calculations or taken from statistic data. Fuel consumption measurements are realized at the gas distribution units of the boiler-houses. Gas registration is carried 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. An3-1.

The typical gas distribution 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.

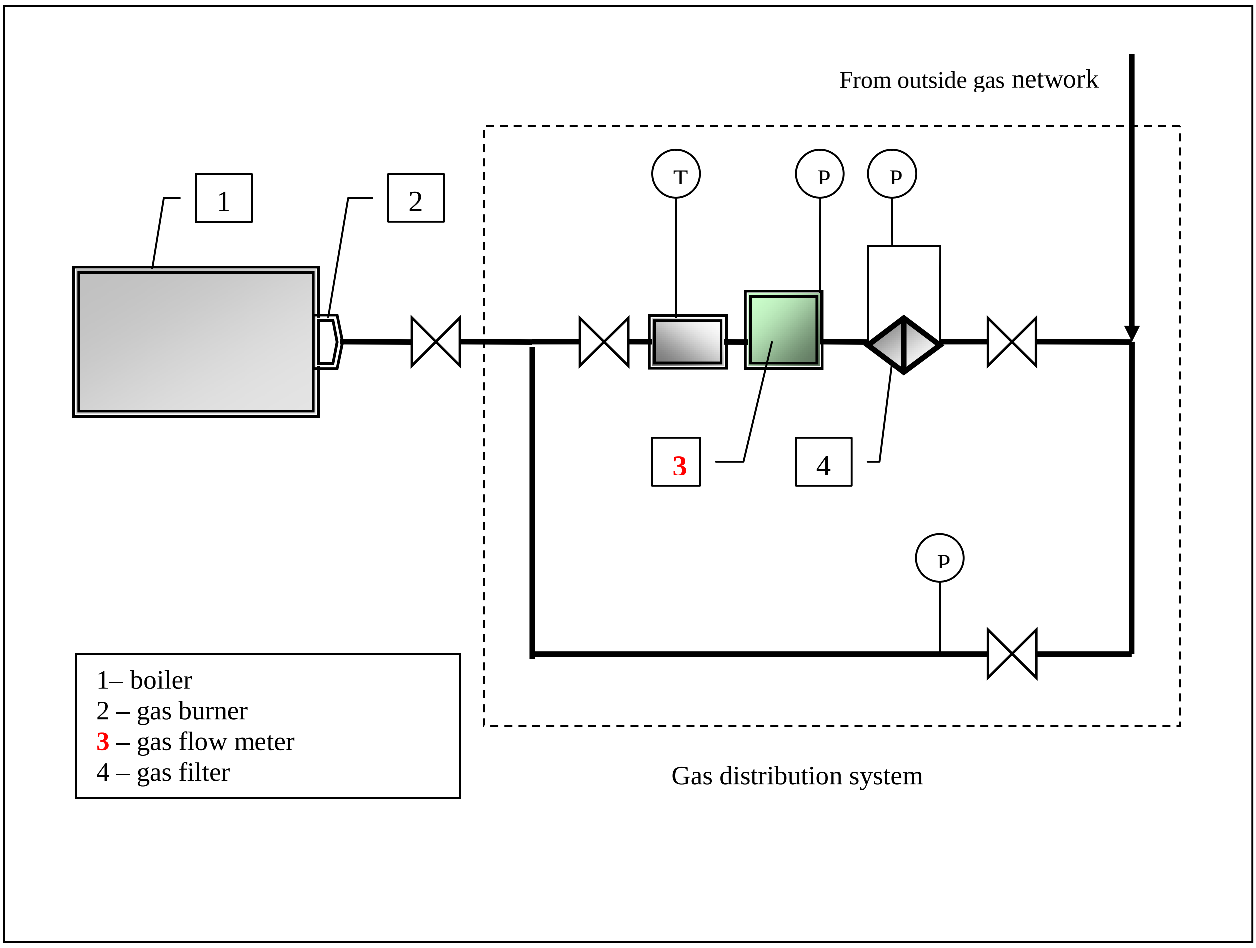

Fig. An3-1. Scheme of the gas distribution system

<u>Monitoring equipment</u>

The equipment to be used by the project executors for monitoring of the relevant parameters are summarized in Table An3-1. The table also provides information on typical equipment accuracy, calibration authority and procedures to follow in case of equipment failure.

ID number and data variable	Equipment	Accuracy	Calibration authority	Calibration interval	Procedure in case of failure
1. Fuel (natural gas) consumption by a boiler house	Gas flow meters	+/-(0.5…2.0)% Usually 1%	SE "Lutsk-standart-metrologiya"	According to technical specifications of the meters	Failure should be immediately 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 are to be recorded in the site events log book
2. Electricity consumption by a boiler house	Electricity meters	+/- (0.2…1) % Usually 0.2%	SE "Lutsk-standart-metrologiya"		
4. Fuel (natural gas) consumption by the water supply system	Gas flow meters	+/- (0.5…2) % Usually 1%	SE "Lutsk-standart-metrologiya"		
6. Electricity consumption by the water supply system	Electricity meters	+/- (0.2…1) % Usually 0.2%	SE "Lutsk-standart-metrologiya"		
21. Total volume of water supplied to consumers	Flow-meters	+/- 1%	SE "Lutsk-standart-metrologiya"		

Table An3-1. Monitoring equipment

<u>Level of uncertainty and errors</u>

Possible uncertainty 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 an 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 21 monitoring parameters, only 5 of them are measured directly. The remaining monitoring parameters used in calculation of the baseline and project 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 measurement errors (maximal) for the two parameters, that impact on the Standard Error, and their level of accuracy are presented in Table An3-4.

ID number and data variable	Measurement error	Comment
1. Fuel (natural gas) consumption by a boiler house	± (0.5…2.0) %	Accuracy of data is high due to necessity of information for commercial account purposes
2. Electricity consumption by a boiler house	± (0.2…1.0) %	Accuracy of data is high due to necessity of information for commercial account purposes
4. Fuel (natural gas) consumption by the water supply system	± (0.5…2.0) %	Accuracy of data is high due to necessity of information for commercial account purposes
6. Electricity consumption by the water supply system	± (0.2…1.0) %	Accuracy of data is high due to necessity of information for commercial account purposes
21. Total volume of water supplied to consumers	± 1 %	Accuracy of data is high due to necessity of information for commercial account purposes

Table An3-2. Measurement errors

Monitoring of environmental impacts

As the project involves rehabilitation of existing heat and water supply systems leading to improvement of their energy efficiency and therefore to the better environmental performance of the systems, and is not a new building project, no negative environmental impacts are expected.

There is therefore no need to monitor special environmental impact indicators during implementation and operation of the project activities.

Project management

The overall responsibility for the project management and implementation is carried out by the Head of the Board of PJSC “Oblteplocomunenergo”, Mr. Ivan Lusta., and appointed responsible persons at enterprises that implement the project.

Possible bottlenecks and mistakes in project implementation should be identified and solved by responsible stuff of enterprises that implement the project.

Responsibilities for data collection

Appointed responsible persons at enterprises that implement the project are presented in Table An3-3.

Dr. Dmytro Paderno, deputy director of the Institute of Engineering Ecology, is responsible for baseline and monitoring project specific approach development.

Mr. Valerii Logvyn, engineer of the Institute of Engineering Ecology, is responsible for data processing.

Data collection for natural gas consumption is provided in the following way:

1. Natural gas consumption is measured by gas flow meter, installed at a boiler-house. All boiler-houses are equipped with gas flow meters.

2. The majority of boiler-houses are equipped with automatic correctors for gas temperature and pressure. Gas consumption is registered automatically. Every day operator of a boiler house makes registration of daily gas consumption in the special paper journal “Journal of registration of boiler-house’s operation parameters”.

3. At the boiler-houses that are not equipped with gas volume correctors, operator of a boiler house every 2 hours registers parameters of natural gas (temperature and pressure) in the paper journal “Journal of

registration of boiler-house's operation parameters". These parameters are used to bring gas consumption to standard conditions.

4. Every day operators report values of gas consumption by phone to Production-Technical Department (PTD) of enterprises, where they are storing and used for payments to gas suppliers.

5. Every month the account centers transfer data to gas suppliers.

Data monitored and required for emission reductions calculation and verification, according to paragraph 37 of the JI guidelines, are to be kept for two years after the last transfer of ERs for the project.

Scheme of data collection for a Monitoring Report is shown at Fig. An3-2.

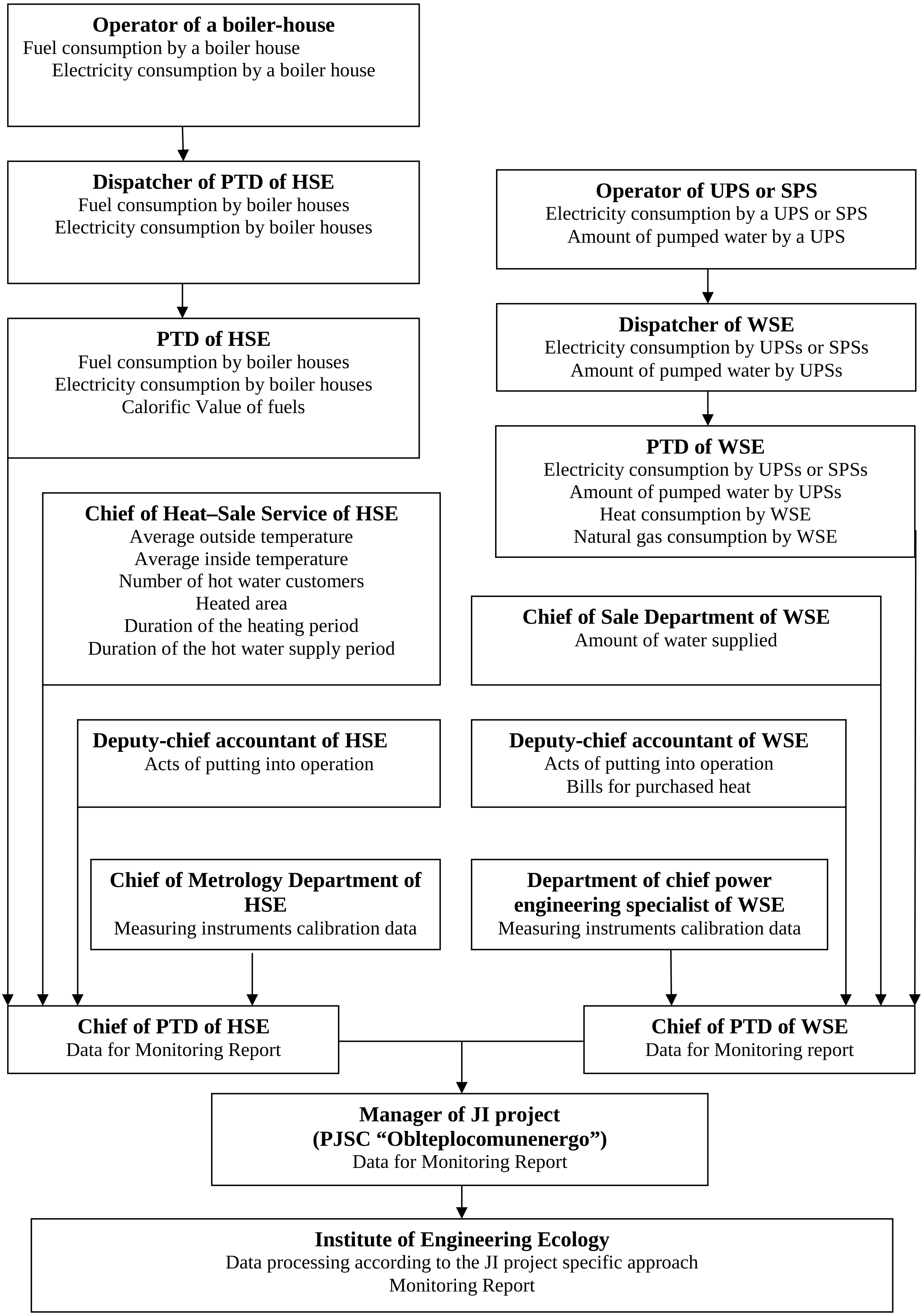

Fig. An3-2. Scheme of data collection for Monitoring Report

Trainings

As far as the main activity of enterprises that implement the project will not be changed in course of the JI project implementation, the special technical trainings for personnel are not necessary. The technical personnel of the enterprise have sufficient knowledge and experience for implementation of the project activity and maintenance of the usual equipment.

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

Enterprises that implement the project provide personnel retraining according to protection of labour norms. The enterprises have the Labour protection departments, which are responsible for raising the level of personnel skills and trainings.

In course of the JI project development, specialists of Institute of Engineering Ecology carried out a comprehensive consultations and trainings for representatives of involved enterprises on the necessary data collection according to Monitoring plan for the project.

The special training was held in June, 2012.

The special group was organized consisted of representatives of enterprises that implement the project and Institute of Engineering Ecology, in particular:

Oleksandr Kyrychuk - SME “Lutskteplo”, Director;
Roman Dudchyk - SME “Lutskteplo”, Engineer;
Sergii Strok - ME “Lutskvodokanal”, Chief Engineer;
Volodymyr Nespay - ME “Lutskvodokanal”, Head of Energy resources department;
Valerii Logvyn - Institute of Engineering Ecology, engineer;
Nataliya Bezushko - Institute of Engineering Ecology, engineer.

Responsibilities for data management

All collected data will be transferred to Oleksiy Teterya (PJSC “Oblteplocomunenergo”), who will be responsible for data storage and archiving, entry of the data into the monitoring spreadsheets. Valerii Logvyn and Nataliya Bezushko will be responsible for the data processing according to the JI project specific approach and for development of Monitoring Reports. Support and coordination of monitoring and verification processes will be undertaken by Dmytro Paderno. Responsibilities for data management are presented in Table An3-3.

Activity	Responsible person	
	Name	Position and department
Data storage and archiving	Roman Dudchyk	Engineer of SME “Lutskteplo”
Data storage and archiving	Volodymyr Nespay	Head of Energy resources department of ME “Lutskvodokanal”
Operation management of the JI project, data storage and archiving	Oleksiy Teterya	First Deputy Head of the Board of PJSC “Oblteplocomunenergo”
Management of the JI project	Ivan Lusta	Head of the Board of PJSC “Oblteplocomunenergo”
Support and coordination of monitoring and verification processes	Dmytro Paderno	Deputy Director of Institute of Engineering Ecology, Ltd
Data processing according to the JI project specific approach, development of Monitoring Reports	Valerii Logvyn	Scientific researcher of Institute of Engineering Ecology, Ltd
Data processing according to the JI project specific approach, development of Monitoring Reports	Nataliya Bezushko	Engineer of Institute of Engineering Ecology, Ltd

Table An3-3. Responsibilities for data management