JI MONITORING REPORT

(for reporting period 01.01.2008 – 31.12.2012**)**

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MONITORING REPORT OF JI PROJECT
Monitoring period:
01/01/2008 – 31/12/2011

Version 02
December 24, 2012

Modernization of the heat supply system of Ternopil city

CONTENS

SUPPORTING DOCUMENTS

Annex 1.[1]: "Calculation of GHG emission reductions"

Annex 2. "Registry of the heating system modernization"

Annex 3. "Types of measuring equipment"

[1] Annexes 1, 2, 3 provided in Excel files

SECTION A. General project activity and monitoring information

A.1. Title of the Project:

Modernization of the heat supply system of Ternopil city
Sectoral scope – 1 Energy industries (renewable - / non-renewable sources of energy)

A.2. Status of JI Project:

Joint Implementation Project "Modernization of the heat supply system of Ternopil city" was determined by the Bureau Veritas Certification, determination report No. UKRAINE-DET/0787/2012 from 05/11/2012. The Project was approved by the State Environmental Investment Agency of Ukraine (Letter of Approval No. 3871/23/7 dated 19/12/2012) and Swiss Federal Office for the Environment (Letter of Approval No. J294-0485 from 23/11/2012).

A.3. Brief Description of the Project:

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.
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..
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.

A.4. Period of the monitoring:

- Beginning of the monitoring period: 01/01/2008
- Completion of the monitoring period: 31/12/2011

A.5. Methodologies Used for Project Activities:

A.5.1. Methodology for baseline determination:

JI Project "Modernization of the heat supply system of Ternopil city" provides for the complex modernization of the enterprises households with the purpose of reduction fossil fuel consumption in the provision of services for the production and supply of heat energy. It is expected introduction of advanced energy efficient equipment, taking into account the latest trends and technologies in the heat supplying industry.

The specific approach used by the project has two important advantages (at least, in the Ukrainian conditions) compared to AM0044 Methodology (Version 01) «Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors»- Version 01»[2].

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

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2 http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5/eb28_repan01_AM0044.pdf?t=dVJ8bWdjcGtqfDCHJJANBKYeJAgZaiK33W8H

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 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[3]), 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"[4] , "Reconstruction of heat supply system in Chernihiv Region"[5] , "Reconstruction of heat supply system in Crimea"[6] , and "Reconstruction of heat supply system in Kharkiv"[7] , 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. For each year of the project, the baseline scenario will be different due to the influence of external factors such as weather conditions, changes in net calorific value of the fuel, the number of consumers, and more.

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:

$FC^{j}_{b,NG}$	Total amount of natural gas consumption, in historical period «j», in the baseline scenario, ths m3;
$NCV^{j}_{b,NG}$	Net calorific value of natural gas, in historical period «j», in the baseline scenario, TJ/mln m3;
$EF^{j}_{b,C,NG}$	Carbon emission factor in the course of natural gas combustion , in historical period «j», in the baseline scenario, t C/TJ
$OXID^{j}_{b,NG}$	Carbon oxidation factor in the course of natural gas combustion, in historical period «j», in the baseline scenario, Relative units
T^{j}_{out}	Average outdoor temperature during historical heating period "*j*", ^{o}C
T^{j}_{in}	Average indoor temperature during historical heating period "*j*", ^{o}C
n^{j}_{w}	Average number of consumers, personal bills in historical period "*j*", people
N^{j}_{w}	Duration of hot water supply service provision in historical period "*j*", h
N^{j}_{h}	Duration of heat supply service provision in historical period "*j*",

[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;

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[3] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5/eb28_repan01_AM0044.pdf?t=dVJ8bWdjcGtqfDCHJJANBKYeJAgZaiK33W8H

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

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

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

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

[out]- index corresponding to outdoor temperature;
[C] – index corresponding to carbon;
[NG] - index relating to natural gas.

A.5.2. Monitoring Methodology:

The proposed Project applies a JI specific approach in accordance with the JI Guidance on criteria for baseline setting and monitoring, Version 03[8], of the (Joint Implementation Supervisory Committee – JISC)).
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 given 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 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}	Average outdoor temperature during the heating period, ^{o}C
T_{in}	Average indoor temperature during the heating period, ^{o}C
n_{w}	Number of consumers of hot water, people
N_{w}	Duration of hot water supply service provision, h
N_{h}	Duration of heat supply service provision, h
F_{h}	Heated area, ths m^2

[y] - index relating to monitoring period;
[p] - index relating to project scenario;
[NG] - index relating to natural gas.

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

[in] – index corresponding to indoor temperature;
[out] – index corresponding to outdoor temperature;
[h]- index relating to heating;
[w]- index relating to hot water supply;

A.6. Status of implementation including the schedule of the project's milestones:

Implementation of project activities began in late 2004, as provided in the determined PDD version 02. However, emissions during 2004 conservatively excluded from the calculation. Therefore, the start date of the crediting period was taken 01/01/2005.
In this monitoring report presented reductions that achieved under the project during the period 01/01/2008 - 31/12/2011.
Status of the project during the period 01/01/2008 - 31/12/2011, including its main steps provided below (Table 1).

Table 1. Status of project implementation

Name of the phase	Year of implementation			
	2008	2009	2010	2011
Replacement of boiler-aggregates, units	13	12	-	4
Installation of heat exchangers, units	-	2	-	2
Heating networks replacement, m	6,2	440	1495	480

The implementation of measures under the project is conducted in accordance with the project plan, which is included in the determined PDD version 02.
Detailed information on the measures implemented in departments and areas are included in Annex 2. "Registry of the heating system modernization".

A.7. Possible deviations from or revisions of the registered version of PDD:

Significant deviations from the registered PDD were not observed.

A.8. Possible deviations from or revisions of the registered plan of monitoring:

Deviations or revisions to the registered monitoring plan not observed.

A.9. Persons responsible for the preparation and submission of monitoring report:

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SECTION B. Key monitoring activities

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 for JI projects" (Version 03).[9]

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.

Control and monitoring of the system reduced to measuring of fuel consumption. Other parameters are obtained by using of calculation method or from statistical data.

For the data processing at the volume of energy carriers consumption at the objects of the enterprise is installed the natural gas measuring equipment.

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.

B.1. Information on the types of measuring equipment, class of accuracy and calibration procedures.

The order (procedure) of verification of measuring equipment (including electricity meters, natural gas) is defined by the Law of Ukraine of 11.02.1998 № 113/98-VR "On metrology and metrological activity" (hereinafter - the Law). In particular, the article number 28 of the Law stipulates that measuring devices are in use, shall be calibrated periodically. The procedure for establishing calibration interval is determined by a legal act authorized central executive body in the field of metrology (hereinafter - CEBM). Businesses, organizations and individuals shall timely (including calibration interval) provide measuring equipment for calibration.

For the measuring of the consumption of natural gas it is used the next types of gas meters, provided in the table below (Table 2):

Table 2. The main types of gas meters

Measuring equipment	Type	Interval of verification/calibratio	Accuracy class

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

		n	
Rotary gas meter	GMS	2 years	1 %
Diaphragm gas meter	"Metrix"	2 years	1 %
Ultrasonic gas meter	Kurs-01	2 years	1 %
Rotary gas meter	RH-K	2 years	1 %
Rotary gas meter	RL	2 years	1 %
Turbine gas meter	LH	2 years	1 %
Diaphragm gas meter	G («Samhas»)	2 years	1 %
The calculator of gas volume	Universal	2 years	1 %

Details of the measuring equipment installed at each subscriber is given in Annex 3. "Types of measuring equipment"

B.2. Data collection (summary data for the whole monitoring period):

Data and parameters that are subject to periodic monitoring in accordance with the monitoring plan presented in the PDD version 02, and a list of constant values used for calculation of emission reductions is given in section B.2.1. and B.2.2. Monitoring Report, and also in Annex 1 "Calculation of GHG emission reductions".

B.2.1. List of fixed parameters and constant values

Table 3. Fixed parameters which are not controlled during the monitoring period

Parameter	Description	Data source	Value, measurement units	Comments
$FC^{j}_{b,NG}$	Total amount of Natural gas consumption, in historical period «j», in the baseline scenario, ths m^3	Gas meters and Form N-11-MTP "Report on the use of fuel, heat energy and electricity"	See Annex 1[10]. «Calculation of GHG emission reduction»	Measuring will be performed by using of gas meters, the energy resources department of the enterprise reads information from calculators of volume of natural gas remotely at each boiler house, the data will be entered into the form N 11-MTP "Report on the use of fuel, heat and electricity"
$NCV^{j}_{b,NG}$	Net calorific value of natural gas, in historical period «j», in the baseline scenario	Data of the enterprise	2004 Natural gas, TJ/mln. m^3: 33,58	Information on values of net calorific value of natural gas combustion are available in the note of JSC "Ternopilmiskhaz". Information on values of net

[10] Annexes 1, 2, 3 provided in Excel files form

				calorific value of coal combustion are available in certificates of supplier.
$EF^{j}_{b,C,NG}$	Carbon emission factor in the course of natural gas combustion, in historical period «j», in the baseline scenario, t C/ TJ	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010»"[11]	<table><tr><th></th><th>2004</th></tr><tr><td>Natural gas, t C/TJ</td><td>15,18</td></tr></table>	The parameter is used according to the "Guidance on criteria for baseline setting and monitoring"[12]
$OXID^{j}_{b,NG}$	Carbon oxidation factor in the course of Natural gas combustion, in historical period «j», in the baseline scenario	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine for 1990-2010»[13]	<table><tr><th></th><th>2004</th></tr><tr><td>Natural gas, Relative units</td><td>0,995</td></tr></table>	The parameter is used according to the "Guidance on criteria for baseline setting and monitoring"[14]
$T^{j}_{out,b}$	Average outdoor temperature in heating period "j'	Enterprise's data	Refer to Annex 1[15]. «Calculation of GHG emission reduction»	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$T^{j}_{in,b}$	Average outdoor temperature in heating historical period "j'	Enterprise's data	Refer to Annex 1[16]. «Calculation of GHG emission reduction»	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$n^{j}_{w,b}$	Average number of consumers, personal bills in historical period "j"	Enterprise's data	Refer to Annex 1[17]. «Calculation of GHG emission reduction»	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$N^{j}_{w,b}$	Duration of hot water	Enterprise's data	Refer to Annex 1[18]. «Calculation of GHG	Data allowing for calculation of

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

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

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

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

[15] Annexes 1, 2, 3 provided in Excel files form

[16] Annexes 1, 2, 3 provided in Excel files form

[17] Annexes 1, 2, 3 provided in Excel files form

	supply service provision in historical period «j»		emission reduction»	GHG; information will be archived in paper and electronic form
$N^{j}_{h,b}$	Duration of heating period in historical period «j»	Enterprise's data	Refer to Annex 1[19]. «Calculation of GHG emission reduction»	Data allowing for calculation of GHG; information will be archived in paper and electronic form

B.2.2. The list of parameters that are subject to periodic monitoring.

Table 4. Parameters which are monitored during the entire monitoring period and used to calculate project and baseline emissions.

Parameter	Description	Data source	Value, measurement units	Comments	Parameter
$FC^{y}_{p,NG}$	Total amount of natural gas consumption, in monitoring period «y», in the project scenario	Gas meters and form N 11-MTP «Report on fuel, heat and electricity consumption»	ths m^3	Monthly	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»
$NCV^{y}_{p,NG}$	Net calorific value of natural gas, in monitoring period «y», in the project scenario	Enterprise's data	TJ/mln m^3	Annually	Information on net calorific value of natural gas combustion is available in the certificate of JSC "Ternopilmiskhaz". Information on low heat value combustion of coal available in certificates supplier.
$EF^{y}_{p,C,NG}$	Carbon emission factor in the course of natural gas	«National inventory report of anthropogenic greenhouse gas emissions by	t C/TJ	Annually	The parameter is used according to the "Guidance on criteria for baseline setting and monitoring"[21]

[18] Annexes 1, 2, 3 provided in Excel files form
[19] Annexes 1, 2, 3 provided in Excel files form
[21] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

	combustion, in monitoring period «y», in the project scenario	sources and removals by sinks in Ukraine in 1990-2010 pp.»[20]			
$OXID^{y}_{p,NG}$	Carbon oxidation factor in the course of natural gas combustion, in monitoring period «y», in the project scenario	«National inventory report of anthropogenic greenhouse gas emissions by sources and removals by sinks in Ukraine in 1990-2010 pp.»[22]	Relative units	Annually	The parameter is used according to the "Guidance on criteria for baseline setting and monitoring"[23]
$T_{out,p}$	Average outdoor temperature during the heating period	Enterprise's data	°C	Once in the reporting period. Daily temperature is registered every day.	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$T_{in,p}$	Average indoor temperature during the heating period	Enterprise's data	°C	Once in the reporting period.	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$n_{w,p}$	Average number of consumers, personal bills	Enterprise's data	people	Once per year	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$N_{w,p}$	Duration of hot water supply service provision	Enterprise's data	Hours	Once per year	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$N_{h,p}$	Duration of heat supply service provision	Enterprise's data	Hours	Once per year	Data allowing for calculation of GHG; information will be archived in paper and electronic form
$F_{h,p}$	Heated area	Enterprise's data	тис. м^3	Once per year	Data allowing for calculation of GHG; information will be archived in paper and electronic form

The values for years used to calculate GHG emissions in the project and baseline scenarios are presented in Annex 1.[24]: "Calculation of GHG emission reductions".

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

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

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

[24] Annexes 1, 2, 3 provided in Excel files form

B.2.3. Data concerning leaks:

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[25]) approved methodology AM0044 version 01 "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 01 »[26]), leakage is not expected.

B.2.4. Data relating to environmental and social impacts:

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." [27]

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.

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 NOx, SOx, 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.

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

[26] http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_L4AQZSBA770KNI0BUSG1JVIWCXIFU5/eb28_repan01_AM0044.pdf?t=dVJ8bWdjcGtqfDCHJJANBKYeJAgZaiK33W8H

[27] http://document.ua/proektuvannja.-sklad-i-zmist-materialiv-ocinki-vpliviv-na-na-nor3146.html

According to the Ukrainian Law "On wastes»[28], (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 spoiled, spoiled waste filter materials; spoiled wiping materials, used or contaminated; particles of solid lubricants, water delimiters; damaged tires , used or damaged, used metal containers (cans under paint), waste rubber, waste stuffing; waste of fluoroplastic;;
- Disposal of used batteries, scrap non-ferrous metals;
- Removal of waste.

Effects on biodiversity

There is no impact on biodiversity.
Transboundary impacts of the project activity according to their definition in the text ratified by Ukraine "Convention on Transboundary Pollution at a great distance," will not take place.

B.3. Emergencies and procedures to identify and eliminate faults at HNUE "Ternopilmiskteplokomunenergo":

In the process of heating services providing during the heating period at facilities of the enterprise takes place the malfunction in the equipment operation and heat supplying to consumers.
In operation time the detection and elimination of faults on the heat supplying objects takes place visually or through devices by thermal area where the accident takes place. In the heat areas were established emergency and technical teams and management. Their willingness is annually checking.
In free time detection and elimination of faults on objects heating occurs by emergency - dispatching service that exists and operates at the enterprise are running around the clock. It has emergency equipment and has the necessary equipment, tools and materials.
All force majeure situations fixed documented and sent in a special form to the enterprise. The essence of the project and the activities which it provides, does not foresee any factors that may lead to unexpected greenhouse gas emissions other than those described in the project documentation.

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

SECTION C. Quality assurance and quality control measures

C.1. Roles and responsibilities

HNUE «Ternopilmiskteplokomunenergo» as a Heat supply organization consumes energy to produce, transport and supply thermal energy.
For processing of data on the amount of consumed energy at the facilities of the enterprise meters of natural gas are established.
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.

C.2. Personnel training

Since the main activity of HNUE «Ternopilmiskteplokomunenergo» has not changed due to the JI project implementation and monitoring of the project is within the established practices of the enterprise, the special technical training for staff is needed. The technical staff of the enterprise has sufficient knowledge and experience to implement the project and its monitoring.
In case of installation of new (the one that has never used by the enterprise) equipment, manufacturing company or supplier of this equipment conducts training on the specifics of operation of such equipment.

C.3. Involvement of Stakeholders

JSC "Ternopilmiskhaz", Ternopil city - organization that carries out verification (calibration) of gas meters.

C.4. Internal audit and control methods

Internal cross-check and audits are conducted for all data to be monitored directly. Director reviews the monthly and annual reports and conducts random checks of primary documents.
For continuous variables and fixed parameters and factors the quality assurance consists of checking and ensuring that the values are taken from reliable (those that are generally recognized and/or are based on scientific research), such that are subject of verification (data that are in the public domain or available to project participants) sources.

SECTION D. Calculation of GHG emissions reductions

D.1. Formulae used for calculation of GHG emission reductions.

D.1.1. Formulae for calculation the project emissions:

$$PE_p^y = PE_{p,HEAT}^y , \quad (1)$$

$PE_{p,HEAT}^y$ - 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.

$$PE_{p,HEAT}^y = \frac{NCV_{p,NG}^y \cdot FC_{p,NG,i}^y \cdot EF_{p,CO2,NG}^y}{1000} , \quad (2)$$

$NCV_{p,NG}^y$ - 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.

$$EF_{p,CO2,NG}^y = EF_{p,C,NG}^y \cdot OXID_{p,NG}^y \cdot \frac{44}{12} , \quad (3)$$

$EF_{p,C,NG}^y$ - 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.1.2. The formulae used for calculation of emissions under the baseline scenario:

$$BE_b^y = BE_{b,HEAT}^y = \frac{NCV_{b,NG}^y \cdot EF_{b,CO2,NG}^y \cdot FC_{b,NG,i}^y}{1000} , \quad (4)$$

$NCV_{b,NG}^y$ - 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);

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

$$EF^{y}_{b,CO2,NG} = EF^{y}_{b,C,NG} \cdot OXID^{y}_{b,NG} \cdot \frac{44}{12} \quad (5)$$

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

$OXID^{y}_{b,NG}$ - 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 $BE^{y}_{b,HEAT}$ may vary:

$$BE^{y}_{b,HEAT} = BE^{y}_{b,HEAT,h} + BE^{y}_{b,HEAT,w}, \quad (6)$$

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

$BE^{y}_{b,HEAT,w}$ - 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 $BE^{y}_{b,HEAT}$:

$$BE^{y}_{b,HEAT} = \frac{NCV^{j}_{b,NG} \cdot EF^{j}_{b,CO2,NG} \cdot \left[FC^{j}_{b,NG} \cdot a^{j}_{b} \cdot K_1 \cdot K_h + FC^{j}_{b,HEAT}\left(1 - a^{j}_{b}\right) \cdot K_1 \cdot K_w\right]}{1000}, \quad (7)$$

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:

$$BE^{y}_{b,HEAT} = \frac{NCV^{j}_{b,NG} \cdot EF^{j}_{b,CO2,NG} \cdot \left[FC^{j}_{b,NG} \cdot a^{j}_{b} \cdot K_1 \cdot K_h + FC^{y}_{p,NG}\left(1 - a^{y}_{p}\right) \cdot K_1 \cdot K_{w0}\right]}{1000} \quad (8)$$

$NCV^{j}_{b,NG}$ - net calorific value of Natural gas in monitoring period *y* in the baseline scenario, GJ/t (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 (t).

$FC^{y}_{p,NG}$ - 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.

$$a^j_b = L^j_{h,b} \cdot g \cdot N^j_{h,b} / (L^j{}_{h,b} \cdot g \cdot N^j{}_{h,b} + L^j_{w,b} \cdot N^j{}_{w,b}), \quad (9)$$

$L^j_{h,b}, L^j_{w,b}$ – 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;

[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:

$$K_1 = NCV^j_{b,NG} / NCV^y_{p,NG} \quad , \quad (10)$$

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, TJ/mln 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:

$$FC^y_{b,NG_h} = FC^y_{b,NG,i} \cdot a = Q_h * 3{,}6 / NCV^y_{b,NG} \cdot \eta_h \, , \quad (11)$$

$FC^y_{b,NG,h}$ - 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 (t).

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

Q_h - necessary heat for heating, kWh;

3,6 – factor of kWh into MJ conversion;

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

$NCV^y_{b,NG}$ - 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:

$Q_{h,b,p} = Q_{h,b} * K_h = Q_{h,p}$, (12)

$Q_{h,b,p}$ – 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:

$K_h = Q_{h,p} / Q_{h,b}$, (13)

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):

$Q_h = F_h * K_h * (T_{in} - T_{out}) * N_h$, (14)

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*K;

T_{in} – average indoor temperature in the heating period, K (or ^0C);

T_{out} – average outdoor temperature in the heating period, K (or ^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:

$K_h = (F_{h,p} * K_{h,p}) * (T_{in,p} - T_{out,p}) * N_{h,p} / F_{h,b} * K_{h,b} * (T_{in,b} - T_{out,b}) * N_{h,b}$, (15)

Temperature change factor:

$K_2 = (T_{in,p} - T_{out,p}) / (T_{in,b} - T_{out,b})$, (16)

Heated area and thermal insulation change factor:

$K_3 = (F_{h,p} * k_{h,p}) / F_{h,b} * K_{h,b} = [(F_{h,n,p} - F_{h,t,p} - F_{h,n,p}) * K_{h,b} + (F_{h,n,p} + F_{h,t,p}) * K_{h,n}] / F_{h,b} * K_{h,b}$, (17)

$F_{h,b}$ – 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:
$K_4 = N_{h,p} / N^{j}_{h,b}$, (18)
$N^{j}_{h,b}$ – 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,
$K_h = K_2 * K_3 * K_4$, (19)
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:

$$FC^{y}_{b,NG,w} = FC^{y}_{b,NG,i} \cdot (1-a) = Q_w \cdot 3{,}6 / NCV^{y}_{b,NG} \cdot \eta_w , \quad (20)$$

$FC^{y}_{b,NG,i,w}$ - 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:
$Q_{w,b,p} = Q_{w,b} * K_w = Q_{w,p}$, (21)
$Q_{w,b,p}$ – 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:

$K_w = Q_{w,p} / Q_{w,b}$, (22)

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

$Q_w = n_w * v_w * N_w$, (23)

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:

$K_w = n_{w,p} * v_{w,p} * N_{w,p} / n_{w,b} * v_{w,b} * N_{w,b}$, (24)

Coefficient of the change of the number of consumers:

$K_5 = n_{w,p} / n^{j}_{w,b}$, (25)

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

$K_6 = v_{w,p} / v_{w,b}$, (26)

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:

$K_7 = N_{w,p} / N_w$, (27)

$N_{w,b}$ – 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,

$K_w = K_5 * K_6 * K_7$, (28)

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, (29)

Therefore

Kw0=1, (30)

D.1.3. Formulae for calculating leaks:

Leaks are not expected

D.1.4. Формули для розрахунку скорочення викидів ПГ:

$ER^y = BE_b^y - PE_p^y$,

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.2. Results of GHG emissions reductions monitoring

D.2.1. GHG emissions in the project scenario

As a result of project implementation during the reporting period were achieved following GHG emissions:

Monitoring period: 01/01/2008 – 31/12/2011	**Total project emissions, t CO_2eq**
2008	151 999
2009	153 465
2010	164 968
2011	152 240
Total	**622 672**

D.2.2. GHG emissions in the baseline scenario

Emissions that would have occurred in the absence of the project activity, are:

Monitoring period: (01/01/2008 – 31/12/2011)	**Baseline emissions, t CO_2eq**
2008	301 682
2009	316 083
2010	334 485
2011	323 428
Total	**1 275 678**

D.2.3. Leaks:

Leaks are not expected.

D.2.4. Emission reductions resulting from the project implementation in the monitoring period:

Emission reductions resulting from the project are calculated as the difference between baseline and project emissions.

Monitoring period: 01/01/2008 – 31/12/2011	**Emissions reduction, t CO_2eq**
2008	149 683
2009	162 618
2010	169 517
2011	171 188
Total	**653 006**