JOINT IMPLEMENTATION PROJECT

«Modernization of the heat supply system of Ternopil city»

Position of the head of the organization, institution, body, which prepared the document

Director
CEP Carbon Emissions Partners S.A.
(position)

(signature)
PS

Fabian Knodel
(name and patronymic, last name)

Position of the economic entity – owner of the source, where the Joint Implementation Project is planned to be carried out

Director CE "TMTKE"

(date)

(signature)
PS
14034534

A. Chumak
(surname, name and patronymic of the person)

Ternopil 2012 October

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:

Modernization of the heat supply system of Ternopil city
Sectoral scope:
Sectoral scope 1 – Energy industries (renewable/non-renewable sources)
PDD Version: 02
Date: October 25, 2012

A.2. Description of the project:

The purposes of the project activities

The purpose of the project is reduction of fossil fuel consumption by modernization of a centralized heat supply system of Ternopil city. The project, initiated by HNUE "Ternopilmiskteplokomunenergo", will lead to the reduction of greenhouse gas (GHG) emissions to the atmosphere and contribute to the improvement of ecological situation in the region. The purpose of the project is to promote sustainable development of the region by introducing energy saving technologies.

Historical details of HNUE "Ternopilmiskteplokomunenergo"

The main activity of HNUE "Ternopilmiskteplokomunenergo" is production and supply of thermal energy for heat and hot water supply in Ternopil city. All the generated heat is sold to local consumers, including residential, municipal consumers and state-owned organizations. Market of the product has been stable for many years.

Description of conditions of project implementation

One of the main objectives of HNUE "Ternopilmiskteplokomunenergo" is uninterrupted heat supply to consumers in Ternopil city, as well as implementation of advanced solutions for the economical use of fossil fuel. For the implementation of the above, special attention is paid to the improvement of quality of maintenance of heat supply systems, timely overhaul thereof, pipelines protection from corrosion and other damage. However, the structure of existing tariffs heat and hot water supply that is regulated by the state does not take into consideration amortization and investment needs of heat generation companies. This hinders the flow of sufficient funds for the purposes of repair, modernization and development of heat supply networks, procurement of appropriate technological equipment and components.

The baseline scenario.
The baseline scenario provides for the further use of existing equipment and conduction of the planned repair and restoration works without significant investment. Specific energy consumption in the provision of heat supply services would remain constant, leading to greenhouse gas emissions at the level of pre-project years. Justification for the baseline scenario is described in Section B.

Project scenario.
The project scenario provides for the modernization of the boiler equipment and heat supply networks that will increase efficiency and reduce heat losses in heating systems, improving the quality of service of heat and hot water supply.

The project involves the reduction of greenhouse gases (GHG) due to:

- Replacement of old boilers with new higher energy efficient ones;
- Modernization of boiler equipment;
- Modernization of heating systems, installation of pre-insulated pipes.

The Project implementation will provide significant economic and social benefits, positive impact on the environment of Ternopil city. The social impact of the project is positive, because after its implementation the heating services will improve.

Estimated project risks are limited and minimized because the Government of Ukraine declared the district heating and municipal energy sector as the priority of national energy saving measures.

History of the project activities

23/09/2004 – HNUE "Ternopilmiskteplokomunenergo" started implementation of measures to modernize the district heating system of Ternopil city as a JI project.

17/08/2012– project idea note on the justification of anthropogenic GHG emission reductions was developed and submitted to the State Environmental Investment Agency of Ukraine

18/10/2012 – The State Environmental Investment Agency of Ukraine issued a Letter of Endorsement № 3085/23/7 of the JI project «Modernization of the heat supply system of Ternopil city».

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)	• HNUE "Ternopilmiskteplokomunenergo"	No
Switzerland	• CEP Carbon Emissions Pertners S.A.	No
*Please indicate if the Party involved is a Host Party.		

HNUE "Ternopilmiskteplokomunenergo" is an organization that implements the project (Applicant, Supplier). Code in the Unified State Register of Enterprises and Organizations of Ukraine 14034534. Type of activity: 35.30 – Heat generation and distribution; 43.22 - Installation of water supply systems, heating systems and air conditioning. HNUE "Ternopilmiskteplokomunenergo" is responsible for design, construction and installation work performed by its own staff or through contractors. The enterprise finances the project and does not receive profit.

CEP Carbon Emis Partners S.A. is a research and engineering organization. It is responsible for the development of project design documents for the joint implementation project. Besides, it will participate in determination, monitoring and verification of the project.

Information on the organization, that is a potential ERUs purchaser is provided in Annex 1.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project is located in Ternopil city in western Ukraine (Figure 1).

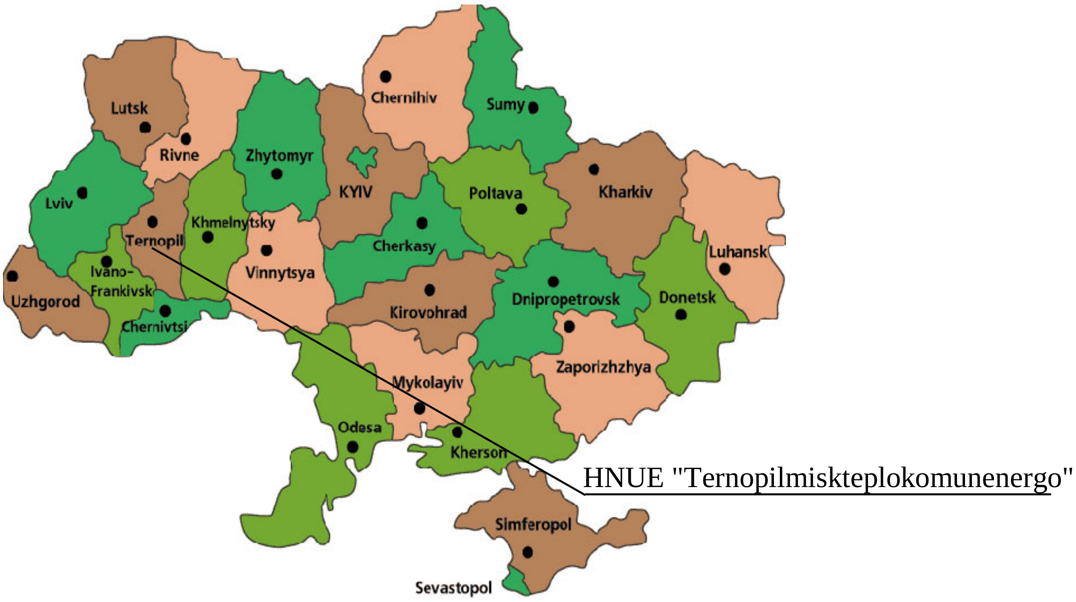

Figure 1. Location of HNUE "Ternopilmiskteplokomunenergo" on the map of Ukraine.

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 the UN Framework Convention on Climate Change on February 4, 2004[1]. It is listed in the Annex 1 and meets the requirements to participation in Joint Implementation projects[2].

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

Ternopil region - administrative-territorial unit of Ukraine with its center in the Ternopil city. Located on the Podolsk Upland, the southern border of Ternopil region runs along the Dniester River, the east - on Zbruch. Area is 13.8 thousand km².

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

Ternopil city.

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

The project is located in Ukraine and covers the land area of Ternopil city.
Location of head office:
Latitude: 49° 33' 12" NL
Longitude: 25° 35' 41" EL
Time zone: GMT +2:00

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[1] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1430-15
[2] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?page=1&nreg=995_801

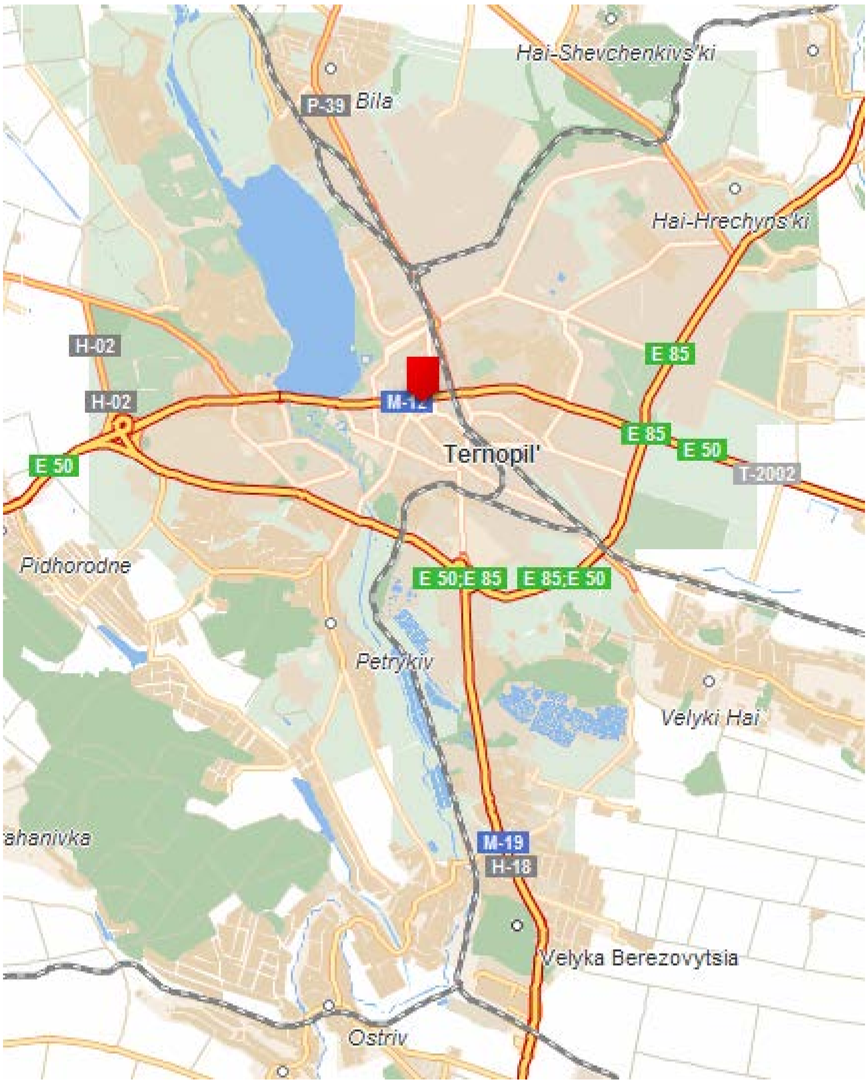

Figure 2 The map of Ternopil.

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

JI Project “Modernization of the heat supply system of Ternopil city” provides for complex modernization of the enterprise in order to reduce the consumption of fossil fuel while rendering services related to production and supply of heat energy. It is planned that implementation of the new energy efficient equipment will be carried out taking into account the most recent heat supply trends and technologies. The project uses state-of-the-art technologies that would enable the significant increase of efficiency.

Below we provide the description of the main activities and technologies under the project, the detailed description of a the implemented activities related to increasing the effectiveness of consumption of fossil fuel on the enterprose will be provided at the stage of monitoring of JI Project “Modernization of the heat supply system of Ternopil city ”.

1. Implementation of high-efficiency natural gas boilers. Brief description of equipment and its specification are provided below, and also on the Internet site of the seller. [3]

Figure3. Boiler Kolvi 3000

Kolvi 3000 - fire-tube boiler gas fired. Equipped with a gas burner with a different operating fuel pressure.

Table 1. Specification of efficient boiler Kolvi 3000

Name of indicators	**Dimension**	**Technical Data**
Boiler heating capacity	kW	3000
Maximum temperature of water heating	^{o}C	115
Efficiency, %	%	92
Maximum working pressure	Bar	6

Implementation of highly effective natural gas boilers will make it possible to reduce the emissions due to higher efficiency compared to the obsolete boilers of the similar capacity.

2. Installation of heat exchange equipment. Short description of equipment and its characteristics are provided below and also on the Internet site of the seller. [4]

Plate brazed heat exchangers - a direct-flow device, with a counterflow. Heat transfer surface consists of corrugated plates made of stainless steel, stacked and welded together using copper.

Gasketed plate heat exchangers consist of a fixed and mobile (presser) plates with fittings (flanges), between which a threaded rod with fasteners fixed package with heat exchanger plates and gaskets.

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[3] http://kolvi.prom.ua/p3763721-promyshlennyj-zharotrubnyj-gazovyj.html

[4] http://teta-romstal.prom.ua/p952620-teploobmenniki-zilmetswep-kolvi.html

Figure 4. Kolvi heat exchangers.

Implementation of plate heat exchangers will cause lower fossil fuel consumption by boiler houses due to the use of water heat from the heat supply network. This will cause lower GHG emissions into the atmosphere.

3. Replacement of heat supply networks with pre-insulated pipes. Brief description and characteristics of pre-insulated pipes are provided below and also on Internet site of the seller. [5]

Figure 5. Pre-insulated steel pipes.

Shop-assembled pre-insulated pipes with heat- and hydro-insulation are made of polyurethane foam with external polyethylene cover for underground tubing with external zinc-plated steel capsule for surface tubing.

Implementation of this technology will make it possible to increase the terms of safe operation of heat supply systems, reduce heat losses as a result of insulation of pipelines, and reduce the leakage of heat transfer agent through faulty sections that would lead to reduction of heat losses in the heat supply system, saving of fuel used for heating the agent. This will lead to reduction of GHG emissions.

Stages of Project's implementation

Table 2. Schedule of reconstruction and modernization of the heat supply system

Activities	Implementation date							
	2004**	2005	2006	2007	2008	2009	2010	2011

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[5] http://ttplast.spravka.ua/products/3.html

1*	▨	▨	▨
2			▨
3			▨
** - see Section A.4.2. for itemized names and description of activities* ***-implementation of project started in September 2004*			

At the moment of launching the project, HNUE "Ternopilmiskteplokomunenergo" was only engaged in supporting the working state of Mykolaiv city and region's heat supply system. These activities included repairing malfunctions occurring in the process of rendering heating and hot water supply services and replacing the old and out-of-order equipment, given the fact that it was rather cheap. The current project includes, but is not limited to, the introduction of new energy-saving equipment, taking into account the recent trends of supply.

With proper maintenance service replacement of implemented equipment within the project during the project period is not expected, since it meets all the criteria of the world modern general practice. Training of workers and specialists of HNUE "Ternopilmiskteplokomunenergo" will be in accordance with practice existing before the project and, if appropriate, because of lack of skills for work with equipment that is implemented within the project activity, equipment manufacturers will conduct briefings and training, according to contracts for the purchase of equipment.

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 reconstruction of boilers and heat distribution networks, will increase the energy efficiency of the heat supply system in Ternopil city so that it will produce the same amount of heat while consuming less fossil fuel. Reducing fossil fuel consumption will reduce greenhouse gas emissions.

In the absence of the proposed project, all equipment, including old with low efficiency, but able to operate, will operate normally for a long time and will not reduce emissions.

The Government of Ukraine declared that the heat supply sector is a priority area for national energy saving development. This is stated in the State program of reform and development of municipal economy in 2004-2010 (Law of Ukraine "On Heat Supply» N 2479-VI as of 09/07/2010) [6], Law of Ukraine as of 01/07/1994 № 74/94-VR «On Energy Saving"[7] and the Law Ukraine N 1026-V as of 16/05/2007 "On amendments to the Law of Ukraine "On energy saving". The new Law of Ukraine "On heat supply N 2633-IV as of 02/06/2005 regulates all relations in the market of heat supply. It did not significantly change the existing market practice, but will stimulate the introduction of energy saving measures and technologies with greater energy efficiency.

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

Table 3. Estimated amount of emission reductions for the period preceding the first commitment period (2005-2007)

	Years
Length of the crediting period	3

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[6] http://zakon.nau.ua/doc/?uid=1088.850.2&nobreak=1

[7] http://zakon.nau.ua/doc/?uid=1086.76.8&nobreak=1

Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2005	143 158
2006	146 965
2007	148 457
Total estimated GHG emission reductions over the crediting period (tonnes of CO_2 equivalent)	**438 580**
Annual average of estimated GHG emission reductions over the crediting period (tonnes of CO_2 equivalent)	**146 193**

Table 4. Estimated amount of emission reductions over the first commitment period (2008-2012)

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	149 683
2009	162 618
2010	169 516
2011	171 188
2012	171 188
Total estimated GHG emission reductions over the crediting period (tonnes of CO_2 equivalent)	**824 193**
Annual average of estimated emission reductions GHG over the crediting period (tonnes of CO_2 equivalent)	**164 839**

Table 5. Estimated amount of emission reductions for the period following the first commitment period (2013-2020)

	Years
Length of the crediting period	8
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	171 188
2014	171 188
2015	171 188
2016	171 188
2017	171 188
2018	171 188
2019	171 188
2020	171 188
Total estimated GHG emission reductions over the crediting period (tonnes of CO_2 equivalent)	**1 369 504**

Annual average of estimated GHG emission reductions over the crediting period (tonnes of CO_2 equivalent)	**171 188**

Detailed information about emission reductions estimation can be found in Supporting Document 1 (Excel file).
Description of formulae used for preliminary estimation of the quantity of emission reduction units is given in Section D and in the Supporting Document 1.

A.5. Project approval by the Parties involved:

Letter of Endorsement dated 18/10/2012 № 3085/23/7 of the JI project «Modernization of the heat supply system of Ternopil city» was issued by the State Environmental Investment Agency of Ukraine.

Upon determination of the project, the PDD and the Determination report will be submitted to the State Environmental Investment Agency of Ukraine in order to obtain a Letter of Approval.

SECTION B. Baseline

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

The proposed project uses the specific approach based on the approved Methodology AM0044 Version 1.0 Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors» - Version 1.0[8].

The principal challenge for implementation of the JI Projects for reconstruction of heat supply systems in Ukraine is the actual absence of monitoring equipment for measuring amounts of heat and heating agent used at municipal boiler and heating plants. Only usage of fossil fuel is registered on the regular basis. This makes virtually impossible the application of AM0044 Methodology, because the main calculation factor is the amount of heat output that has to be measured by meter (of heat output) and by temperature sensor (boiler temperature regime) on a monthly basis.

The specific approach used by the project was based on the permanent control of fuel consumption and taking other factors into account, such as: user switching on or off, change of fuel efficiency, climate change, ratio between usage of fuel for heating and for hot water supply, fuel consumption for company's own needs, etc.

The specific approach used by the project has two important advantages (at least, in the Ukrainian conditions) compared to AM0044 Methodology (Version 01):

- It takes into account the quality of heat supply (heating and hot water supply). Practically each year, for various reasons (receiving fuel in smaller amounts and at a higher price, especially of the natural gas, nearly 95% of which is used in Ukraine for city heat supply needs), customers receive less amount of heat than needed, as a result the temperature inside of buildings is below the norm. The purpose of JI Projects, including this one, is GHG emission reduction, which should not worsen the social conditions of the population, and getting closer to the normative quality of heat supply is a very important result. Thus, the amount of fuel consumed after project implementation shall be calculated for the conditions of supply in accordance with the heat supply norms, and, according to the monitoring plan, the implementation of the total control (monitoring) of its quality is planned (measurement of internal temperature in specific houses and also the registration of complaints about the bad quality heat supply). This helps to enhance control of heat supply to the customers, it also rules out the possibility of deliberate heat supply reduction and, thus, the consumption of fuel in order to increase the number of generated GHG emission reduction units (ERU) at the stage of project verification.
- Determination of fuel consumption in the base year (baseline), taking into account that the majority of municipal heat supply companies of Ukraine that use natural gas as fuel, consumption of which is constantly measured by high-precision meters, seems to be more accurate than determination of fuel consumption through usage of heat energy, effectiveness of boilers and of heat capacity of fuel. Especially this pertains to efficiency that is changing depending on boiler workload, which also changes significantly in the systems of heat supply both during the day and during the year, very often manually instead of automatically. As a result of averaging of these values without the system of heat computation in place, significant deviations may occur. Measurement of fuel consumption by meters only requires data collection and some arithmetic operations.

The project uses the specific approach based on the regular measurement of fuel consumption and adjustments of the baseline under the possibility of change of parameters during the reporting year. Various parameters include changes in heating capacity of fuels, quality of heat supply, change of weather conditions, change of amount of customers, etc. Taking into account only change of fuel efficiency does not eliminate the possibility

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[8] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5

of insufficient heat supply to customers (worsening of the service of heat supply), and the possible warming in a reporting year, fuel quality change, reduction in the number of consumers, and other factors may lead to artificial overestimation of the number of ERUs.

Taking the above into account, unlike the Methodology AM0044(Version 01), the specific approach that was developed for the projects “Centralized heat supply” in the Ukrainian condition, and is used in the JI projects “Reconstruction of heat supply system in Donetsk Region”[9], “Reconstruction of heat supply system in Chernihiv Region”[10], “Reconstruction of heat supply system in Crimea”[11], and “Reconstruction of heat supply system in Kharkiv”[12], is the most acceptable, specific, it corresponds to the principle of conservatism, and also completely corresponds to the purposes and tasks of the Kyoto Protocol.

Studying of the baseline shall be performed for each year in which emission reductions were traded, in order to adjust the ratios influencing the baseline. The detailed information is presented in Section D.

The dynamic baseline was chosen in accordance with Guidance on criteria for baseline setting and monitoring, Version 03[13]. In accordance with the Guidelines for the joint implementation projects’ design document form users, Version 04[14], the following step-wise approach shall be used for description and justification of the chosen baseline:

Step 1. Indication and description of the approach applied.

The Baseline shall be determined by choosing the most plausible scenario from the list and description of plausible future scenarios based of conservative assumptions.
The following steps were applied to determine the most plausible baseline scenario:
1. Determination of the plausible alternatives that could be the baseline scenario.
2. Justification of ruling out the alternatives that are improbable from technical and (or) economic perspectives.

During establishment of baseline and justifying additionality (Section B.2.), the following key factors were taken into consideration:

- State policy and applicable legislation in energy sector;
- Economic situation in energy sector of Ukraine and forecasted demand for fossil fuel;
- Technical aspects of management and operation of the system for heat delivery;
- Availability of the capital including investment hindrances characteristic of HNUE "Ternopilmiskteplokomunenergo";
- Local availability of technologies and equipment;
- Price and availability of fuel.

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

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

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

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

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

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

Step 2. Application of the approach chosen

Choice of the plausible baseline scenario is based on assessment of alternative versions of logistics for potential heat production and transportation by the heat supply system as of eth beginning of the project implementation (2005).

The following alternatives were analyzed:

Alternative 1.1: Proceeding with the current practice without realization of JI project.

Alternative 1.2: Project activities without using the JI mechanism.

Detailed analysis of each alternative is provided below.

Alternative 1.1

Proceeding with the current practice of implementing the minimal repairs against the general degradation of the heat supply system.

Scenario of implementing minimal repair works against the general degradation of the heat supply system is the most plausible. There are no barriers to this Baseline scenario (no investment barriers because this scenario does not require additional investments, and no technological barriers because the qualified staff operates the equipment and no additional training is required). This scenario reflects the general practice in place in Ukraine.

Correspondingly, *Alternative 1.1* may be viewed as the most plausible baseline.

Alternative 1.2

Project operations without using the Joint Implementation mechanism.

The principal barrier that prevents implementation of this scenario is investment barrier because this would require the obtaining of additional funds. Such investment is characterized by a considerable payback period and high investment risks.

This alternative may not be considered as the most plausible baseline scenario, because the principal barrier to its implementation is the lack of investments into the new technological equipment and high investment risks.

Analysis of described alternatives shows that *Alternative 1.1 is the most plausible.*

The results of the investment analysis performed in Section B.2 prove that *Alternative 1.2* may not be considered the most plausible from the financial viewpoint. The detailed information about analysis of investment barriers is provided in Section B.2.

The results of analysis performed in accordance with Tool for the demonstration and assessment of additionality, Version 06.0.0[15], Section B.2, show that the project scenario is additional.

Description of baseline scenario

Baseline scenario provides for continuation of the current practice of implementation of minimal repairs against the general degradation of heat supply system of Ternopil city.

This scenario is less ecologically friendly for the nearest future (including the first period of obligations, 2008-2012), because GHG emission will stay on the same level, or will even get worse, but economically this is more attractive scenario. This is why this practice may not provide for reduction of GHG emission. In addition, the continued operation of obsolete equipment (the majority of which was made is the USSR), low

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

efficiency of heat supply systems will result in excessive spending of fossil fuel that will impair atmosphere by polluting it with GHG.

The detailed information on the algorithm of baseline setting is provided below and in Section D.1.

Baseline GHG emissions:

Baseline GHG emissions:

$$BE_b^y = BE_{b\ ,HEAT}^y = \frac{NCV_{b,NG}^y \cdot EF_{b,CO2,NG}^y \cdot FC_{b,NG,i}^y}{1000}, \qquad \text{(B1)}$$

$NCV_{b,NG}^y$ - net calorific value of naturel gas in monitoring period *y* in the baseline scenario, GJ/ths m^3;

$EF_{b,CO2,NG}^y$ - default carbon dioxide emission factor for stationary combustion of natural gas in monitoring period *y* in the baseline scenario (t CO_2/TJ);

$FC_{b,NG,i}^y$ - total amount of natural gas, which would have been combusted by consumer *i*, in monitoring period *y* in the baseline scenario, ths m^3;

1000 – index to convert ths m^3 into million m^3.

[y]- index corresponding to monitoring period;

[b] - index corresponding to baseline scenario;

[NG]- index corresponding to natural gas;

[i]- index relating to consumer;

[HEAT] - index relating to heat carrier supplied by a boiler house.

$$EF_{b,CO2,NG}^y = EF_{b,C,NG}^y \cdot OXID_{b,NG}^y \cdot \frac{44}{12} \qquad \text{(B2)}$$

$EF_{b,C,NG}^y$ - carbon emission factor for natural gas combustion in monitoring period *y* in the baseline scenario, (t C/TJ);

$OXID_{b,NG}^y$ - carbon oxidation factor for natural gas combustion in monitoring period *y* in the baseline scenario, (relative units);

$\frac{44}{12}$ - stoichiometric ratio between CO_2 and C molecular masses, (t CO_2/t C);

[y]- index corresponding to monitoring period;

[b] - index corresponding to baseline scenario;

[NG]- index corresponding to natural gas;

According to Dynamic Baseline assumption, the value of $BE_{b,HEAT}^y$ may vary:

$$BE_{b,HEAT}^y = BE_{b,HEAT,h}^y + BE_{b,HEAT,w}^y, \qquad \text{(B3)}$$

$BE_{b,HEAT,h}^y$ - emissions from fossil fuel combustion for heat generation for heating in monitoring period *y* in the baseline scenario, (t CO_2eq);

$BE_{b,HEAT,w}^y$ - emissions from fossil fuel combustion for heat generation for hot water supply in monitoring period *y* in the baseline scenario, (t CO_2eq).

For the cases when hot water supply existed in the baseline period (irrelevant of the service duration, (1-$a_b \neq$ 0), the following formula is used for $BE_{b,HEAT}^y$:

$$BE_{b,HEAT}^y = \frac{NCV_{b,NG}^j \cdot EF_{b,CO2,NG}^j \cdot \left\lfloor FC_{b,NG}^j \cdot a_b^j \cdot K_1 \cdot K_h + FC_{b,HEAT}^j \left(1 - a_b^j\right) \cdot K_1 \cdot K_w \right\rfloor}{1000}, \qquad \text{(B4)}$$

For the cases when no hot water supply existed in the baseline period ((1-a_b) = 0), and hot water supply only started in the reporting period (thanks to the improved heat supply services), the following formula is used:

$$BE^{y}_{b,HEAT} = \frac{NCV^{j}_{b,NG} \cdot EF^{j}_{b,CO2,NG} \cdot \left[FC^{j}_{b,NG} \cdot a^{j}_{b} \cdot K_1 \cdot K_h + FC^{y}_{p,NG}\left(1 - a^{y}_{p}\right) \cdot K_1 \cdot K_{w0}\right]}{1000} \qquad \text{(B5)}$$

$NCV^{j}_{b,NG}$ - net calorific value of natural gas in monitoring period y in the baseline scenario,GJ/ths m^3;

$EF^{j}_{b,CO2,NG}$ - default CO_2 emission factor for stationary combustion of Natural gas in monitoring period y in the baseline scenario, t CO_2/TJ;

$FC^{j}_{b,NG}$ - total amount of natural gas, which would have been combusted by consumer i, in monitoring period y in the baseline scenario, ths m^3;

$FC^{y}_{p,NG}$ - total amount of natural gas, which would have been combusted by consumer i, in monitoring period y of the project scenario, ths m^3 (t);

K_1, K_h, K_w, K_{w0} – adjustment factors;

a^{j}_{b} – part of fuel (heat) consumed for heating;

$(1 - a^{j}_{b})$ – part of fuel (heat) consumed for hot water supply.

1000 – index to convert ths m^3 into million m^3.

$$a^{j}_{b} = L^{j}_{h,b} \cdot g \cdot N^{j}_{h,b} / (L^{j}_{h,b} \cdot g \cdot N^{j}_{h,b} + L^{j}_{w,b} \cdot N^{j}_{w,b}), \qquad \text{(B6)}$$

$L^{j}_{h,b}, L^{j}_{w,b}$ – maximum load for heating and hot water supply services, MW;

g – factor for recalculation of the average heat load during heating period (defined for every boiler house individually on historical basis (usually 0.4-0.8);

$N^{j}_{h,b}, N^{j}_{w,b}$ – duration of heating period and period of hot water supply services, hours;

[j]- index corresponding to historical period;

[b] - index corresponding to baseline scenario;

[p]- index corresponding to the project scenario;

[NG]- index corresponding to natural gas;

[h]- index relating to heating;

[w]- index relating to hot water supply;

[HEAT] - index relating to heat carrier supplied by a boiler house.

Adjustment factors:

$$K_1 = NCV^{j}_{b,NG} / NCV^{y}_{p,NG} \quad , \qquad \text{(B7)}$$

K_1 - factor of the change of net calorific value of fossil fuel.

$NCV^{j}_{b,NG}$ - net calorific value of natural gas in historical period j in the baseline scenario, GJ/ths m^3;

$NCV^{y}_{p,NG}$ - net calorific value of natural gas in monitoring period y in the project scenario, TJ/mln m^3;

To establish the Dynamic Baseline that takes into account external factors such as weather conditions, heated area, etc., adjustment factor for heating should be used.

The amount of fuel consumed for heating is proportional to the necessary amount of heat in heating period Q_h:

$$FC^{y}_{b,NG_h} = FC^{y}_{b,NG,i} \cdot a = Q_h * 3{,}6 / NCV^{y}_{b,NG} \cdot \eta_h , \qquad \text{(B8)}$$

$FC^{y}_{b,NG,i,h}$ - total amount of natural gas, which would have been combusted by consumer i for heating, in monitoring period y in the baseline scenario, ths m^3;

$FC^{y}_{b,NG,i}$ - total amount of natural gas, which would have been combusted by consumer I , in monitoring period y in the baseline scenario, ths m^3;

Q_h - necessary heat for heating, kWh;
3,6 – factor of kWh into MJ conversion;
a – part of fuel (heat) consumed for heating;
$NCV^{y}_{b,NG}$ - net calorific value of natural gas in monitoring period y in the baseline scenario, TJ/mln m^3;
η_h – overall boiler-house efficiency.

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

$Q_{h,b,p} = Q_{h,b}*K_h = Q_{h,p}$, (B9)

$Q_{h,b,p}$ – necessary heat for the Dynamic Baseline, assumed as equal to $Q_{p,}$ kWh,;
Q_{hp} – necessary heat for reporting period, kWh;
$Q_{h,b}$ – necessary heat for the baseline period, kWh;
K_h – average adjustment factor for heating.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[h]- index relating to heating;

This equasion allows us to determine the average adjustment factor:

$K_h = Q_{h,p} / Q_{h,b}$, (B10)

Q_{hp} – necessary heat for reporting period, kWh;
$Q_{h,b}$ – necessary heat for the baseline period, kWh;

The necessary amount of heat for heating of premises during the year, according to the “Standards and standardization guidelines for fuel and heat consumption for heating of residential and public buildings as well as for public and utility needs in Ukraine. KTM 204 Ukraine 244-94”, (formula 2.17):

$Q_h = F_h*K_h*(T_{in} - T_{out})*N_h$, (B11)

Q_h – necessary amount of heat for heating, kWh;
F_h – heated area in premises, ths m^2;
K_h – average heat exchange coefficient for buildings, kW/m^2*^0C;
T_{in} – average indoor temperature in the heating period, ^0C;
T_{out} – average outdoor temperature in the heating period, ^0C;
N_h – duration of the heating period per year, h.
[in] - index corresponding to indoor temperature;
[out]- index corresponding to outdoor temperature;
[h]- index relating to heating;
[p]- index corresponding to the project scenario;

Therefore:

$K_h = (F_{h,p}*K_{h,p})*(T_{in,p} - T_{out,p})*N_{h,p} / F_{h,b}*K_{h,b}*(T_{in,b} - T_{out,b})*N_{h,b}$, (B12)

Temperature change factor:

$К_2=(T_{in,p} - T_{out,p}) / (T_{in,b} - T_{out,b})$, (B13)

Heated area and thermal insulation change factor:

$К_3 = (F_{h,p} * k_{h,p}) / F_{h,b} * К_{h,b} = [(F_{h,n,p} – F_{h,t,p} – F_{h,n,p}) * К_{h,b} + (F_{h,n,p} + F_{h,t,p}) * К_{h,n}] / F_{h,b} * К_{h,b}$, (B14)

$F_{h,b}$ – heated area in premises in the baseline period, m^2;

$F_{h,p}$ – heated area in premises in the reporting period, m^2;

$F_{h,n,p}$ – heated area of new buildings connected to the heat supply system (assumed, with new improved thermal insulation) in the reporting period, m^2;

$F_{h,t,p}$ – heated area of buildings (existing in the baseline year) in the reporting period with improved thermal insulation, m^2;

$К_{h,b}$ – average heat exchange coefficient for buildings in the baseline year, kW/m^2*K;

$К_{h,p}$ – average heat exchange coefficient for buildings in the reporting year, kW/m^2*K;

$К_{h,n}$ – heat exchange factor of heated buildings with new thermal insulation (new or old buildings with new thermal insulation), kW/m^2*K;

[in] - index corresponding to indoor temperature;

[out]- index corresponding to outdoor temperature;

[h]- index relating to heating;

[b] - index corresponding to baseline scenario;

[p]- index corresponding to the project scenario;

Coefficient of the change of heating period duration:

$К_4 = N_{h,p} / N^{j}_{h,b}$, (B15)

$N^{j}_{h,b}$ – duration of heating period in the baseline period, h;

$N_{h,p}$ – duration of heating period in the reporting period, h.

[h]- index relating to heating;

[p]- index corresponding to the project scenario;

[b] - index corresponding to baseline scenario;

Thus,

$К_h = К_2 * К_3 * К_4$, (B16)

To establish the Dynamic Baseline that takes into account external factors such as weather conditions, number of consumers, etc., adjustment factor for hot water supply should be used.

The amount of fuel consumed for hot water supply is proportional to the necessary amount of heat in the period of service provision, Q_w:

$$FC^{y}_{b,NG,w} = FC^{y}_{b,NG,i} \cdot (1-a) = Q_w \cdot 3{,}6 / NCV^{y}_{b,NG} \cdot \eta_w , \qquad \text{(B17)}$$

$FC^{y}_{b,NG,i,w}$ - total amount of natural gas, which would have been combusted by consumer *i* for hot water, in monitoring period *y* in the baseline scenario, ths m^3;

$FC^{y}_{b,NG,i}$ - total amount of natural gas, which would have been combusted by consumer *i* , in monitoring period *y* in the baseline scenario, ths m^3.

Q_h – necessary heat for hot water supply, kWh;

3,6 – factor of kWh into MJ conversion;

a – part of fuel (heat) consumed for heating;

$NCV^{y}_{b,NG}$ - net calorific value of natural gas in monitoring period *y* in the baseline scenario, TJ/mln m^3;

η_w – overall hot water system efficiency.

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

$Q_{w,b,p} = Q_{w,b}*K_w = Q_{w,p}$, (B18)

$Q_{w,b,p}$ – necessary amount of heat for hot water supply for the Dynamic Baseline, assumed to be equal to $Q_{w,p}$;
$Q_{w,p}$ – necessary amount of heat for hot water supply in the reporting period, kWh;
$Q_{w,b}$ – necessary amount of heat for hot water supply in the baseline period, kWh;
K_w – average adjustement coefficient for hot water supply.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[h]- index relating to heating;
[w]- index relating to hot water supply;

This equasion allows us to determine the average adjustment coefficient:

$K_w = Q_{w,p} / Q_{w,b}$, (B19)

Kw component can be determined by correlation of heat used for hot water supply in the baseline and reporting periods:

$Q_w = n_w*v_w *N_w$, (B20)

Q_w – Necessary amount of heat for hot water supply, kWh;
n_w – average number of consumers, individual accounts;
v_w – standard specific hot water consumption per individual account (in thermal units, kWh/h);
N_w – duration of service provision per year, h.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[w]- index relating to hot water supply;

Thus:

$K_w = n_{w,p}*v_{w,p}*N_{w,p} / n_{w,b}*v_{w,b}*N_{w,b}$, (B21)

Coefficient of the change of the number of consumers:

$K_5 = n_{w,p} / n^{j}_{w,b}$, (B22)

Coefficient of the change of standard specific hot water consumption per individual account:

$K_6 = v_{w,p} / v_{w,b}$, (B23)

At the moment, standard specific hot water consumption proposed in KTM 204 Ukraine 244-94 in 1993 is effective. There is no information concerning changes, therefore $K_6 = 1$ and is not subject to special monitoring.

Coefficient of the change of the duration of the period of hot water supply services:

$K_7 = N_{w,p} / N_w$, (B24)

$N_{w,b}$ – duration of the period of hot water supply services in the baseline period, h;
$N_{w,p}$ – duration of the period of hot water supply services in the reporting period, h.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[w]- index relating to hot water supply;

Thus,

$K_w = K_5 * K_6 * K_7$, (B25)

Adjustment coefficients for hot water supply in the case when there was no hot water supply in the baseline period, but the service was provided in the reporting period:

In the case when there was no hot water supply in the baseline period, number of consumers, standard specific hot water consumption, duration of the period of hot water supply services in the baseline year are assumed to be equal to the corresponding values in the reporting period,

K5 = K6 = K7 = 1, (B26)

Therefore

Kw0=1, (B27)

To set the baseline the following parameters are used:

Data/Parameter	$FC_{b,NG}^{j}$
Data unit	ths m^3
Description	Total amount of natural gas burnt by consumer, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	Gas meters and form N 11-MTP «Report on fuel, heat and electricity consumption»
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement takes place by means of gas meters, department of fuel and energy resources reads the volume of natural gas calculators remotely on each boiler, the data entered in the form N 11-MTP «Report on fuel, heat and electricity consumption»
QA/QC procedures (to be) applied	Measurements are carried out by meters that regularly undergo calibration and verification in accordance with the procedures of quality management, the Law of Ukraine "On metrology and metrological activity."[16] The final results were entered in the official reports provided to the regulatory authorities, which checked these reports.
Any comment	Information on the amount of consumed fossil fuels is the basis for calculations of greenhouse gases, which is achived on paper and electronically.

Data/Parameter	$NCV_{b,NG}^{j}$
Data unit	TJ/mln m^3
Description	Net calorific value of natural gas, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	Company's data. Information on net calorific heat value combustion of natural gas available in the certificate of HNUE "Ternopilmiskteplokomunenergo".
Value of data applied (for ex ante	2004

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[16] http://www.ucrf.gov.ua/uk/doc/laws/1099563058/

calculations/determinations)	Natural gas, TJ/mln m3 33,91
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form.

Data/Parameter	$EF_{b,C,NG}^{j}$
Data unit	t C/TJ
Description	Carbon emission factor in the course of natural gas combustion, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010».[17]
Value of data applied (for ex ante calculations/determinations)	2004 Natural gas, t C/TJ 15,18
Justification of the choice of data or description of measurement methods and procedures (to be) applied	According to "Guidance on criteria for baseline setting and monitoring" [18]
QA/QC procedures (to be) applied	National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	$OXID_{b,NG}^{j}$
Data unit	Relative units
Description	Carbon oxidation factor in the course of natural gas combustion, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010» [19]

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

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

Value of data applied (for ex ante calculations/determinations)	<table><tr><td></td><td>2004</td></tr><tr><td>Natural gas, GJ/ths m3</td><td>0,995</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	According to “Guidance on criteria for baseline setting and monitoring”[20]
QA/QC procedures (to be) applied	National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	T_{out}
Data unit	^{o}C
Description	Average outdoor temperature during the heating period
Time of determination/monitoring	Once in the reporting period. The day temperature is recorded every day
Source of data (to be) used	Company’s data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	T_{in}
Data unit	^{o}C
Description	Average indoor temperature during the heating period
Time of determination/monitoring	Once in the reporting period
Source of data (to be) used	Company’s data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of	N/A

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

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

measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	n_w
Data unit	people
Description	Average number of consumers, personal bills
Time of determination/monitoring	Once a year
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	N_w
Data unit	h
Description	Duration of hot water supply service provision in year
Time of determination/monitoring	Once a year
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	N_h
Data unit	h
Description	Duration of heat supply service provision

Time of determination/monitoring	Once a year
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	F_h
Data unit	ths m^2
Description	Heated area
Time of determination/monitoring	Once a year
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

More detailed consideration of baseline emissions is provided in Sections D, E and Annex 2.

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:

Anthropogenic emissions of greenhouse gases in the project scenario will be decreased due to complex modernization of heat generating and distribution equipment by introduction of technologies proposed in the project activity and described above.
Implementation of these measures would significantly reduce the consumption of fuel resources in providing heat supply services, which will cause the reduction of emissions of greenhouse gases into the environment.

Additionality of the project

The additionality of the project activity is demonstrated and assessed by using the "Tool for the demonstration and assessment of additionality" [21] (Version 06.0.0). This manual was elaborated in original for CDM projects, but it may be also applied to JI projects.

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

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

There are two alternatives to this project (which have already been discussed in Section B.1).
Alternative 1.1: Continuation of existing situation, without JI project implementation.
Alternative 1.2: Project activity without application of Joint Implementation mechanism.

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

According to the Law of Ukraine "On licensing of certain activities»[22] № 1775-III dated June 1, 2000, and "On the heat supply»[23] № 2633-IV dated June 2, 2005; Resolution of the Cabinet of Ministers of Ukraine "On Amendments to resolutions of the Cabinet of Ministers of Ukraine № 1698[24] as of November 14, 2000 and № 756[25] as of July 4, 200» № 549[26] as of April 19, 2006 and "On the establishment of licensing authorities» № 1698[27] as of November 14, 2000, conducting business on the production, transport by the main local heat distribution networks and on heat supply requires a license issued by the Ministry of Housing and Communal Services of Ukraine. HNUE "Ternopilmiskteplokomunenergo" has such a license. The project "Modernization of the heat supply system of Ternopil city" is prepared according to the Law of Ukraine "On Heat Supply» № 2633[28] dated dated June 2, 2005 and № 3260 - IV as of December 22, 2005 "On Amendments to the Law of Ukraine "On the heat supply" on the minimum use of technological natural gas"[29]. However, alternative scenarios, namely scenario "business as usual". Continuation of existing practices without JI project and project activity without JI mechanism - consistent with mandatory laws and regulations.

Alternative 1.1: Continuation of current practice of exploitation of HNUE "Ternopilmiskteplokomunenergo" existing heat supply system is the most realistic and credible alternative to the Project implementation, since this variant is associated with minimal costs for HNUE "Ternopilmiskteplokomunenergo".

Alternative 1.2: Project activity without application of Joint Implementation mechanism.
So far HNUE "Ternopilmiskteplokomunenergo" has not performed any significant measures for modernization of the heat supply system. Moreover, HNUE "Ternopilmiskteplokomunenergo" does not have any financial incentives to cover such costs on implementation of this Project except for possible proceeds that

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

[22] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1775-14

[23] http://zakon.nau.ua/doc/?uid=1088.850.2&nobreak=1

[24] http://zakon1.rada.gov.ua/laws/show/1698-2000-п

[25] http://zakon2.rada.gov.ua/laws/show/756-2001-п

[26] http://zakon1.rada.gov.ua/laws/show/549-2006-п

[27] http://www.dpa.cv.ua/index.php?option=com_content&view=article&id=59:---14--2000---1698-l----r&catid=142:2009-06-05-09-37-06&Itemid=61

[28] http://zakon2.rada.gov.ua/laws/show/2633-15

[29] http://zakon1.rada.gov.ua/laws/show/4222-17

are received under the mechanism established by article 6 of the Kyoto Protocol to the UN Framework Convention On Climate Change. Therefore *Alternative 1.2.* can't be considered as plausible baseline.

Outcome of Sub-step 1b. Under such circumstances one may say that all scenarios are consistent with current laws and regulatory acts.

Therefore Step 1 is satisfied.

According to the document the "Tool for the demonstration and assessment of additionality» [30] (Version 06.0.0) further justification of additionality shall be performed by means of investment analysis.

Step 2 - Investment Analysis.

The main purpose of investment analysis is to determine whether the proposed project:

(a) is not the most economically or financially attractive, or

(b) is not economically or financial feasible without income from sale of emission reduction units (ERUs) related to the JI project.

Sub-step 2a - Determination of appropriate analysis method.

There are three methods used for investment analysis:

- a simple cost analysis (Variant I);
- a comparative investment analysis (Variant II);
- a benchmark analysis (variant III).

If the project activities and alternatives identified in Step 1 do not receive other financial or economic benefits other than income related to JI, then the simple cost analysis (Variant I) is applied. Otherwise, the comparative investment analysis (Variant II) or the benchmark analysis (variant III) are used.

Guidelines for additionality allow for performance of comparative investment analysis, which compares corresponding financial indices for the most realistic and reasonable investment alternatives (Variant II), or the benchmark analysis (Variant III). For this project it is appropriate to apply analysis using Variation III, according to the instructions of the Tool for the demonstration and assessment of additionality.

Sub-step 2b–Banchmark analysis.

The proposed project «Modernization of the heat supply system of Ternopil city» will be implemented by the project participant, namely HNUE "Ternopilmiskteplokomunenergo". The approach recommended in paragraph 12 (a) of the Guidelines on the assessment of investment analysis version05[31] provides for using of a discount rate that is determined by considering the weighted average cost of capital (WACC). WACC is calculated as a weighted average cost of own and debt capital. The structure of capital is taken in the form of 50% of own and 50% of debt capital. In accordance with paragraph 18 of the "Guidelines on the assessment of investment analysis ver.05"[32] cost of own capital is calculated as the sum of risk-free rate (3%)[33], the risk premium on investment in own capital (6,75%)[34]. and country risk (6,5%)[35]. Thus the cost of own capital is 16,25%. The cost of own capital is estimated at the average cost of credit in foreign currency as of 2004

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

[31] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

[32] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

[33] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

[34] http://pages.stern.nyu.edu/~adamodar/pc/archives/ctryprem04.xls

[35] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

according to the NBU, which was 12,9%[36]. Nominal discount rate (WACC) is equal to 14,6%. Cash flow is adjusted by inflation index for the Eurozone (2,3%)[37].

If the proposed project (not implemented as a JI project) has a less favourable rate, i.e. lower internal rate of return (IRR), than the total limit level, the project may not be considered as financially attractive.

Sub-step 2c – Calculation and comparison of financial indicators.

Financial analysis refers to the time of making investment decisions. The following assumptions were used based on information provided by the company.

The project requires investment of more than 11 million euros (according to the NBU rate)[38];

1. Calculation period is 20 years (Minimal term of the equipment operation);

2. The residual value is calculated as the result of multiplication of unused resource for initial expenses.

Analysis of cash flow takes into account the cash outflow connected with investments and operational costs[39] and cash inflow associated with the receipt of revenues from providing of services by the enterprise.

Financial performance of the project is provided in Table 6 below.

Table 6. Financial indicators of the project

Revenues without VAT (ths EUR)	Cash flow (ths EUR)	dr (discount rate)	NPV (ths EUR)	IRR (%)	Residual value (ths EUR)
12 861 341	9 057 530	14,6%	696 843	11,11%	5 705 717

Data source of expenditures of HNUE "Ternopilmiskteplokomunenergo" is the information provided by the company. Income calculated in by multiplying the price for natural gas[40] on amount of natural gas that was saved now by installing new energy efficient equipment.

When analyzing the cash flow the IRR is below the established limit level and has negative value. As a result NPV is negative. Therefore the project cannot be considered as financially attractive.

Sub-step 2d: Sensitivity analysis

The sensitivity analysis is conducted to confirm whether the conclusions on the financial / economic attractiveness are enough stable at different substantiated variants of the baseline conditions change. The following two key factors were considered in sensitivity analysis: investment and operational expenses as well as tariff for natural gas transportation. According to the guidelines for additionality (paragraph 17) the sensitivity analysis should be made for key indicators in the range of variation ± 10%.

Table 7. Investment and operational costs

	-10%	0%	10%
Operational expenses, eur	0	0	0
Investment expenses, eur	8 558 575	9 509 528	10 460 480

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[36] http://www.bank.gov.ua/doccatalog/document?id=36530 , page 54

[37] http://www.finfacts.ie/inflation.htm

[38] http://www.bank.gov.ua/control/uk/curmetal/currency/search?formType=searchPeriodForm&time_step=daily&currency=196&periodStartTime=01.09.2004&periodEndTime=30.09.2004&outer=table&execute=%D0%92%D0%B8%D0%BA%D0%BE%D0%BD%D0%B0%D1%82%D0%B8

[39] Accompanying document 2

[40] http://expert-ua.info/document/archiveiv/law3hguwt.htm

Company income, eur	12 861 341	12 861 341	12 861 341
NPV (ths EUR)	-287 799	-696 843	-1 105 886
IRR (%)	13,0%	11,1%	9,6%

Table 8. Income from service provided

	-10%	0%	10%
Operational expenses, eur	0	0	0
Investment expenses, eur	9 509 528	9 509 528	9 509 528
Company income, eur	11 575 207	12 861 341	14 147 475
NPV (ths EUR)	-1 036 202	-696 843	-357 483
IRR (%)	9,5%	11,1%	12,8%

Sensitivity analysis was used to assess the sensitivity of the project to changes that may occur during the project implementation. Analysis of change of incorm from the production of heat in the range of -10% and +10% demonstrated that the IRR varies from 9,5% to 12,8%. Analysis of investment and operational costs in the range of -10% and +10% demonstrated that the IRR varies from 9,6% to 13,0%. Expenditures that are considered in the framework of the project are high, and increase of expenditures will result in a negative NPV. But in case of expected price of the investment and the income from the sale of ERUs the project is viable and will bring enough profit even in case of credit financing of the project and it shouldn't make a profit even if the above changes in price of investment take place.

Outcome of Step 2: Sensitivity analysis consistently supports (for a realistic range of assumptions) the conclusion that the project is unlikely to be financially / economically attractive.

Step 3: Barrier Analysis

According to the Guidelines of additionality the barrier analysis was not conducted.

Step 4: Common practice analysis

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

Analysis of other activity similar to the one proposed in the Project demonstrated absence of similar projects in Ukraine.

Existing practice of exploitation of existing capacities represented in the variant of the baseline chosen for this Project is the common one for Ukraine. According to the current practice all modernization and measures to improve the technological equipment operated in manufacturing and supplying of thermal energy by upgrading boiler heating equipment and networks, are borne by the company and HNUE "Ternopilmiskteplokomunenergo" does not have any incentive to implement new equipment and technologies.

Outcome of Sub-step 4a: Since there are no similar projects in Ukraine, there is no need to conduct analysis of similar project activity.

According to the «Tool for the demonstration and assessment of additionality»[41] (Version 06.0.0) all steps are satisfied but there are still some obstacles.

One of them is additional costs of facilities modernization in case of JI project implementation;

The barrier is associated with the structure of the existing tariffs on services of enterprise that does not include an investment component to improve the heating system. This situation leads to a constant shortage of funds and the inability to timely implement major repairs, ensure equipment operation and invest in modernization and infrastructure development галузі теплозабезпечення.

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

We conclude that all of the above may prejudice the implementation of the proposed project as well as other alternatives - partial project activity (implementation of not-all project equipment) without application of Joint Implementation mechanism.

However, one of the alternatives is a continuation of "business as usual." (Continuation of existing practices without JI project.) Since the obstacles identified above are directly related to investment in modernization of heat supply system, HNUE "Ternopilmiskteplokomunenergo" has no obstacles to further exploitation of equipment for heat supply at the same level. Therefore identified obstacles cannot prejudice the introduction of at least one alternative scenario - continuation of "business as usual."

Conclusion

Based on the above analysis we can conclude that the project is additional.

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

The project boundary includes boiler houses and heat supply networks of HNUE "Ternopilmiskteplokomunenergo" used in the production of heat and heat supply, a list of boiler houses and heat networks is provided in the "Register of basic technological equipment as of July 24, 2012 included to the boundaries of JI project "Modernization of the heat supply system of Ternopil city".

Total number of boiler-houses - 36 units, Heat networks - 59.2 km.

The baseline scenario provides for the further use of existing equipment and conduction of the planned repair and restoration works without significant investment. Specific energy consumption in the provision of heat supply services would remain constant, leading to greenhouse gas emissions at the level of pre-project years. Detailed information on parametrs, used to set the baseline scenario is provided in Section B.1 and D.1.

Table 9 demonstrates the overview of GHG emission sources in the baseline scenario boundary for the project.

Table 9. An overview of all sources of emissions in the baseline scenario.

Source	**Gas**	**Included / Excluded**	**Substantiation / explanation**
Baseline emissions			
GHG emissions caused by heat production and supply	CO_2	Included	GHG emissions from heat generating equipment of the heat supply system that uses fossil fuel for heat production and thus causes emissions to the atmosphere.

The project scenario provides for the modernization of the boiler equipment and heat supply networks that will increase efficiency and reduce heat losses in heating systems. This will result in reduction fossil fuel consumption, which in turn will reduce GHG emissions. Detailed information on parametrs, used to set the project scenario is provided in Section D.1.

Table 10 demonstrates the overview of GHG emission sources in the project scenario boundary.

Table 10. An overview of all sources of emissions in the project scenario.

Source	**Gas**	**Included / Excluded**	**Substantiation / explanation**

Project emissions			
GHG emissions caused by heat production and supply	CO_2	Included	GHG emissions from heat generating equipment of the heat supply system that uses fossil fuel for heat production and thus causes emissions to the atmosphere.

The monitoring plan is designed for accurate and clear measurement and calculation of greenhouse gas emissions. Detailed information on parametrs monitored during the whole crediting period is provided in Section D of the PDD.

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

Baseline formation date: 01/06/2012
The baseline has been set by CEP Carbon Emissions Partners S.A., project developer, and its owner HNUE "Ternopilmiskteplokomunenergo".

HNUE "Ternopilmiskteplokomunenergo"
16 Ivana Franka St., 46001, Ternopil, Ukraine
Telephone +38 0352 25 25 39
Director
Chumak Andriy Kostyantynovych
E-mail: pta-teplo@tr.ukrtel.net
HNUE "Ternopilmiskteplokomunenergo" is the project participant (stated in Annex 1).

CEP Carbon Emissions Partners S.A.:
Route de Thonon 45, Geneva, Switzerland.
Fabian Knodel,
Director.
Telephone: +41 (76) 3461157
Fax: +41 (76) 3461157
E-mail: 0709bp@gmail.com

CEP Carbon Emissions Partners S.A. is the project participant (stated in Annex 1).

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project is 23/09/2004, when HNUE "Ternopilmiskteplokomunenergo" started implementation of measures to modernize the heat supply system in Ternopil city in the framework of JI project.

C.2. Expected operational lifetime of the project:

Expected operational lifetime of the project in years and months is 15 years or 180 months from 01/01/2005 to 31/12/2020.

C.3. Length of the crediting period:

The length of the crediting period in years and months is 15 years or 180 months. The date on which the first emission reductions are expected to be generated was taken as the starting date of the crediting period, namely 01/01/2005.

ERUs generation refers to the first commitment period of 5 years (01 January 2008 - December 31, 2012). Prolongation of the crediting period beyond 2012 is subject to approval by the host Party. Calculations of emission reductions are provided separately for the period before 2012 and after 2012.

If after the first commitment period under the Kyoto Protocol its validity is prolonged, the crediting period under the project will be prolonged by 8 years /96 months until December 31, 2020.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The proposed project uses a specific approach to JI projects based on requirements to JI projects according to paragraph 9 (a) of "Guidance on criteria for baseline setting and monitoring" (Version 03[42]).

The monitoring plan is designed for accurate and clear measurement and calculation of greenhouse gas emissions and is implemented according to practices established at HNUE "Ternopilmiskteplokomunenergo" for measurement of consumed natural gas and coal. Project monitoring does not require any changes in the existing system of data accounting and collection. All relevant data are calculated and recorded and stored within two years after transfer of the last emission reduction units generated by the project.

The monitoring plan includes measures (measurements, maintenance, registration and calibration), which should be implemented to satisfy the requirements of the chosen methodology of monitoring and guarantee the possibility of verification of calculation on GHG emission reductions. The main stages of the monitoring plan are described below.

Data and parameters not monitored throughout the whole crediting period, but determined only once, which are available at the stage of PDD development:

$FC_{b,NG}^{j}$	Total amount of natural gas consumption, in historical period «j», in the baseline scenario, ths m3;
$NCV_{b,NG}^{j}$	Net calorific value of natural gas, in historical period «j», in the baseline scenario, TJ/mln m3;
$EF_{b,C,NG}^{j}$	Carbon emission factor in the course of natural gas combustion , in historical period «j», in the baseline scenario, t C/TJ
$OXID_{b,NG}^{j}$	Carbon oxidation factor in the course of natural gas combustion, in historical period «j», in the baseline scenario, Relative units
$T_{out,b}^{j}$	Average outdoor temperature in heating historical period «j», oC
$T_{in,b}^{j}$	Average indoor temperature in heating historical period «j», oC
$n_{w,b}^{j}$	Average number of consumers, personal bills, in historical period «j», people
$N_{w,b}^{j}$	Duration of hot water supply service provision in historical period «j», h
$N_{h,b}^{j}$	Duration of heat supply service provision in historical period «j», h

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

[j] – index relating to historical period;
[b] - index corresponding to baseline scenario;
[h]- index relating to heating;
[w]- index relating to hot water supply;
[in] - index corresponding to indoor temperature;
[out]- index corresponding to outdoor temperature;
[NG] - index relating to natural gas.

Data and parameters that are not monitored during the crediting period but are identified only once and are not available at the PDD development stage: none

Data and parameters monitored during the whole crediting period:

$FC^{y}_{p,NG}$	Total amount of natural gas consumption, in monitoring period «y», in the project scenario, ths m3;
$NCV^{y}_{p,NG}$	Net calorific value of natural gas, in monitoring period «y», in the project scenario, TJ/mln m3;
$EF^{y}_{p,C,NG}$	Carbon emission factor in the course of natural gas combustion, in monitoring period «y», in the project scenario, t C /TJ
$OXID^{y}_{p,NG}$	Carbon oxidation factor in the course of natural gas combustion, in monitoring period «y», in the project scenario, Relative units
$T_{out,p}$	Average outdoor temperature during the heating period, oC
$T_{in,p}$	Average indoor temperature during the heating period, oC
$n_{w,p}$	Average number of consumers, personal bills, people
$N_{w,p}$	Duration of hot water supply service provision, h
$N_{h,p}$	Duration of heat supply service provision, h
$F_{h,p}$	Heated area, ths m2

[y] - index relating to monitoring period;
[p] - index relating to project scenario;
[h]- index relating to heating;
[w]- index relating to hot water supply;

[in] - index corresponding to indoor temperature;
[out]- index corresponding to outdoor temperature;
[NG] - index relating to natural gas.

Table of parameters to be included in the process of monitoring and ERU calculation verification is presented in Sections **D.1.1.1** and **D.1.1.3.**

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

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

Data/Parameter	$FC_{p,NG,i}^{y}$
Data unit	ths m^3
Description	Total amount of natural gas burnt by consumer, in monitoring period «y» абонентом «*i*»
Time of determination/monitoring	Monthly
Source of data (to be) used	Gas meters and energy resources and form N 11-MTP «Report on fuel, heat and electricity consumption»
Value of data applied (for ex ante calculations/determinations)	Subject to periodic monitoring.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement takes place by means of gas meters, department of fuel and energy resources reads the volume of natural gas calculators remotely on each boiler, the data entered in the form N 11-MTP «Report on fuel, heat and electricity consumption»
QA/QC procedures (to be) applied	Measurements are carried out by meters that regularly undergo calibration and verification in accordance with the procedures of quality management, the Law of Ukraine "On metrology and metrological activity."[43] The final results were entered in the official reports provided to the regulatory authorities, which checked these

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[43] http://www.ucrf.gov.ua/uk/doc/laws/1099563058/

	reports.
Any comment	Information on the amount of consumed fossil fuels is the basis for calculations of greenhouse gases, which is achived on paper and electronically.

Data/Parameter	$NCV^{y}_{p,NG}$
Data unit	TJ/mln m3
Description	Net calorific value of natural gas, in monitoring period «y» project scenario
Time of determination/monitoring	Annually
Source of data (to be) used	Company’s data. Information on net calorific value combustion of natural gas available in the certificate of HNUE «Ternopilmiskteplokomunenergo». Information on net calorific value combustion of coal available in certificates supplier.
Value of data applied (for ex ante calculations/determinations)	see table below
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A

	2004	2005	2006	2007
Natural gas, TJ/mln m3	33,58	33,79	33,79	33,79
	2008	2009	2010	2011
Natural gas, TJ/mln m3	33,93	33,83	33,87	33,78

Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

<table>
<tr><th>Data/Parameter</th><th>$EF_{p,C,NG}^{y}$</th></tr>
<tr><td>Data unit</td><td>t C/TJ</td></tr>
<tr><td>Description</td><td>Carbon emission factor in the course of natural gas combustion, in monitoring period «y» project scenario</td></tr>
<tr><td>Time of determination/monitoring</td><td>Annually</td></tr>
<tr><td>Source of data (to be) used</td><td>«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010»</td></tr>
<tr><td>Value of data applied (for ex ante calculations/determinations)</td><td>
<table>
<tr><td></td><td>2004</td><td>2005</td><td>2006</td><td>2007</td></tr>
<tr><td>Natural gas, t C/TJ</td><td>15,18</td><td>15,19</td><td>15,22</td><td>15,16</td></tr>
<tr><td></td><td>2008</td><td>2009</td><td>2010</td><td>2011</td></tr>
<tr><td>Natural gas, t C/TJ</td><td>15,17</td><td>15,17</td><td>15,20</td><td>15,17</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>According to “Guidance on criteria for baseline setting and monitoring”[44]</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat</td></tr>
<tr><td>Any comment</td><td>Data allowing for calculation of GHG; information will be archived in paper and electronic form</td></tr>
</table>

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

<table>
<tr><td>Data/Parameter</td><td>$OXID^{y}_{p,NG}$</td></tr>
<tr><td>Data unit</td><td>Relative units</td></tr>
<tr><td>Description</td><td>Carbon oxidation factor in the course of natural gas combustion, in monitoring period «y» project scenario</td></tr>
<tr><td>Time of determination/monitoring</td><td>Annually</td></tr>
<tr><td>Source of data (to be) used</td><td>«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010» [45]</td></tr>
<tr><td>Value of data applied (for ex ante calculations/determinations)</td><td>
<table>
<tr><td></td><td>2004</td><td>2005</td><td>2006</td><td>2007</td></tr>
<tr><td>Natural gas, Relative units</td><td>0,995</td><td>0,995</td><td>0,995</td><td>0,995</td></tr>
<tr><td></td><td>2008</td><td>2009</td><td>2010</td><td>2011</td></tr>
<tr><td>Natural gas, Relative units</td><td>0,995</td><td>0,995</td><td>0,995</td><td>0,995</td></tr>
</table>
</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>According to “Guidance on criteria for baseline setting and monitoring”[46]</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat</td></tr>
<tr><td>Any comment</td><td>Data allowing for calculation of GHG; information will be archived in paper and electronic form</td></tr>
</table>

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

[46] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.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):

Greenhouse gas (GHG) emissions in the project scenario:

$$PE_{p}^{y} = PE_{p,HEAT}^{y}, \qquad (D1)$$

$PE_{p,HEAT}^{y}$ - GHG emissions from fossil fuel combustion in the course of heat generation in monitoring period *y*, in the project scenario, (t CO_2eq);

[y]- index corresponding to monitoring period;

[p] - index corresponding to the project scenario;

[HEAT] - index relating to heat carrier supplied by a boiler house.

$$PE_{p,HEAT}^{y} = \frac{NCV_{p,NG}^{y} \cdot FC_{p,NG,i}^{y} \cdot EF_{p,CO2,NG}^{y}}{1000}, \qquad (D2)$$

$NCV_{p,NG}^{y}$ - net calorific value of natural gas, in monitoring period *y*, in the project scenario, TJ/ mln m^3;

$EF_{p,CO2,NG}^{y}$ - default carbon dioxide emission factor for stationary combustion of natural gas, in monitoring period *y*, in the project scenario, t CO_2/TJ;

$FC_{p,NG,i}^{y}$ - total amount of natural gas, combusted by consumer *i*, in monitoring period *y*, in the project scenario, ths m^3.

1000 – index to convert ths m^3 into million m^3;

[y]- index corresponding to monitoring period;

[p] - index corresponding to the project scenario;

[NG]- index corresponding to natural gas;

[i]- index corresponding to consumer;

[HEAT] - index relating to heat carrier supplied by a boiler house.

$$EF_{p,CO2,NG}^{y} = EF_{p,C,NG}^{y} \cdot OXID_{p,NG}^{y} \cdot \frac{44}{12}, \qquad (D3)$$

$EF_{p,C,NG}^{y}$ - carbon emission factor for Natural gas combustion, in monitoring period *y*, in the project scenario, (t C/TJ);

$OXID_{p,NG}^{y}$ - carbon oxidation factor for Natural gas combustion, in monitoring period *y*, in the project scenario, (relative units);

$\frac{44}{12}$ - stoichiometric ratio between CO_2 and C molecular masses, (t CO_2/t C);

[y]- index corresponding to monitoring period;

[p] - index corresponding to the project scenario;

[NG] - index relating to natural gas.

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:

Data/Parameter	$FC^{j}_{b,NG}$
Data unit	ths m^3
Description	Total amount of natural gas burnt by consumer, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	Gas meters and form N 11-MTP «Report on fuel, heat and electricity consumption»
Value of data applied (for ex ante calculations/determinations)	Refer to Supporting document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Measurement takes place by means of gas meters, department of fuel and energy resources reads the volume of natural gas calculators remotely on each boiler, the data entered in the form N 11-MTP «Report on fuel, heat and electricity consumption»
QA/QC procedures (to be) applied	Measurements are carried out by meters that regularly undergo calibration and verification in accordance with the procedures of quality management, the Law of Ukraine "On metrology and metrological activity."[47] The final results were entered in the official reports provided to the regulatory authorities, which checked these reports.
Any comment	Information on the amount of consumed fossil fuels is the basis for calculations of greenhouse gases, which is achived on paper and electronically.

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[47] http://www.ucrf.gov.ua/uk/doc/laws/1099563058/

Data/Parameter	$NCV_{b,NG}^{j}$
Data unit	TJ/mln m3
Description	Net calorific value of natural gas, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	Company's data. Information on net calorific value combustion of natural gas available in the certificate of HNUE «Ternopilmiskteplokomunenergo»Information on net calorific value combustion of coal available in certificates supplier.
Value of data applied (for ex ante calculations/determinations)	<table><tr><td></td><td>2004</td></tr><tr><td>Natural gas, TJ/mln m³</td><td>33,58</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form.

Data/Parameter	$EF_{b,C,NG}^{j}$
Data unit	t C/TJ
Description	Carbon emission factor in the course of natural gas combustion, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project

Source of data (to be) used	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010».[48]
Value of data applied (for ex ante calculations/determinations)	<table><tr><th></th><th>2004</th></tr><tr><td>Natural gas, t C/TJ</td><td>15,18</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures (to be) applied	According to “Guidance on criteria for baseline setting and monitoring” [49]
QA/QC procedures (to be) applied	National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	$OXID_{b,NG}^{j}$
Data unit	Relative units
Description	Carbon oxidation factor in the course of natural gas combustion, in historical period «j», in the baseline scenario
Time of determination/monitoring	Determined once and the begining of the project
Source of data (to be) used	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010» [50]
Value of data applied (for ex ante calculations/determinations)	<table><tr><th></th><th>2004</th></tr><tr><td>Hard coal (for population), TJ/ths t</td><td>0,956</td></tr></table>

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

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

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

	Natural gas, GJ/ths m3 | 0,995
Justification of the choice of data or description of measurement methods and procedures (to be) applied	According to "Guidance on criteria for baseline setting and monitoring"[51]
QA/QC procedures (to be) applied	National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine is an official report submitted to the UNFCCC secretariat
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	T_{out}
Data unit	^{o}C
Description	Average outdoor temperature during the heating period
Time of determination/monitoring	Once in the reporting period. The day temperature is recorded every day
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived

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

	in paper and electronic form

Data/Parameter	T_{in}
Data unit	^{o}C
Description	Average indoor temperature during the heating period
Time of determination/monitoring	Once in the reporting period
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	n_w
Data unit	people
Description	Average number of consumers, personal bills
Time of determination/monitoring	Once a year
Source of data (to be) used	Company's data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of	N/A

data or description of measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	N_w
Data unit	h
Description	Duration of hot water supply service provision in year
Time of determination/monitoring	Once a year
Source of data (to be) used	Company’s data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	N_h
Data unit	h
Description	Duration of heat supply service provision
Time of determination/monitoring	Once a year

Source of data (to be) used	Company’s data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

Data/Parameter	F_h
Data unit	ths m^2
Description	Heated area
Time of determination/monitoring	Once a year
Source of data (to be) used	Company’s data
Value of data applied (for ex ante calculations/determinations)	See Accompanying document 1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	N/A
QA/QC procedures (to be) applied	N/A
Any comment	Data allowing for calculation of GHG; information will be archived in paper and electronic form

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

Baseline GHG emissions:

$$BE_b^y = BE_{b\ ,HEAT}^y = \frac{NCV_{b,NG}^y \cdot EF_{b,CO2,NG}^y \cdot FC_{b,NG,i}^y}{1000}, \qquad \text{(D4)}$$

$NCV_{b,NG}^y$ - net calorific value of natural gas in monitoring period *y* in the baseline scenario, TJ/mln m^3;

$EF_{b,CO2,NG}^y$ - default carbon dioxide emission factor for stationary combustion of Natural gas in monitoring period *y* in the baseline scenario (t CO_2/TJ);

$FC_{b,NG,i}^y$ - total amount of natural gas, which would have been combusted by consumer *i*, in monitoring period *y* in the baseline scenario, ths m^3;

1000 – index to convert ths m^3 into million m^3.

[y]- index corresponding to monitoring period;

[b] - index corresponding to baseline scenario;

[NG]- index corresponding to natural gas;

[i]- index relating to consumer;

[HEAT] - index relating to heat carrier supplied by a boiler house.

$$EF_{b,CO2,NG}^y = EF_{b,C,NG}^y \cdot OXID_{b,NG}^y \cdot \frac{44}{12} \qquad \text{(D5)}$$

$EF_{b,C,NG}^y$ - carbon emission factor for natural gas combustion in monitoring period *y* in the baseline scenario, t C/TJ;

$OXID_{b,NG}^y$ - carbon oxidation factor for natural gas combustion in monitoring period *y* in the baseline scenario, relative units;

$\frac{44}{12}$ - stoichiometric ratio between CO_2 and C molecular masses, (t CO_2/t C);

[y]- index corresponding to monitoring period;

[b] - index corresponding to baseline scenario;

[NG]- index corresponding to natural gas;

According to Dynamic Baseline assumption, the value of $BE_{b,HEAT}^y$ may vary:

$$BE_{b,HEAT}^y = BE_{b,HEAT,h}^y + BE_{b,HEAT,w}^y, \qquad \text{(D6)}$$

$BE_{b,HEAT,h}^{y}$ - emissions from fossil fuel combustion for heat generation for heating in monitoring period *y* in the baseline scenario, (t CO_2eq);

$BE_{b,HEAT,w}^{y}$ - emissions from fossil fuel combustion for heat generation for hot water supply in monitoring period *y* in the baseline scenario, (t CO_2eq).

For the cases when hot water supply existed in the baseline period (irrelevant of the service duration, ($1-a_b \neq 0$), the following formula is used for $BE_{b,HEAT}^{y}$:

$$BE_{b,HEAT}^{y} = \frac{NCV_{b,NG}^{j} \cdot EF_{b,CO2,NG}^{j} \cdot \left\lfloor FC_{b,NG}^{j} \cdot a_b^j \cdot K_1 \cdot K_h + FC_{b,HEAT}^{j}\left(1-a_b^j\right)\cdot K_1 \cdot K_w \right\rfloor}{1000}, \qquad (D7)$$

For the cases when no hot water supply existed in the baseline period (($1-a_b$) = 0), and hot water supply only started in the reporting period (thanks to the improved heat supply services), the following formula is used:

$$BE_{b,HEAT}^{y} = \frac{NCV_{b,NG}^{j} \cdot EF_{b,CO2,NG}^{j} \cdot \left\lfloor FC_{b,NG}^{j} \cdot a_b^j \cdot K_1 \cdot K_h + FC_{p,NG}^{y}\left(1-a_p^y\right)\cdot K_1 \cdot K_{w0} \right\rfloor}{1000} \qquad (D8)$$

$NCV_{b,NG}^{j}$ - net calorific value of Natural gas in monitoring period *y* in the baseline scenario, GJ/t (GJ/ths m^3);

$EF_{b,CO2,NG}^{j}$ - default CO_2 emission factor for stationary combustion of Natural gas in monitoring period *y* in the baseline scenario (t CO_2/TJ);

$FC_{b,NG}^{j}$ - total amount of natural gas, which would have been combusted by consumer *i*, in monitoring period *y* in the baseline scenario, ths m^3 (t).

$FC_{p,NG}^{y}$ - total amount of natural gas, which would have been combusted by consumer *i*, in monitoring period *y* of the project scenario, ths m^3 (t);

K_1, K_h, K_w, K_{w0} – adjustment factors;

a_b^j – part of fuel (heat) consumed for heating;

$(1-a_b^j)$ – part of fuel (heat) consumed for hot water supply.

1000 – index to convert ths m^3 into million m^3.

$$a_b^j = L_{h,b}^{j} \cdot g \cdot N_{h,b}^{j} / (L_{h,b}^{j} \cdot g \cdot N_{h,b}^{j} + L_{w,b}^{j} \cdot N_{w,b}^{j}), \qquad (D9)$$

$L_{h,b}^{j}, L_{w,b}^{j}$ – maximum load for heating and hot water supply services, MW;

g – factor for recalculation of the average heat load during heating period (defined for every boiler house individually on historical basis (usually 0.4-0.8);

$N_{h,b}^{j}, N_{w,b}^{j}$ – duration of heating period and period of hot water supply services;

[j]- index corresponding to historical period;

[b] - index corresponding to baseline scenario;

[p]- index corresponding to the project scenario;
[NG]- index corresponding to natural gas;
[h]- index relating to heating;
[w]- index relating to hot water supply;
[HEAT] - index relating to heat carrier supplied by a boiler house.

Adjustment factors:

$$K_1 = NCV_{b,NG}^{j} / NCV_{p,NG}^{y} \quad , \qquad \text{(D10)}$$

K_1 - factor of the change of net calorific value of fossil fuel.

$NCV_{b,NG}^{j}$ - net calorific value of natural gas in historical period j in the baseline scenario, TJ/mln m^3;

$NCV_{p,NG}^{y}$ - net calorific value of natural gas in monitoring period *y* in the project scenario, TJ/mln m^3;

To establish the Dynamic Baseline that takes into account external factors such as weather conditions, heated area, etc., adjustment factor for heating should be used.

The amount of fuel consumed for heating is proportional to the necessary amount of heat in heating period Q_h:

$$FC_{b,NG\,h}^{y} = FC_{b,NG,i}^{y} \cdot a = Q_h * 3{,}6 / NCV_{b,NG}^{y} \cdot \eta_h \, , \qquad \text{(D11)}$$

$FC_{b,NG,h}^{y}$ - total amount of natural gas, which would have been combusted by consumer *i* for heating, in monitoring period *y* in the baseline scenario, ths m^3 (t).

$FC_{b,NG,i}^{y}$ - total amount of natural gas, which would have been combusted by consumer *I* , in monitoring period *y* in the baseline scenario, ths m^3, (t).

Q_h - necessary heat for heating, kWh;
3,6 – factor of kWh into MJ conversion;
a – part of fuel (heat) consumed for heating;

$NCV_{b,NG}^{y}$ - net calorific value of natural gas in monitoring period *y* in the baseline scenario, GJ/ths m^3 (GJ/t);

η_h – overall boiler-house efficiency.

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

$$Q_{h,b,p} = Q_{h,b} * K_h = Q_{h,p}, \qquad \text{(D12)}$$

$Q_{h,b,p}$ – necessary heat for the Dynamic Baseline, assumed as equal to $Q_{p,}$;
Q_{hp} – necessary heat for reporting period;
$Q_{h,b}$ – necessary heat for the baseline period;
K_h – average adjustment factor for heating.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[h]- index relating to heating;

This equasion allows us to determine the average adjustment factor:
$K_h = Q_{h,p} / Q_{h,b}$, (D13)
Q_{hp} – necessary heat for reporting period, kWh;
$Q_{h,b}$ – necessary heat for the baseline period, kWh;

The necessary amount of heat for heating of premises during the year, according to the “Standards and standardization guidelines for fuel and heat consumption for heating of residential and public buildings as well as for public and utility needs in Ukraine. KTM 204 Ukraine 244-94”, (formula 2.17):
$Q_h = F_h * K_h * (T_{in} - T_{out}) * N_h$, (D14)

Q_h – necessary amount of heat for heating, kWh;
F_h – heated area in premises, m^2;
K_h – average heat exchange coefficient for buildings, $kW/m^{2} * {}^{0}C$;
T_{in} – average indoor temperature in the heating period, ${}^{0}C$;
T_{out} – average outdoor temperature in the heating period, ${}^{0}C$;
N_h – duration of the heating period per year, h.
[in] - index corresponding to indoor temperature;
[out]- index corresponding to outdoor temperature;
[h]- index relating to heating;
[p]- index corresponding to the project scenario;

Therefore:
$K_h = (F_{h,p} * K_{h,p}) * (T_{in,p} - T_{out,p}) * N_{h,p} \; / \; F_{h,b} * K_{h,b} * (T_{in,b} - T_{out,b}) * N_{h,b}$, (D15)

Temperature change factor:

$K_2=(T_{in,p} - T_{out,p}) / (T_{in,b} - T_{out,b})$, (D16)

Heated area and thermal insulation change factor:

$K_3 = (F_{h,p} * k_{h,p}) / F_{h,b} * K_{h,b} = [(F_{h,n,p} – F_{h,t,p} – F_{h,n,p}) * K_{h,b} + (F_{h,n,p} + F_{h,t,p}) * K_{h,n}] / F_{h,b} * K_{h,b}$, (D17)

$F_{h,b}$ – heated area in premises in the baseline period, m^2;

$F_{h,p}$ – heated area in premises in the reporting period, m^2;

$F_{h,n,p}$ – heated area of new buildings connected to the heat supply system (assumed, with new improved thermal insulation) in the reporting period, m^2;

$F_{h,t,p}$ – heated area of buildings (existing in the baseline year) in the reporting period with improved thermal insulation, m^2;

$K_{h,b}$ – average heat exchange coefficient for buildings in the baseline year, kW/m^2*K;

$K_{h,p}$ – average heat exchange coefficient for buildings in the reporting year, kW/m^2*K;

$K_{h,n}$ – heat exchange factor of heated buildings with new thermal insulation (new or old buildings with new thermal insulation), kW/m^2*K;

[in] - index corresponding to indoor temperature;

[out]- index corresponding to outdoor temperature;

[h]- index relating to heating;

[b] - index corresponding to baseline scenario;

[p]- index corresponding to the project scenario;

Coefficient of the change of heating period duration:

$K_4 = N_{h,p} / N^j_{h,b}$, (D18)

$N^j_{h,b}$ – duration of heating period in the baseline period, h;

$N_{h,p}$ – duration of heating period in the reporting period, h.

[h]- index relating to heating;

[p]- index corresponding to the project scenario;

[b] - index corresponding to baseline scenario;

Thus,

$K_h = K_2 * K_3 * K_4$, (D19)

To establish the Dynamic Baseline that takes into account external factors such as weather conditions, number of consumers, etc., adjustment factor for hot water supply should be used.

The amount of fuel consumed for hot water supply is proportional to the necessary amount of heat in the period of service provision, Q_w:

$$FC^{y}_{b,NG,w} = FC^{y}_{b,NG,i} \cdot (1-a) = Q_w \cdot 3{,}6 / NCV^{y}_{b,NG} \cdot \eta_w , \qquad \text{(D20)}$$

$FC^{y}_{b,NG,i,w}$ - total amount of naureal gas, which would have been combusted by consumer *i* for hot water, in monitoring period *y* in the baseline scenario, ths m^3.

$FC^{y}_{b,NG,i}$ - total amount of natural gas, which would have been combusted by consumer *i* , in monitoring period *y* in the baseline scenario, ths m^3.

Q_h – necessary heat for hot water supply, kWh;
3,6 – factor of kWh into MJ conversion;
a – part of fuel (heat) consumed for heating;

$NCV^{y}_{b,NG}$ - net calorific value of natural gas in monitoring period *y* in the baseline scenario, GJ/ths m^3 (GJ/t);

η_w – overall hot water system efficiency.

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

$Q_{w,b,p} = Q_{w,b}*K_w = Q_{w,p}$, (D21)

$Q_{w,b,p}$ – necessary amount of heat for hot water supply for the Dynamic Baseline, assumed to be equal to $Q_{w,p}$;
$Q_{w,p}$ – necessary amount of heat for hot water supply in the reporting period;
$Q_{w,b}$ – necessary amount of heat for hot water supply in the baseline period;
K_w – average adjustement coefficient for hot water supply.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[h]- index relating to heating;
[w]- index relating to hot water supply;

This equasion allows us to determine the average adjustment coefficient:

$K_w = Q_{w,p} / Q_{w,b}$, (D22)

Kw component can be determined by correlation of heat used for hot water supply in the baseline and reporting periods:

$Q_w = n_w*v_w*N_w$, (D23)

Q_w – Necessary amount of heat for hot water supply, kWh;
n_w – average number of consumers, individual accounts;
v_w – standard specific hot water consumption per individual account (in thermal units, kWh/h);
N_w – duration of service provision per year, h.

[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[w]- index relating to hot water supply;

Thus:

$K_w = n_{w,p} * v_{w,p} * N_{w,p} / n_{w,b} * v_{w,b} * N_{w,b}$, (D24)

Coefficient of the change of the number of consumers:

$K_5 = n_{w,p} / n^{j}_{w,b}$, (D25)

Coefficient of the change of standard specific hot water consumption per individual account:

$K_6 = v_{w,p} / v_{w,b}$, (D26)

At the moment, standard specific hot water consumption proposed in KTM 204 Ukraine 244-94 in 1993 is effective. There is no information concerning changes, therefore $K_6 = 1$ and is not subject to special monitoring.

Coefficient of the change of the duration of the period of hot water supply services:

$K_7 = N_{w,p} / N_w$, (D27)

$N_{w,b}$ – duration of the period of hot water supply services in the baseline period, h;
$N_{w,p}$ – duration of the period of hot water supply services in the reporting period, h.
[b] - index corresponding to baseline scenario;
[p]- index corresponding to the project scenario;
[w]- index relating to hot water supply;

Thus,

$K_w = K_5 * K_6 * K_7$, (D28)

Adjustment coefficients for hot water supply in the case when there was no hot water supply in the baseline period, but the service was provided in the reporting period:

In the case when there was no hot water supply in the baseline period, number of consumers, standard specific hot water consumption, duration of the period of hot water supply services in the baseline year are assumed to be equal to the corresponding values in the reporting period,

K5 = K6 = K7 = 1, (D29)

Therefore

Kw0=1, (D30)

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

N/A

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):

N/A

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

According to selected specific approach based upon the requirements of JI projects in accordance with paragraph 9 (a) Guidance on criteria for baseline setting and monitoring for Joint Implementation, Version 03 (JI Guidance on criteria for baseline setting and monitoring, Version 03) approved methodology AM0044 version 1.0 "energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating» («Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors» - Version 1.0 »), leakage is not expected.

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

N/A

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

N/A

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):

Quantity of Emission Reduction Units (ER), t CO_2e:

$$ER^y = BE_b^y - PE_p^y \quad , \qquad (D31)$$

ER^y – emission reductions due to the project activity in monitoring period «y» (t CO_2eq);

BE_b^y – total estimated GHG emissions in monitoring period «y» in the baseline scenario (t CO_2eq);

PE_p^y – total estimated GHG emissions in monitoring period «y» in the project scenario (t CO_2eq);

[y] – index that corresponds to monitoring period;
[p] – index that corresponds to the project scenario;
[b] – index that corresponds to the baseline scenario.

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

The main legislative acts of Ukraine concerning the monitoring of the environmental impact of business entities are:

- Law of Ukraine № 1264-XII «On environmental protection”[52] dated 25/06/1991;
- Law of Ukraine № 2707-XII «On atmospheric air protection»[53] dated 16/10/1992.
- Current rules on emission limitation: «Norms of maximum permissible emissions of pollutants from permanent sources» – approved by the Ministry of Environmental Protection of Ukraine dated 27/06/2006, №309 and registered in the Ministry of Justice of Ukraine dated 01/09/2006, №912/12786.

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.
$FC^{j}_{b,NG}$	Low	Calibration of accounting and metering devices is carried out according to manufacturer's instructions, approved methodologies of verification / calibration of metering equipment and also in accordance with the national standards of Ukraine;
$FC^{y}_{p,NG,i}$	Low	Calibration of accounting and metering devices is carried out according to manufacturer's instructions, approved methodologies of verification / calibration of metering equipment and also in accordance with the national standards of Ukraine;
$NCV^{j}_{b,NG}$	Low	Information on net calorific value combustion of natural gas available in the certificate of HNUE «Ternopilmiskteplokomunenergo» Information on net calorific value combustion of coal available in certificates supplier.
$NCV^{y}_{p,NG}$	Low	Information on net calorific value combustion of natural gas available in the certificate of HNUE «Ternopilmiskteplokomunenergo» Information on net calorific value combustion of coal available in certificates supplier.
$EF^{j}_{b,C,NG}$	Low	Carbon emission factor for natural gas combustion is determined according to the “National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine in 1990-2010”, issued by the State Environmental Investment Agency of Ukraine. This document is subject to periodic review and adding of actual data thereto.
$EF^{y}_{p,C,NG}$	Low	Carbon emission factor for natural gas combustion is determined according to the “National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine in 1990-2010”, issued by the State Environmental Investment Agency of Ukraine. This document is subject to periodic review and adding of actual data thereto.

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[52] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1264-12

[53] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2707-12

$OXID_{b,NG}^{j}$	Low	Carbon oxidation factor for natural gas combustion is determined according to the “National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine in 1990-2010”, issued by the State Environmental Investment Agency of Ukraine. This document is subject to periodic review and adding of actual data thereto.
$OXID_{p,NG}^{y}$	Low	Carbon oxidation factor for natural gas combustion is determined according to the “National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine in 1990-2010”, issued by the State Environmental Investment Agency of Ukraine. This document is subject to periodic review and adding of actual data thereto.
T_{out}	Low	Calibration of accounting and metering devices is carried out according to manufacturer's instructions, approved methodologies of verification / calibration of metering equipment and also in accordance with the national standards of Ukraine;
T_{in}	Low	Calibration of accounting and metering devices is carried out according to manufacturer's instructions, approved methodologies of verification / calibration of metering equipment and also in accordance with the national standards of Ukraine;
n_w	Low	Statistical data. Quality assurance is not needed.
N_w	Low	Statistical data. Quality assurance is not needed.
N_h	Low	Statistical data. Quality assurance is not needed.
F_h	Low	Statistical data. Quality assurance is not needed.

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

HNUE «Ternopilmiskteplokomunenergo» for the needs of industrial activity consumes natural gas. All energy consumption is accounted with using commercial devices accounting figures which serves as sources of data of consumption.

According to the structure of the company responsible for the organization of service of collecting, verifying, processing and clearance in accordance with the approved form is a Department of Heat Inspection (DHI).

Data on consumption of natural gas are processed by DHI daily from 8.00 am. to 12.00-15.00 pm. based on operative information of operators, masters, senior masters of boiler houses as of 23.00 hours of the previous day, which is provided to dispatchers of emergency dispatch service (EDS) or directly to engineers DHI.

Accounting for energy resources is conducted by DHI.:

- Daily in electronic form;
- The reporting period (month / year) in electronic and documentary form.

Responsible for collecting information:

- Heads of heating districts;
- About gas, if necessary, gas service and TRC;

Compile data and reports prepare - DHI responsibility.

On the consumption of energy resources on targets in displays of sealed metering (including indicators, differences of performance and organic volume) documented bilateral Reports of JSC "Ternopilmiskhaz" on which the relevant Acts and bills is issued.

DHI prepares statistical reports regarding consumption of energy resources and heat production under specified forms, namely 11-MTP.

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

The monitoring plan is determined by the project developer, CEP Carbon Emissions Partners S.A., and HNUE "Ternopilmiskteplokomunenergo".

HNUE "Ternopilmiskteplokomunenergo"
16 Ivana Franka St., 46001, Ternopil, Ukraine
Telephone +38 0352 25 25 39
Director
Chumak Andriy Kostyantynovych
E-mail: pta-teplo@tr.ukrtel.net
HNUE "Ternopilmiskteplokomunenergo" is the project participant (stated in Annex 1).

CEP Carbon Emissions Partners S.A.:
Route de Thonon 45, Geneva, Switzerland.
Fabian Knodel,
Director.
Telephone: +41 (76) 3461157
Fax: +41 (76) 3461157
E-mail: 0709bp@gmail.com

CEP Carbon Emissions Partners S.A. is the project participant (stated in Annex 1).

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Estimation of project emissions was made according to the formulas given in Section D.1.1.2.
Results of calculations are given in tables below. The calculations are presented in Supporting Document 1.1 attached to PDD.
Estimated project emissions for the period of 2005-2011 are calculated using actual data of HNUE "Ternopilmiskteplokomunenergo" on fossil fuel consumption; for the period of 2012-2020 estimated data according to the company strategic development plan were used.

Table 11. Estimated project emissions for the period January 1, 2005 – December 31, 2007

Year	Project emissions (tonnes of CO2 equivalent)
2005	185 498
2006	181 579
2007	169 147
Total project emissions over the crediting period 2005-2007 (tonnes of CO_2 equivalent)	**536 224**

Table 12. Estimated project emissions for the period January 1, 2008 – December 31, 2012

Year	Project emissions (tonnes of CO_2 equivalent)
2008	151 999
2009	153 465
2010	164 968
2011	152 240
2012	152 240
Total project emissions over the crediting period from 2008 to 2012 (tonnes of CO_2 equivalent)	**774 912**

*Table 13***.** *timated project emissions for the period January 1, 2013 - December 31, 2020*

Year	Project emissions (tonnes of CO_2 equivalent)
2013	152 240
2014	152 240
2015	152 240
2016	152 240
2017	152 240
2018	152 240
2019	152 240
2020	152 240
Total project emissions over the crediting period from 2013 to 2020 (tonnes of CO_2 equivalent)	**1 217 920**

E.2. Estimated leakage:

No leakage is expected.

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

No leakage is expected.

E.4. Estimated baseline emissions:

Estimation of baseline emissions was made according to the formulae given in Section D.1.1.4.

Results of calculations are given in tables below. The calculations are presented in Supporting Document 1 attached to the PDD.
Estimated baseline GHG emissions for the period of 2005-2011 are calculated by taking ex-post data of fossil fuel consumed by HNUE "Ternopilmiskteplokomunenergo", for the period of 2012-2020 predicted data according to the company development plan were used.

Table 14. Estimated baseline emissions for the period January 1, 2005 – December 31, 2007

Year	Estimated baseline emissions (tonnes of CO_2 equivalent)
2005	328 657
2006	328 544
2007	317 605
Total baseline emissions over the crediting period 2005-2007 (tonnes of CO_2 equivalent)	**974 806**

Table 15. Estimated baseline emissions for the period January 1, 2008 року – December 31, 2012

Year	Estimated baseline emissions (tonnes of CO_2 equivalent)
2008	301 682
2009	316 083
2010	334 485
2011	323 428
2012	323 428
Total baseline emissions over the crediting period from 2008 to 2012 (tonnes of CO2 equivalent)	**1 599 106**

Table 16. Estimated baseline emissions for *the period January 1, 2013 - December 31, 2020*

Year	Estimated baseline emissions (tonnes of CO_2 equivalent)
2013	323 428
2014	323 428
2015	323 428
2016	323 428
2017	323 428
2018	323 428
2019	323 428
2020	323 428
Total baseline emissions over the crediting period from 2013 to 2020 (tonnes of CO_2 equivalent)	**2 587 424**

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

Emission reductions were calculated according to the formula (D.13) provided in Section D.1.1.4. Results of calculations are given in tables below. The calculations are presented in Supporting Document 1 attached to the PDD.

Table 17. Estimated emission reduction for the period from January 1, 2005– December 31, 2007

Year	Estimated emission reduction (tonnes of CO_2 equivalent)
2005	143 158
2006	146 965
2007	148 457
Total estimated emission reduction over the crediting period 2005-2007 (tonnes of CO_2 equivalent)	**438 580**

Table 18. Estimated emission reduction for the period from January 1, 2008 – December 31, 2012

Year	Estimated emission reduction (tonnes of CO_2 equivalent)
2008	149 683
2009	162 618
2010	169 516
2011	171 188
2012	171 188
Total estimated emission reduction over the crediting period from 2008 to 2012 (tonnes of CO_2 equivalent)	**824 193**

Table 19. Estimated emission reduction for the period January 1, 2013 - December 31, 2020

Year	Estimated emission reduction (tonnes of CO_2 equivalent)
2013	171 188
2014	171 188
2015	171 188
2016	171 188
2017	171 188
2018	171 188
2019	171 188
2020	171 188
Total estimated emission reduction over the crediting period from 2013 to 2020 (tonnes of CO_2 equivalent)	**1 369 504**

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

Table 20. Table containing results of estimation of emission reduction for the period from January 1, 2005 to December 31, 2007.

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reduction (tonnes of CO_2 equivalent)
2005	185 498	0	328 657	143 158
2006	181 579	0	328 544	146 965
2007	169 147	0	317 605	148 457
Total estimated emission reduction (tonnes of CO_2 equivalent)	**536 224**	**0**	**974 806**	**438 580**

Table 21. Table containing results of estimation of emission reduction for the period from January 1, 2008, to December 31, 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 reduction (tonnes of CO_2 equivalent)
2008	151 999	0	301 682	149 683
2009	153 465	0	316 083	162 618
2010	164 968	0	334 485	169 516
2011	152 240	0	323 428	171 188
2012	152 240	0	323 428	171 188
Total estimated emission reduction (tonnes of CO_2 equivalent)	**774 912**	**0**	**1 599 106**	**824 193**

Table 22. Table containing results of estimation of emission reduction for the period from January 1, 2013, to December 31, 2020

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 reduction (tonnes of CO_2 equivalent)
2013	152 240	0	323 428	171 188
2014	152 240	0	323 428	171 188
2015	152 240	0	323 428	171 188
2016	152 240	0	323 428	171 188
2017	152 240	0	323 428	171 188
2018	152 240	0	323 428	171 188
2019	152 240	0	323 428	171 188
2020	152 240	0	323 428	171 188

Total estimated emission reduction (tonnes of CO_2 equivalent)	**1 217 920**	**0**	**2 587 424**	**1 369 504**

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 legislation, projects of new construction, reconstruction and technical reequipment of industrial and public facilities must include Environmental Impact Assessment (EIA), the basic requirements of which are listed in the State building norms of Ukraine A.2.2-1-2003. "Structure and Content of Impact Assessment (EIA) for the design and construction of enterprises, buildings and structures."

HNUE "Ternopilmiskteplokomunenergo" has the necessary Environmental Impact Assessment for its activity in accordance with Ukrainian law. In general the project «Modernization of the heat supply system of Ternopil city» will have a positive impact on the environment.

Transboundary impacts of the project activity according to their definition in the text ratified by Ukraine "Convention on Transboundary Pollution at a great distance," does not take place.

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 water medium

There is influence on water medium. Existing technologies of heat energy production exploited at the facilities of HNUE "Ternopilmiskteplokomunenergo" provide for sewage disposal to drainage network subject to compulsory chemical control. It is provided for in accordance with the Water Code of Ukraine, State Standard 28.74-82 “Hygiene Rules and Quality Control”, Building Standards and Rules 4630-92 in relation to determination of maximum permissible concentration for internal water objects. There will be no discharge of sewage to surface water bodies..

Project implementation will have positive effect. It will enable to decrease water consumption and quantity of waste waters as a result. Decrease in water consumption will be due to replacement of heat distribution networks, that in turn will decrease water leakages from the network. Decrease in waste waters will be due to rehabilitation of heat supply network reducing blows and emergency areas.

Impact on air

The project implementation will have positive effect on ambient air:
1) Reduction of NO_x, SO_x, CO emissions and solid particles due to application of more environmental friendly clean technologies in boiler-houses;
2) Decrease of heat pollution of the atmosphere (due to decrease of the temperature of combustion gases);
3) Emissions reduction per unit of fuel subject to equal loading of boiler-houses.

Impact on land use.

There is no impact on the land/soil.

Waste generation, their treatment and disposal

In the process of project implementation the generation of waste will occur after assembling of worn-out and obsolete equipment, burners, pipes, etc. Also there some construction waste will be formed due to dismantling of boilers and construction of biler-houses, etc. Utilization of old equipment will have positive effect on the environment.

According to the Ukrainian Law "On wastes»[54], (Article 17) «Obligations of business entities' activity in the sphere of wastes disposal»:
- enterprises shall produce the report about formation, collection, transportation, storage, treatment, utilization, destruction and removal of wastes.
- to ensure complete collection, appropriate storage and prevention of wastes deterioration, for utilization of which there is corresponding technology in Ukraine.

It is planned to carry out the following measures in the process of construction work to reduce the negative impact on land resources:
- Disposal of solid waste, not hazardous industrial waste (4th class of danger);
- Recycling;
- Disposal of waste fluorescent lamps;
- Utilization of oil and grease, motor damaged or waste, materials for filtering waste, materials cleaning cloths spoiled, or contaminated waste, solid particles, oil, vodovidokremlyuvachiv, tires damaged, used or damaged, used metal packaging (cans of paint on), waste rubber, oil seals waste, waste PTFE;
- Disposal of used batteries, scrap non-ferrous metals;
- Removal of waste.

Effects on biodiversity

There is no impact on biodiversity.

We may conclude that «Modernization of the heat supply system of Ternopil city» doesn't cause any negative impact on the environment.

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[54] http://zakon2.rada.gov.ua/laws/show/187/98-вр

SECTION G. Stakeholders' comments

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

In pursuance of requirements of Art. 18 of the Law of Ukraine "On planning and development of areas"[55] and Art. 11 of the Law of Ukraine "On ecological expertise"[56], HNUE "Ternopilmiskteplokomunenergo" informs the public through local media on the implementation of area planning .

All obtained comments related to the project implementation were positive. Negative comments and critical comments relating to the project were not made.

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[55] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1699-14

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

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Heating Network Utility Enterprise "Ternopilmiskteplokomunenergo"
Street/P.O.Box:	Ivana Franka St.
Building:	16
City:	Ternopil
State/Region:	Ternopil region
Postal code:	46001
Country:	Ukraine
Phone:	+38 0352 25 25 39
Fax:	+38 0352 25 25 39
E-mail:	pta-teplo@tr.ukrtel.net
URL:	
Represented by:	
Title:	Director
Salutation:	
Last name:	Chumak
Middle name:	Kostyantynovych
First name:	Andriy
Department:	
Phone (direct):	
Fax (direct):	+38 0352 25 25 39
Mobile:	
Personal e-mail:	pta-teplo@tr.ukrtel.net

Project developer and consultant:

Organisation:	CEP Carbon Emissions Partners S.A.
Street/ P.O. Box:	Route de Thonon
Building:	52
City:	Geneva
State/Region:	
Postal code:	Case postale 170 CH-1222 Vésenaz
Country:	Switzerland
Phone:	+41 (76) 3461157
Fax:	+41 (76) 3461157
E-mail:	0709bp@gmail.com
URL:	
Represented by:	
Title	Director
Salution	
Last Name	Knodel
Middle name:	
First Name:	Fabian
Department:	
Phone (direct):	+41 (76) 3461157
Fax (direct):	
Mobile:	
Personal e-mail	

Potential ERUs purchaser

Organisation:	EVO CARBON TRADING SERVICES LTD
Street/P.O.Box:	High Road
Building:	869
City:	London
State/Region:	
Postal code:	N12 8QA
Country:	UK
Phone:	+ 44 7500828771
Fax:	+ 44 7500828771
E-mail:	negorova@evocarbontrading.co.uk
URL:	www.evocarbontrading.co.uk
Represented by:	
Title:	Director
Salutation:	
Last name:	Egorova
Middle name:	
First name:	Natalia
Department:	
Phone (direct):	+ 44 7500828771
Fax (direct):	
Mobile:	
Personal e-mail:	

ANNEX 2

BASELINE INFORMATION

The baseline was set according to a specific approach to the Joint Implementation (JI) projects, relying on " Guidance on criteria for baseline setting and monitoring " (Version 03) [57] of Joint Implementation Supervisory Committee.

Key information for determining the baseline is presented in the tables below.

Parameter	Description of the parameter	Value (for the fixed parameter)	Source of data
$FC_{b,NG}^{j}$	Total amount of Natural gas consumption, in historical period «j», in the baseline scenario, ths m^3	Refer to Section B 1.	Measurement takes place by means of gas meters, department of fuel and energy resources reads the volume of natural gas calculators remotely on each boiler, the data entered in the form N 11-MTP «Report on fuel, heat and electricity consumption»
$NCV_{b,NG}^{j}$	Net calorific value of natural gas, in historical period «j», in the baseline scenario, TJ/mln m^3	Refer to Section B 1.	Company's data. Information on net calorific value combustion of natural gas available in the certificate of PJSC "Ternopilmiskgas".
$OXID_{b,NG}^{j}$	Carbon oxidation factor in the course of Natural gas combustion, in historical period «j», in the baseline scenario, Relative units	Refer to Section B 1.	Carbon oxidation factor when combusting fossil fuel is used to determine on default carbon dioxide emission factor for stationary combustion of fossil fuels in Ukraine. The data source for this parameter is the the «National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010» [58]
$EF_{b,C,NG}^{j}$	Carbon emission factor in the course of natural gas combustion, in historical period «j», in the baseline scenario, t C/ TJ	Refer to Section B 1.	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010» [59]

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

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

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

T_{out}	Average outdoor temperature during the heating period, ^{o}C	Refer to Section B 1.	Company's data
T_{in}	Average indoor temperature during the heating period, ^{o}C	Refer to Section B 1.	Company's data
n_w	Number of consumers of hot water, people	Refer to Section B 1.	Company's data
N_w	Duration of hot water supply service provision, h	Refer to Section B 1.	Company's data
N_h	Duration of heat supply service provision, h	Refer to Section B 1.	Company's data
F_h	Heated area, ths m^2	Refer to Section B 1.	Company's data

The baseline is set by using the specific approach based on approved methodology AM0044 «Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors»- Version 1.0»[60].

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[60] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5

Annex 3

MONITORING PLAN

The proposed project uses a specific approach to JI projects based on requirements to JI projects according to paragraph 9 (a) of "Guidance on criteria for baseline setting and monitoring" (Version 03) [61].

The monitoring plan is designed for accurate and clear measurement and calculation of greenhouse gas emissions and is implemented according to practices established at HNUE "Ternopilmiskteplokomunenergo" for measurement of consumed natural gas and coal. Project monitoring does not require any changes in the existing system of data accounting and collection. All relevant data are calculated and recorded and stored within two years after transfer of the last emission reduction units generated by the project.

The monitoring plan includes measures (measurements, maintenance, registration and calibration), which should be implemented to satisfy the requirements of the chosen methodology of monitoring and guarantee the possibility of verification of calculation on GHG emission reductions. The main stages of the monitoring plan are described below.

1. Identification of all potential sources of emissions within the project.
2. Collection of information on greenhouse gas emissions within the project during the crediting period.
3. Evaluation of the project schedule.
4. Gathering information on metering devices and their calibration.
5. Collection and archiving of information on the environmental impact of the project.
6. Data archiving.
7. Determining the structure of responsibility for the project monitoring.
8. Analysis of organization of personnel training.

Data and parameters monitored during the whole crediting period:

$FC^{y}_{p,NG}$	Total amount of natural gas consumption, in monitoring period «y», in the project scenario, ths m^3
$NCV^{y}_{p,NG}$	Net calorific value of natural gas, in monitoring period «y», in the project scenario, TJ/mln m3
$EF^{y}_{p,C,NG}$	Carbon emission factor in the course of natural gas combustion, in monitoring period «y», in the project scenario, tC /TJ
$OXID^{y}_{p,NG}$	Carbon oxidation factor in the course of natural gas combustion, in monitoring period «y», in the project scenario, Relative units
$T_{out,p}$	Average outdoor temperature during the heating period, ^{o}C
$T_{in,p}$	Average indoor temperature during the heating period, ^{o}C
$n_{w,p}$	Number of consumers of hot water, people
$N_{w,p}$	Duration of hot water supply service provision, h
$N_{h,p}$	Duration of heat supply service provision, h
$F_{h,p}$	Heated area, ths m^2

[y] - index relating to monitoring period;

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

[p] - index relating to project scenario;
[NG] - index relating to natural gas;
[h]- index relating to heating;
[w]- index relating to hot water supply;