MONITORING REPORT OF JI PROJECT

ANNUAL REPORT

Version 03
November 15, 2010

"Rehabilitation of the District Heating System in Donetsk City"

CONTENTS

ANNEXES

[1] Annex 2 is provided in electronic form.
[2] Annex 3 is provided in electronic form.

SECTION A. General project activity and monitoring information

A.1 Name of the project:

" Rehabilitation of the District Heating System in Donetsk City "

A.2. JI registration number:

UNFCCC JI registration number:

ITL identification number:

A.3. Short description of the project:

The project's main goal is reduction of fuel consumption, in particular reduction of natural gas consumption (which is imported to Ukraine) by means of centralized heat supply systems rehabilitation in Donetsk city, which includes replacement and rehabilitation of boilers and heat distribution network equipment. Such fuel consumption reduction will result in decrease of greenhouse gas emissions (CO_2 and N_2O). The purpose of the project is sustainable development of the city through implementation of energy saving technologies.

Centralized heat supply system in Donetsk city supplies and sells heat energy in the form of heat, hot water and steam to local consumers, namely: population, municipal consumers and state-owned organizations. This is monopolist in the sphere of heat generation in the city. Market of heat supply is stable for years.

The project was initiated in 2004. It provides for rehabilitation of centralized heat supply system in Donetsk city, including boiler and heat distribution network equipment replacement and rehabilitation. The project "Rehabilitation of the District Heating System in Donetsk City" covers 16 boiler-houses with 56 boilers and 114.84 km of heat distributing networks.

The project ensures increase in efficiency of fuel consumption for greenhouse gas emissions reduction with respect to current practice. Such reduction of fuel consumption will be resulted from increase of the boiler efficiencies and reduction of heat losses in heat supply networks.
The following activities will ensure fuel saving:

- Replacement of old boilers by new highly efficient boilers;
- Transfer of load from the boiler-houses with outdated equipment to the boiler-houses fitted with highly efficient equipment;
- Improvement of heating systems;
- Introduction of pre-insulated pipes;
- Installation of frequency regulators on electric drives of draught equipment and pumps of hot water supply system.

According to collected data the following sum of GHG emission reduction will be achieved during the monitoring period:

Table 1. GHG emission reduction during the monitoring period

Year	2008	2009	01/01/2010 - 30/09/2010	**Total**
Emission reduction, tCO_2e	27121	39985	25757	**92863**

A.4. Monitoring period:

- Monitoring period starting date: 01/01/2008
- Monitoring period closing date: 30/09/2010

A.5. Methodology applied to the project activity (incl. version number):

A.5.1. Baseline methodology:

The proposed Project uses a specific approach for joint implementation projects. At the time when this Project was developed, there was the lack of approved CDM methodologies the such types of the projects. Specific approach that is proposed in the project is similar partially to the methodology "Baseline and monitoring methodology AM0044 (version 01)[3]». However methodology AM0044 (version 01) is not used for the project "Rehabilitation of the District Heating System in Donetsk City", because the project has some differences from applicability conditions of this methodology.

The main reason for impossibility of AM0044 (version 01) use for baseline development is lack of data about heat energy generation because heat energy meters in majority of boiler-houses involved in the project are not available. Institute of Engineering Ecology proposed another methodology, that takes into account all measures involved in the project and it's peculiarities. This methodology is presented in section D (monitoring plan). It was already approved for the JI Project in Chernihiv region and for the similar JI Project in Donetsk region.

The main complication for implementation of the JI projects on district heating in Ukraine is the practical absence of monitoring devices for heat and heat-carrier consumption in the municipal boiler-houses. Only the fuel consumption is registered on a regular basis. It makes practically impossible the application of AM0044 methodology which basic moment is monitoring of the value EGPJ, i, y (thermal energy output of project boiler i in year y) - page 9 of Methodology AM0044, which should be measured every month by flow-meters (the expenditure of heat-carrier) and thermal sensors (temperatures at the input and output of the boiler, etc.).

This also concerns the definition of the average historical value of heat power generation per year $EG_{BL, his, i}$ (average historic heat output from the basic boiler "i").

Specific approach applied in the project is based on continuous measurement of fuel consumption and consider other factors, such as connection or disconnection of the consumers, change of net calorific value of fuel, weather change, ratio of the heat consumption for heating and for hot water supply, consumption for own needs etc.

Specific approach applied in the project has two important advantages compared to AM0044 methodology (version 01) (at least for Ukrainian conditions):

- It takes into account the quality of heat supply (heating and hot water supply). Almost annually and for the various reasons (receiving of less amount and high price of the fuel, in particular natural gas which is nearly 95 % of fuel type used in Ukraine for the needs of the municipal heat supply), the consumers receive less than necessary amount of heat, in the result of which the temperature inside the buildings is much lower than normative one. As the purpose of JI projects, including the current project, is the GHG (CO_2) emission reduction under the conditions of not worsening in any circumstances of the social conditions of population, the approaching of the normative heat supply quality is extremely important. Therefore, the amount of the fuel consumption after project implementation period is calculated for the conditions of providing the normative parameters of heat supply and at least partially of hot water supply, and in accordance with the monitoring plan, the implementation of continuous control (monitoring) of its quality (measurement of internal

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

temperature in the specific buildings as well as registration of residents' complaints for the poor-quality heat supply) is foreseen. This increases the control for the qualitative heat supply for the consumers and excludes deliberate reduction of heat consumption, and, in such a way, of fuel consumption with the purpose of increasing of generation of GHG emissions reduction units (ERUs) at the project verification.

- Definition of the fuel consumption in base year (baseline) in view of the fact that in Ukraine at the majority of the municipal heat supply enterprises the natural gas is used as a fuel, which consumption is measured constantly by the counters with the high measurement accuracy, seems to be more exact, than definition of the fuel consumption with use of heat power, boiler efficiency and heat value of the fuel. This especially concerns the efficiency, which changes greatly depending on load of boilers, which also changes essentially, and often not automatically but manually, in the heat supply systems within a day and within a year. Averaging of such values without having of the heat account system is fraught with serious discrepancies. Definition of the fuel consumption in the presence of counters requires only data collection and implementation of arithmetic actions.

The project applies specific approach based on the continuous measurement of the fuel consumption and adjustment of baseline to parameter changes in reporting year. The variable parameters may be the changes in calorific value of fuels, quality of heat supply, weather changes, changes in customers quantity, etc. Taking into account only equipment efficiency does not eliminate the possibilities of undersupply of heat to customers (deterioration of heat supply service), and possible weather warming in reported year, change in fuel quality, disconnection of some consumers, and other factors, and could lead to artificial overestimation of ERUs amount.

In view of the above mentioned, in contrast to the methodology AM0044 (version 01), specific approach elaborated for projects of "District heating" (DH) in Ukraine and applied in JI projects "Rehabilitation of the District Heating System in Donetsk City"[4], "Rehabilitation of the District Heating System in Chernigiv city»[5], "Rehabilitation of the District Heating System in Crimea»[6] and "Rehabilitation of the District Heating System in Kharkiv City»[7] is the most appropriate, precise, corresponding to the principle of conservatism, and the most closely reflects the aims, goals and spirit of Kyoto Protocol.

The baseline study will be carried out for each year of the emission reduction purchasing, in order to correct adjusting factors which have an influence at the baseline.

A.5.2. Monitoring methodology:

Verification of emission reduction units and baseline scenario
The proposed Project uses a specific approach for joint implementation projects (specific monitoring plan applied in this project was used in JI project "Rehabilitation of Heat Supply Systems in Kharkiv city")[8]: for any project year the baseline scenario may differ due to influence of external factors, such as weather conditions, change of the lower heating value of the fuel, quantity of consumers, etc. We will adjust the Baseline and quantity of Emission Reduction Units for all project years subject to all these factors.

Indicator of project's implementation
The most objective and cumulative factor demonstrating whether the emissions reduction occurred actually, is fuel saving. It may be determined as the difference between basic consumption of fuel and fuel consumption after project's implementation. If boilers consume fuel on project level, then all other indicators, such as efficiency of new boilers' and burners' operation, heat loss at heat distribution networks, shall be corresponding.

Verification of project performance indicators

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

Municipal commercial enterprise "Donetskmiskteplomerezha"collects and keeps the data relating to fuel acquired for heating in the form of fuel bills. Information about saved fuel will be attached to the verification reports annually with all corresponding documents and historical information about fuel purchase by the Supplier.

We will apply the following methodological approach.

Quantity of emission reduction units (ERUs), t CO_2e:

$$ERU = \sum[E_{i,\,b} - E_{i,\,r}] \quad (1)$$

Sum of all boiler-houses (i), involved in project.

$$E_{i,\,b} = E_{1i,\,b} + E_{cons\ i,\,b}, \quad (2)$$
$$E_{i,\,r} = E_{1i,\,r} + E_{cons\ i,\,r}, \quad (3)$$

where:
$E_{1i,\,b}$ and $E_{1i,\,r}$ –CO_2 emissions due to fuel consumption for heating and hot water supply to (i) boiler-houses in basic and reporting years correspondingly, t CO_2e;
$E_{cons\ i,\,b}$ and $E_{cons\ i,\,r}$ – CO_2 emissions due to electric energy consumption from network by the boiler-house (i) in basic and reporting years correspondingly, t CO_2e.

[$_i$] index – boiler-house;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

For each boiler-house:

$$E_{1,\,b} = LHV_b * Cef * B_b \quad (4)$$
$$E_{1,\,r} = LHV_r * Cef * B_r \quad (5)$$
$$E_{cons\ b} = P_b * CEF \quad (6)$$
$$E_{cons\ r} = P_r * CEF \quad (7)$$

where:
LHV – the lower heating value in basic and project, MJ/m^3 (MJ/kg);
Cef – CO_2 emission factor, $KtCO_2$/TJ;
B_b – basic quantity of consumed fuel, 1000 m^3 or tons;
B_r – project quantity of consumed fuel, 1000 m^3 or tons;
CEF – Carbon emission factor in the course of electric energy production in Ukraine, t CO_2e/MW.
P_b – basic consumption of electric energy by the boiler-houses, wherein energy-saving technologies are planned to be implemented, MW*hour;
P_r – project consumption of electric energy by the boiler-houses, wherein energy-saving technologies are implemented, MW*hour;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

According to the assumption of Dynamic Baseline, value of E_1^b may be various:

$$E_{1i,\,b} = E_{hi,\,b}, + E_{wi,\,b}; \quad (8)$$

where the first value describes the emissions due to fuel consumption for heating, and the second value represents fuel consumption for hot water supply.

If there was hot water supply in base year (regardless of service duration, $(1-a_b) \neq 0$), the following formula for $E_{1,b}$ shall be applied:

$$E_{1,b} = LHV_b * Cef * [B_b * a_b * K_1 * K_h + B_b * (1-a_b) * K_1 * K_w], \quad (9)$$

where the first value within brackets describes fuel consumption for heating, and the second value represents fuel consumption for hot water supply

If there was not hot water supply in base year ($(1-a_b) = 0$) at all, and such service appeared in reporting year (owing to improvement of hot water supply to population), the following formula for E_1^b shall be applied:

$$E_{1,b} = LHV_b * Cef * [B_b * a_b * K_1 * K_h + B_r * (1-a_r) * K_1 * K_{w0}] \quad (10)$$

$$E_{1,r} = LHV_r * Cef * B_r \quad (11)$$

where:
LHV – the lower heating value, MJ/m^3 (MJ/kg);
Cef – t CO_2 emission factor, $KtCO_2/TJ$;
B_b – basic quantity of consumed fuel, 1000 m^3 or tons;
B_r – project quantity of consumed fuel, 1000 m^3 or tons;
K_1, K_h, K_w, K_{w0} – adjusting factors;
a – share of fuel (heat) consumed for heating;
(1-a) – share of fuel (heat) consumed for hot water supply;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

$$a_b = L_{h,b} * g * N_{h,b} / (L_{h,b} * g * N_{h,b} + L_{w,b} * N_{w,b}); \quad (12)$$
$$a_r = L_{h,r} * g * N_{h,r} / (L_{h,r} * g * N_{h,r} + L_{w,r} * N_{w,r}), \quad (13)$$

where:
L_h, L_w – maximal load for rendering services as to heating and hot water supply, MW;
g – conversion factor for average heating load during the heating period (shall be determined for each boiler-house on historical basis (usually 0.4-0.8);
N_h, N_w – duration of heating period and hot water supply period per annum, hour;
[$_h$] index – heating;
[$_w$] index – hot water supply;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

Adjusting factors:

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

$$K_1 = LHV_b / LHV_r \quad (14)$$

2. Adjusting factor for heating shall be applied for development of Dynamic Baseline, taking into account all external factors, such as weather conditions, Heating area , etc.

Quantity of fuel consumed for heating is proportional to required heat for heating period, Q_h:

$$B_h = B * a = Q_h / LHV * \eta_h, \quad (15)$$

where η - total effectiveness of boiler-house.

According to the assumptions as to Dynamic baseline required heat in base year for correct comparison shall be reduced to actual conditions (external conditions of the project) of reporting year:

$$Q_{h,b,r} = Q_{h,b} * K_h = Q_{h,r} \quad (16)$$

where:
$Q_{h, b, r}$ – necessary heat for Dynamic baseline; it is conceded to be equal to Q_r – necessary heat for reporting year
$Q_{h, b}$ – necessary heat for base year,
K_h – average adjusting factor for heating.
[$_h$] index – heating;
[$_w$] index – hot water supply;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

Average adjusting factor may be determined on the basis of such equality:
$K_h = Q_{h\,r} / Q_{h\,b.}$ (17)

Required heat for buildings' heating within the year, according to the "Norms and instructions of fuel and heat energy losses rate setting for heating of dwelling and civil buildings, as well as social needs in Ukraine. KTM 204 Ukraine 244-94"[9], (formula 2.17]:

$$Q_h = F_h * k_h * (T_{in} - T_{out}) * N_h, \quad (18)$$

where:
Q_h – required heatof heat for heating, kW*hour;
F_h – Heating area of premises, m^2;
k_h – average heat transfer factor of the buildings, kW/m^2*K;
T_{in} – average temperature inside the premises during heating period, K (or ^0C);
T_{out} – average external temperature during heating period, K (or ^0C);
N_h – duration of heating period per annum, hour.
[$_h$] index – heating;
[$_{in}$] index – internal temperature;
[$_{out}$] index – external temperature.

Therefore:
$$K_h = (F_{h, r} * k_{h\,r}) * (T_{in, r} - T_{out, r}) * N_{h, r} / F_{h, b} * k_{h, b} * (T_{in, b} - T_{out, b}) * N_{h, b} \quad (19)$$

2.1. K_2 (temperature change factor):

$$K_2 = (T_{in, r} - T_{out, r}) / (T_{in, b} - T_{out, b}) \quad (20)$$

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

$$K_3 = (F_{h, r} * k_{h, r}) / F_{h, b} * k_{h, b} = [(F_{hмг} - F_{h, t, r} - F_{h, n, r}) * k_{h, b} + (F_{h, n, r} + F_{h, t, r}) * k_{h, n}] / F_{h, b} * k_{h, b}, \quad (21)$$

where:
$F_{h, b}$ – Heating area of premises in base year, m^2;
$F_{h, r}$ – Heating area of premises in reporting year, m^2;
$F_{h, n, r}$ – Heating area of new buildings connected to the heat supply system (as assumed, with new (improved) thermal insulation) in reporting year, m^2;
$F_{h, t, r}$ – Heating area of buildings (existed in base year) with improved thermal insulation in reporting year, m^2;
$k_{h, b}$ – average heat transfer factor of the buildings in base year, kW/m^2*K;
$k_{h, r}$ – average heat transfer factor of the buildings in reporting year, kW/m^2*K;
$k_{h, n}$ – heat transfer factor of the heated buildings with new thermal insulation (new or old buildings with new thermal insulation), kW/m^2*K;
[$_h$] index – heating;
[$_{in}$] index – internal temperature;

[9] *Norms and instructions of rate setting for fuel and heat energy discharge for heating of dwelling and civil buildings, as well as social needs in Ukraine. KTM 204 Ukraine 244-94. Kyiv, 2001, 376 p.*

[$_{out}$] index – external temperature.
[$_r$] index – relates to reporting year.

2.4. K_4 (Factor of heating period duration change):

$$K_4 = N_{h,\,r} / N_{h,\,b} \quad (22)$$

where:
$N_{h,\,b}$ – duration of heating period in base year, hour;
$N_{h,\,r}$ – duration of heating period in reporting year, hour.
[$_h$] index – heating;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

Thus,

$$K_h = K_2 * K_3 * K_4 \quad (23)$$

3. Adjusting factor for hot water supply shall be used for development of Dynamic Baseline taking into account all external factors, such as weather conditions, quantity of consumers, etc.
Quantity of fuel consumed for hot water supply is proportional to required heat for the period of such service rendering, Q_w:

$$B_w = B*(1-a) = Q_w / LHV*\eta_w, \quad (24)$$

where η - general efficiency of the hot water supply system.

According to the assumptions as to Dynamic baseline required heat of heat in base year for hot water supply (for correct comparison) shall be reduced to actual conditions (external conditions of the project) of reporting year:

$$Q_{w\,b,\,r} = Q_{w,\,b} * K_w = Q_{w,\,r} \quad (25)$$

where:
$Q_{w,\,b,\,r}$ – heat necessary for hot water supply as to Dynamic baseline; it is conceded to be equal to $Q_{w\ \ r}$ – heat necessary for hot water supply in reporting year
$Q_{w,\,b}$ – heat necessary for hot water supply in base year,
K_w – average adjusting factor for hot water supply.
[$_h$] index – heating;
[$_w$] index – hot water supply;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

Average adjusting factor may be determined on the basis of such equality:

$$K_w = Q_{w,\,r} / Q_{w,\,b.} \quad (26)$$

Component K_w may be determined by the correlation of heat consumed for hot water supply in basic and reporting years:

$$Q_w = n_w * v_w * N_w, \quad (27)$$

where:
Q_w – heat necessary for hot water supply, kW*hour;
n_w – average quantity of consumers, personal accounts;
v_w – standard specific discharge of hot water for personal account (in heat units, kW*hour/hour);
N_w – duration of service rendering per annum, hour.
[$_w$] index – hot water supply.

Thus:
$K_w = n_{w,r} * v_{w,r} * N_{w,r} / n_{w,b} * v_{w,b} * N_{w,b}$ (28)

3.1. K_5 (Factor of change of consumers' quantity):

$K_5 = n_{w,r} / n_{w,b}$ (29)

3.2. K_6 (Factor of change of standard specific discharge of hot water for personal account):

$K_6 = v_{w,r} / v_{w,b}$ (30)

At present such standard specific discharge of hot water is effective, which was proposed in KTM 204 Ukraine 244-94[10] in 1993. There is no any information about any changes, therefore $K_6 = 1$ and is not subject to special monitoring.

3.3. K_7 (Factor of change of the duration of hot water supply period):

$K_7 = N_{w,r} / N_{w,b}$ (31)

where:
$N_{w\,b}$ – duration of the hot water supply period in base year, hour;
$N_{w\,r}$ – duration of the hot water supply period in reporting year, hour.
[$_w$] index – hot water supply;
[$_b$] index – relates to base year;
[$_r$] index – relates to reporting year.

Thus,

$K_w = K_5 * K_6 * K_7$. (32)

3.4. Adjusting factor for hot water supply in case, if such service has not been rendered in base year, but was provided in reporting year:

If there was not hot water supply service in base year, values of quantity of consumers, standard specific discharge of hot water, duration of hot water supply period in base year shall be equal to corresponding values in reporting year,

$K_5 = K_6 = K_7 = 1$.

Therefore

$K_{wo} = 1$.

A.6. Status of implementation including major project parts:

Start of project activity according to PDD is 11/10/2004

Starting date of the crediting period was the date when first generated ERUs occur, namely: January 01, 2005. End of crediting period will be the end of life cycle of main equipment, namely: December 31, 2012. Therefore, length of the crediting period will make 8 years/96 months. If after the first period of commitments under Kyoto Protocol its validity is prolonged, crediting period under the project will be prolonged by 12 years/144 months (January 01, 2013 – December 31, 2024). Taking into account the period

[10] *Norms and instructions of rate setting for fuel and heat energy discharge for heating of dwelling and civil buildings, as well as social needs in Ukraine. KTM 204 Ukraine 244-94. Kyiv, 2001, 376 p.*

preceding the crediting period, the crediting period and the period after its expiration, the total crediting period will make 20 years/240 months.

Table 2. Implementation status (according to the PDD)

No.	Measures	Quantity of the units of performed works	Starting of construction	Putting into operation
01/01/ 2008 - 30/09/ 2010				
1	Replacement of boilers	9	01/01/2008	2008-2010
2	Replacement of heating systems, m	4 700	01/01/2008	2008-2010
3	Installation of heat utilizers	2	01/01/2008	2008-2010

Implementation of the rehabilitation of boiler-houses and heating systems is realized mainly according to the project plan with some deviations from the schedule.
Sometimes rehabilitation of boiler-houses has some deviations from the project, namely in change of installed boilers' power. This was induced by change of needs in heat energy. In some cases there is replacement of other (in relation to planned) diameters of heating systems due to production necessity.
Detailed information about measures' implementation is given in Annex 2.

A.7. Deviations or revisions to the registered PDD:

There are no significant deviations from registered version of PDD. Insignificant deviation of actual GHG emission reductions from those stated in PDD version 03 is due to the fact that in the course of PDD elaboration the figures of expected plan for 2008-2010 were differing from actual data for 2008-2010.

A.8. Deviations or revisions to the registered monitoring plan:

There are no deviations from registered monitoring plan.

A.9. Person(s) responsible for the preparation and submission of the monitoring report:

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SECTION B. Key monitoring activities

Control and monitoring comes to measurement of fuel and energy consumption. Other parameters shall be determined by calculating way or on the basis of statistical data. Fuel consumption measurement is conducted at gas distributing station of the boiler-house. Gas is registered in the units of volume coerced to normal conditions by means of automatic correctors of temperature and pressure.

Usually gas distributing station consists of the following equipment:

- Gas filter;
- Metering apparatus for measurement and control of differentiative pressure at gas filter;
- Gas meter;
- Return valve;
- Bypass.

Each hour the operators of boiler-houses take the readings of the temperature of external air, temperature of natural gas and pressure at the input in boiler-house. Consumption of natural gas is measured by gas meter installed in each boiler-house. Every day the operators of boiler-houses records daily consumption of gas in special paper journals.
Every day received information is communicated to monitoring service, and then to the central control room.

From central control room the data are transmitted to the FER (Fuel and Energy Resources) department and technical director.

B.1. Types of measuring equipment:

The following gas meters are applied for measurement of gas consumption:

Universal-0.1 manufacturer: LLC Research and Production Enterprise "Grampeace", Vinnitsa city;
G -100 LGK, manufacturer: OJSC «Promprylad», Ivano-Frankivsk city;
G -250 LGK, manufacturer: OJSC «Promprylad», Ivano-Frankivsk city;
G -400 LGK, manufacturer: OJSC «Promprylad», Ivano-Frankivsk city;
G -600 LGK, manufacturer: OJSC «Promprylad», Ivano-Frankivsk city;
GMS- G40-80, State Company "Arsenal", Kyiv city;
GMS- G65-80, State Company "Arsenal", Kyiv city.
LGK 650 – manufacturer: Concern «Gazovik-Komplekt», Saratov city;
B-25 – manufacturer: Research and Production Enterprise «Measuring technologies», Kyiv city.

B.1.1. Table providing information about applied equipment:

See Annex 2.

B.1.2. Calibration procedure:

According to the current legislation all measuring equipment in Ukraine shall meet stated requirements of corresponding standards and be calibrated periodically.

Table 3. Types of gas meters and interval of their calibration

Type of gas meter	Interval of calibration
G -100 LGK	2 years
G -250 LGK	2 years
G -400 LGK	2 years
G -600 LGK	2 years

GMS- G40-80	2 years
LGK 650	2 years
B-25	2 years
Universal-0.1	2 years

According to the monitoring plan the volume of natural gas consumption may be adjusted by error of measuring equipment according to the principle of conservatism. Consumption of natural gas applied for measurement of Project emissions was adjusted by error of gas meters and electricity supply meters for each boiler-house.
See Annex 3.

B.1.3. Involvement of Third Parties:

1. Measuring equipment was calibrated by Donetsk center of standardization, metrology and certification of meters.
2. Heat value of natural gas shall be taken according to the telephone message of gas supplier or report of independent chemical laboratory. Analyses of independent chemical laboratory shall be done in case of any disputable cases.
3. Daily external temperature obtained by dispatcher of Municipal commercial enterprise "Donetskmiskteplomerezha" in Donetsk metrological center.
4. Municipal housing committee offices provide the Municipal commercial enterprise "Donetskmiskteplomerezha" with personal accounts once per month.

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

Data applied for calculation of emission reductions are given in the Table of Section B.2.1 (List of constant values, variables and given values) and Annex 1 (Data), Annex 2 (Calculation of CO_2 emission reductions in the system of Municipal commercial enterprise "Donetskmiskteplomerezha" and plan of project measures implementation), Annex 3 (Monitoring of gas meters).
Table in the Section B.2.1 contains all parameters necessary for calculation of emission reduction in this monitoring Report.

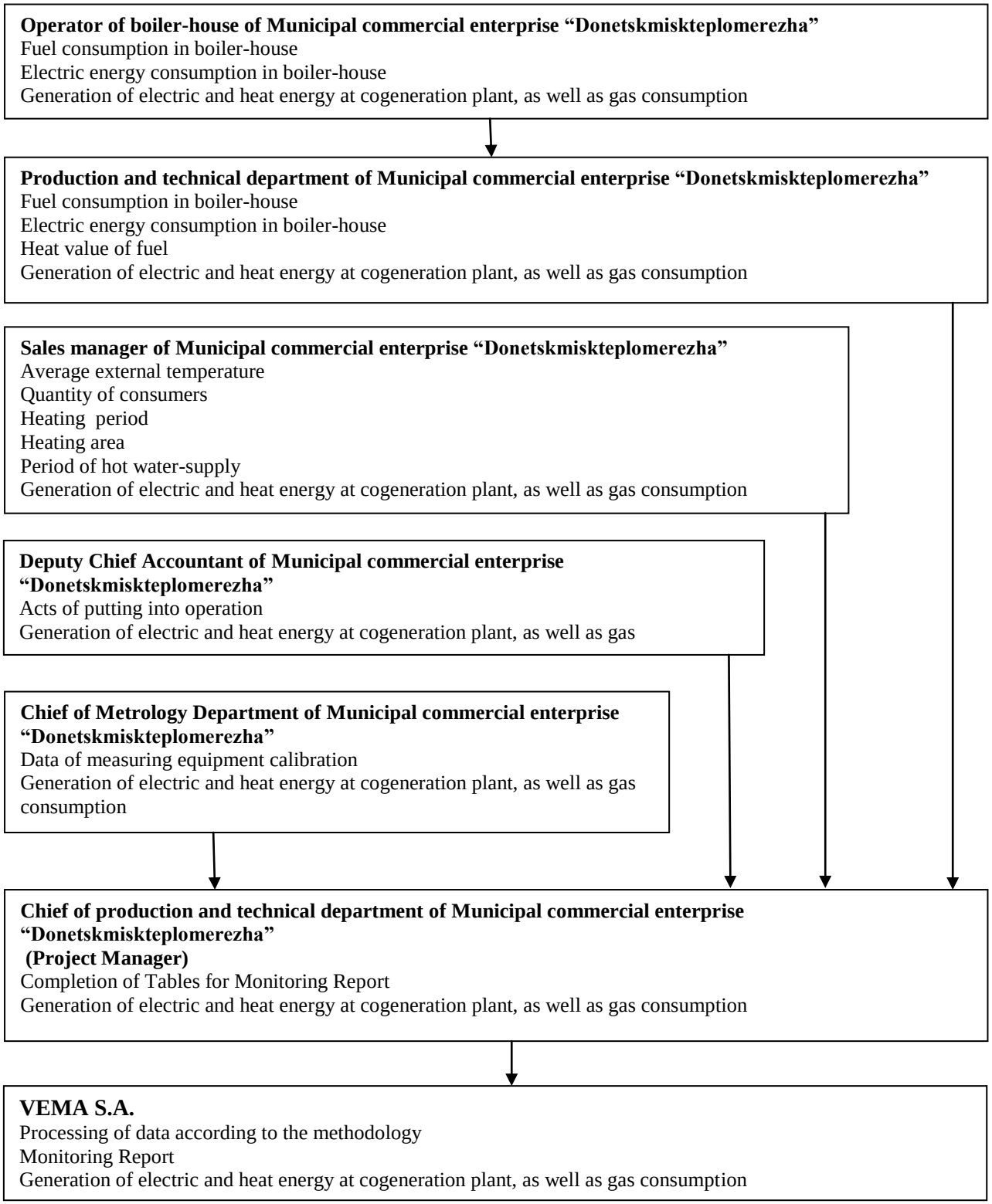

Figure.1. Scheme of data collection for Monitoring Report.

B.2.1. List of constant values, variables and given values

Table 4. Constant values, variables and given values

	Symbol	Parameter	Unit of measurement	Measured (m), calculated (c) or estimated (e))
1	(B_b) and (B_r)	Fuel consumption by boiler-houses (natural gas)	m^3	m
2	(LHV_b) and (LHV_r)	Heat value is calculated on the basis of the lowest heat value (natural gas)	MJ/m^3	m,c
3	($T_{out\ b}$) and ($T_{out\ r}$)	Average external temperature during heating season	^0C	m,c
4	($T_{in\ b}$) and ($T_{in\ r}$)	Average internal temperature during heating season	^0C	m,c
5	(n_{wb} and (n_{wr})	Quantity of consumers		statistics
6	($F_{h\ b}$ and ($F_{h\ r}$)	Total heated area	m^2	statistics
7	(k_{hb})	Average heat-transfer factor of the buildings in basic year	W/m^2*K	statistics
8	($F_{h\ t\ r}$)	Heated area of buildings (existed in basic year) with improved heat insulation	m^2	statistics
9	($F_{h\ n\ r}$)	Heated area of new buildings connected to the heat supply system (it is conceded that such buildings have new improved heat insulation) in reporting year	m^2	statistics
10	($k_{h\ n}$)	Heat-transfer factor of the buildings with new thermal insulation	W/m^2*K	statistics
11	($N_{h\ b}$) and ($N_{h\ r}$)	Duration of heating period	hour	m
12	($N_{w\ b}$) and ($N_{w\ r}$)	Duration of hot water supply period	hour	m
13	$L_{h\ b}$) and ($L_{h\ r}$)	Maximal connected load for heating services	MW	c
14	($L_{w\ b}$) and ($L_{w\ r}$)	Maximal connected load for hot water supply	MW	c

15	($\mathbf{v_{w\,r}}$) and ($\mathbf{v_{w\,b}}$)	Standard specific discharge of hot water at personal account	kWh/hour	State building norms of Ukraine "Buildings and Constructions" Health Protection Establishments State Building Norms B.2.2-10-2001[11]
16	($\mathbf{Cef_r}$) and ($\mathbf{Cef_b}$)	CO_2 emission factor (natural gas)	Kt CO_2e/TJ	IPCC, 2006 Volume 2, table 2.2, page 2.17
17	**g**	Conversion factor for average load within heating period		statistics
18	($\mathbf{P_b}$) and ($\mathbf{P_r}$)	Electric energy consumption by the boiler-houses and heat supply station, wherein frequency regulators, new pumps and ventilators will be installed	MWh	m

Table 5. Natural gas consumption by boiler-houses in base and project years

Code and address of boiler-house		Baseline 2004	Project year 2008	Project year 2009	Project year 2010
		($\mathbf{B_b}$)	($\mathbf{B_r}$)	($\mathbf{B_r}$)	($\mathbf{B_r}$)
1	Ward #289, 9a, Gurova Avenue	6884	5275.00	4796.49	3412.08
2	Ward # 191a, 72a R. Luxemburg Str.	3694	3406.73	3103.73	2304.21
3	Donetsk Polytechnic Institute 135a. Artema Str.	1682	1538.23	1340.27	749.32
4	Ward # 245 135a, Artema Str.	3773	3288.56	3099.69	2352.90
5	Boiler-house, 45 45, Artema Str.	158	127.26	107.06	82.42
6	Boiler-house, 43 43, Artema Str.	202	150.49	121.20	77.77
7	Ward # 138 6a, Antypova Str.	4297	3611.76	3160.29	2347.75
8	Ionina 9b, Ionina Str.	22182	19396.04	17184.14	12133.84
9	KMR 10b, Politboytsov Str.	6611	5418.65	5230.79	3459.76
10	Ward #287 8b, Chapaeva Str.	5448	4608.63	4155.14	2886.58
11	Ward # 756 19, Odyntsova Str.	561	494.90	415.11	299.57
12	RCVD 11a, Kalinina Str.	178	135.34	87.87	55.65
13	City Hospital No.2 23a, Donenergo Str.	248	246.44	195.94	137.46

[11] *http://zakon.nau.ua/doc/?uid=1041.2346.0*

14	SENB 18a, Blagoustroyinna Str.	829	802.95	736.29	486.82
15	Ward #14-67 21a, Arkhitektoriv Str.	5825	4525.81	4363.20	3259.27
16	MR-4 24b, Stakhanova Str.	4808	3775.38	3564.29	2377.54
	Total MCE "Donetskmiskteplomerezha"	**67380**	**56802**	**51662**	**36423**

Table 6. Natural gas consumption by enterprise in base and project years

Enterprise	Baseline 2004	Project year 2008	Project year 2009	Project year 2010
	(B_b)	**(B_r)**	**(B_r)**	**(B_r)**
Total Municipal commercial enterprise "Donetskmiskteplomerezha"	**67 380**	**56 802**	**51 662**	**36 423**

B.2.2. Data concerning GHG emissions by sources of the project activity:

See Annex 1, Annex 2, Annex 3 of this monitoring report.

B.2.3. Data concerning GHG emissions by sources of the baseline**:**

See Annex 1, Annex 2, Annex 3 of this monitoring report.

B.2.4. Data concerning leakage:

Indirect external leakage of CO_2, CH_4, N_2O generated by fuel production and its transportation is excluded. Leakage is not controlled by the project's developer (it is impossible to estimate quantity of leakage), therefore they were excluded.

B.2.5. Data concerning environmental and social impacts:

According to the Ukrainian rules, the design documentation for the new building, reconstruction and technical re-equipment of industrial and civil objects must include the environmental impact assessment, the main requirements for which are listed in the State Building Norms of Ukraine A.2.2-1-2003.

Municipal commercial enterprise "Donetskmiskteplomerezha" has the necessary Environmental Impact Assessment for its activity according to Ukrainian legislation.

In general, the project "Rehabilitation of the District Heating System in Donetsk City" will have positive effect on the environment. The following clauses provide detailed information about positive effect on the environment:

1. Project implementation will make it possible to save natural gas. Natural gas is exhaustible resource, therefore its saving is of great importance;

2. Due to fuel saving and new ecological technologies of fuel burning, project's implementation will reduce emissions of SO_x, NO_x and CO as well as particulate matters (combustion co-products);

3. It is expected that as a result of improvement of heat supply system population in Donetsk city will reduce consumption of electric energy produced by electric heaters, decreasing thus emissions of CO_2, SO_x, NO_x, CO as well as particulate matters.

Requirements of Environmental Impact Assessment are given in the State Building Norms of Ukraine A.2.2-1-2003.

Municipal commercial enterprise "Donetskmiskteplomerezha" conducts necessary Environmental Impact Assessment in the course of capital rehabilitation of the objects. There is also "Technical report of pollutant emission sources inventory at Municipal commercial enterprise "Donetskmiskteplomerezha".

Impact on water medium

There is influence on water medium. Impact on water resources will be the same as in the baseline scenario. Existing technologies of heat energy production exploited at the objects of Municipal commercial enterprise "Donetskmiskteplomerezha" 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. At present ecological situation stabilized and is in dynamic balance. Each water intake is conducted according to the EII.

Project's 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 grid 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) Reduction of electric energy consumption will lead to the air pollutants emissions reduction.
3) Decrease of heat pollution of the atmosphere (due to decrease of the temperature of combustion gases);

4) 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.

Relevant regulation is the sphere of land use is presented by the Land Code of Ukraine. National technological practice/standard: State Standard 17.4.1.02.-83 "Protection of Nature, Soils. Classification of chemical substances for pollution control".

Effects on biodiversity

There is no impact on biodiversity.

B.3. Data processing and archiving (incl. software used):

Collection of data related to fuel consumption at Municipal commercial enterprise "Donetskmiskteplomerezha" is the following:

1. All boiler-houses are equipped with gas meters.

2. Majority of boiler-houses are equipped with automatic correctors of gas temperature and pressure. Gas consumption is registered automatically.

3. Also every hour the operators of boiler-houses take readings of external temperature, temperature and pressure of natural gas at input into the boiler-house and record them in the "Registration Log of boiler-house operation parameters". These parameters are necessary for reduction of gas loss to normal conditions. Gas consumption is measures by the gas meters installed at each boiler-house. Operators of boiler-houses record readings of meters every day in special paper journal.

4. Every day operators communicate the values of fuel consumption to corresponding processing center of Production unit of Municipal commercial enterprise "Donetskmiskteplomerezha". Municipal commercial enterprise "Donetskmiskteplomerezha" has single server. It makes it possible to see value of each controlled parameter for each day of monitoring period.

5. The processing centers communicate the data to gas supplying company.

B.4. Emergencies and technological breakdowns:

There were no emergencies at Municipal commercial enterprise "Donetskmiskteplomerezha" for 33 months (January 01, 2008 – September 30, 2010)

B.5. Procedures for detection and liquidation of malfunctions at Municipal commercial enterprise "Donetskmiskteplomerezha".

In case of any malfunctions of the equipment the operator shall notify the master of boiler-house. If it is impossible to eliminate such malfunction at once (absence of necessary detail, breakdown of engine, etc.) the reserve equipment shall be put into operation and the committee shall be established consisting of representatives of company's technical departments, chief engineer of the district and leading engineers. The act of defect or breakdown shall be executed according to the type of malfunction and handed over to the department of Municipal commercial enterprise "Donetskmiskteplomerezha"in time; the equipment shall be repaired

B.6. External data (type, source, access)

1. Heat value of natural gas shall be taken according to the telephone message of gas supplier or report of independent chemical laboratory.
2. Daily external temperature obtained by dispatcher of Municipal commercial enterprise "Donetskmiskteplomerezha" in Donetsk metrological center.
3. Quantity of consumers of hot water supply service is determined on the basis of information about personal accounts which MCE "Donetskmiskteplomerezha" gets from Municipal housing committee offices once per month.
4. Value of heat-transfer factor of old buildings is determined by Construction norms and specifications 2-3-79 (1998), of new buildings - State Building Norms (B.2.6-31:2006).
5. Duration of heating period is taken according to the clause 7.9.4 of "Rules of technical maintenance of heating equipment and heat supply networks".
6. Standard specific discharge of hot water for one personal account for various types of consumers is determined by KTM 2004 Ukraine 244-94.
7. CO_2 emission factors consumers is determined by the Annex C of Operational Directive for Joint Implementation Project Design Document (Section 1: General Directive; Version 2.2).

B.7. Error level of metering equipment

Error level shall be determined for each type of metering equipment. Generally such level is low. Level of deviation of electric energy metering devices is less than 0,5%.

Devices of commercial recording of electric energy installed at Municipal commercial enterprise "Donetskmiskteplomerezha" correspond to criteria stated above.
Level of deviations of gas meters is less than 1%.
Devices of technological recording of gas installed at Municipal commercial enterprise "Donetskmiskteplomerezha" correspond to criteria stated above.
Permissible error level of stated measurements (in relation to which adjustment is not made in subsequent calculations) is regulated.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management structure:

C.1.1. Roles and responsibilities:

Director of Municipal commercial enterprise "Donetskmiskteplomerezha", Viktor Rogachov, appointed Mrs. Valentyna Skoryk, responsible for implementation and monitoring at Municipal commercial enterprise "Donetskmiskteplomerezha". Valentyna Skoryk controls data collection, measurement, calibration, data record and their storage.
Kucherenko Karina and Yevgeniy Vorobyov, engineers of "VEMA S.A." are responsible for elaboration of baseline and methodology of monitoring, as well as data processing.

C.1.2. Trainings:

Since the principal activities of Municipal commercial enterprise "Donetskmiskteplomerezha"will not change when introducing the Joint Implementation (JI) project, special technical trainings for personnel are not necessary. Technical personal of the enterprise possesses necessary knowledge and experience for execution of project implementation and repair of common equipment.

In case of new equipment application (such equipment which has not been used by this enterprise before), the manufacturing company shall conduct trainings for personnel.
Municipal commercial enterprise "Donetskmiskteplomerezha" retrains the personnel according to the requirements of Norms of labor protection. The enterprise has the Labour Protection Department responsible for professional development and trainings of the personnel.

In the course of JI project elaboration, the specialists of VEMA S.A. held the broadened consultations and trainings for involved representatives of Municipal commercial enterprise "Donetskmiskteplomerezha" about collection of necessary data according to the monitoring plan of the project.

C.2. External and internal audits and control measures:

MCE "Donetskmiskteplomerezha" has an established information collecting system of energy consumption. All boiler equipment of enterprise has measurement equipment such as electric meters and gas meter. Thus, it allows monitoring the parameters relating to the project continuously.
Measurement equipment included at the test plan (calibration) and confided (calibrated) with the established periodicity. There are documented instructions of equipment using at workplaces. All measurement equipments are up to regulatory requirements on the accuracy and measurement error in force in Ukraine. Accuracy is guaranteed by the manufacturer, the error is calculated and confirmed by the equipment certificates.
Thus, the uncertainty level of measurements is included by the Specifications. It is used and taken into account when data from the devices is gathering.
All monitoring equipment is covered by detailed plans of verification (calibration). Verification process is under strict control. According to calibration schedules, all devices are in satisfactory condition.
The monitoring procedures and responsibility of its implementation at the MCE "Donetskmiskteplomerezha" are governed by internal instructions of the enterprise.
Instructions have been developed in accordance with the ISO 9001 standard requirements. It provides the necessary level of measurement accuracy by means of monitoring. According to national legislative requirements, guidelines are reviewed every 3 years.
To reduce measurement errors the most effective available methods are used. Mainly, level of errors is low - usually less than 2% for all parameters that are or will be subject to monitoring.
All equipment used for monitoring is up to national legislation, as well as ISO 9001 standard.
Calibration procedures of all monitoring equipment are described in the RMI-I.19.0.1-07 and RMI-I.19.1.1-07 documents.

External audit:
Each quarter, the project developers of the «VEMA S.A.» conduct the external audit on the MCE "Donetskmiskteplomerezha". The internal audit plan of MCE "Donetskmiskteplomerezha" includes the following measures:
1. Check of electric energy logbooks;
2. Check of natural gas logbooks;
3. Check of electric meters terms calibration;
4. Check of water meters terms calibration;
5. Checking for compliance with the quarterly report of the electric energy consumption on the MCE "Donetskmiskteplomerezha";
6. Checking for compliance with the quarterly report of the natural gas volume consumption on the MCE "Donetskmiskteplomerezha".

C.3. Troubleshooting procedures:

In case of any malfunctions of the equipment the operator shall notify the master of boiler-house. If it is impossible to eliminate such malfunction at once (absence of necessary detail, breakdown of engine, etc.) the reserve equipment shall be put into operation and the committee shall be established consisting of representatives of company's technical departments, chief engineer of the district and leading engineers. The act of defect or breakdown shall be executed according to the type of malfunction and handed over to the department of Municipal commercial enterprise "Donetskmiskteplomerezha" in time; the equipment shall be repaired.

SECTION D. Calculation of GHG emission reductions

D.1. Applied formulas:

This section contains documented formulas applied for calculation of project emissions, baseline emissions and total emission reductions given in the tables below.

Total reduction of emissions

Total reduction of emissions is the difference between the baseline emissions (BE) and project emissions (PE).

Formula 1 – Total emission reduction (ERUs)	
	$ERUs = \sum[E_{i,b} - E_{i,r}]$; [t CO_2e]
	ERUs - Total annual emission reduction [t CO_2e]; $E_{i,b}$ - Baseline CO_2 emissions [t CO_2e]; $E_{i,r}$ - CO_2 emissions in the reported year [tCO_2e].
	The sum is taken over all boiler-houses (i) which are included into the project

Project emissions

Formula 2 –Emissions in the reported year **(E_r)**	
	$E_{i,r} = E_{1i,r} + E_{cons\ i,r}$; [t CO_2e]
	$E_{1i,r}$ – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the reported year, t CO_2e; $E_{cons\ i,r}$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the reported year, t CO_2e.

Formula 3 – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the reported year, ($E_{1i,r}$)	
	$E_{1i,r} = LHV_r * Cef_r * B_{ri}$, [tCO_2e]
	B_{ri} – amount of fuel consumed by a boiler-house in the reported year, ths m^3 or tons; LHV_{ri} – Average annual lower heating value, MJ/m^3 (MJ/kg) ; Cef_i – carbon emission factor, ktCO_2/TJ.

Formula 4 – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the reported year ($E_{cons\ i,r}$)	
	$E_{cons\ i,r} = P_r * CEF_c$

	P_r – electric power consumption by the boiler-houses with energy saving measures implemented, MWh; CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh;

Baseline emissions

Formula 5 – Annual baseline emissions **(**E_b)	
	$E_{i,b} = E_{1i,b} + E_{cons\ i,b}$ [t CO_2e]
	$E_{1i,b}$ – baseline CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house , t CO_2e; $E_{cons\ i,b}$ – CO_2 emissions due to electric power consumption from greed by the i boiler-house in the base year, t CO_2e.

Formula 6 – Baseline CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house, ($E_{1i,b}$)	
	For the case when in the base year the hot water supply service was provided (independent of this service duration, $(1-a_b) \neq 0$), the formulae for E_1^b is: $E_{1,b} = LHV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_b * (1-a_b) * K_1 * K_w]$, where the first term in brackets describes fuel consumption for heating, and the second one – fuel consumption for hot water supply. For the case when in the base year the hot water supply service was absent at all ($(1-a_b) = 0$), and in the reported year this service was provided (due to improvement of heat supply service quality for population), the formulae for $E_{1,b}$ is: $E_{1,b} = LHV_b * Cef_b * [B_b * a_b * K_1 * K_h + B_r * (1-a_r) * K_1 * K_{w0}]$
	LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg); Cef – carbon emission factor, $KtCO_2/TJ$; B_b – amount of fuel consumed by a boiler-house in the base year, ths m^3 or tons; K_1, $K_h = K_2 * K_3 * K_4$; $K_w = K_5 * K_6 * K_7$ – adjustment factors; a_b – portion of fuel (heat), consumed for heating purposes in the base year; $(1-a_b)$ – portion of fuel (heat), consumed for hot water supply services in the base year; a_r – portion of fuel (heat), consumed for heating purposes in the reported year.

Formula 7 – Portion of fuel (heat), consumed for heating purposes in the base year (a_b)	
	$a_b = L_{h,b} * q * N_{h,b} / (L_{h,b} * g * L_{w,b} + L_{w,b} * N_{w,b})$;
	$L_{h,b}$ – maximum connected load required for heating in the base year , MW; $L_{w,b}$ – connected load required for hot water supply service in the base year , MW; g – recalculating factor for average load during heating period (usually 0,4-0,8); $N_{h,b}$ – duration of heating period in the base year , hours $N_{w,b}$ – duration of hot water supply service in the base year, hours.

Formula 8 – Portion of fuel (heat), consumed for heating purposes in the reported year (a_r)	
	$a_r = L_{h,r} * q * N_{h,r} / (L_{h,r} * g * N_{h,r} + L_{w,r} * N_{w,r})$
	$L_{h,r}$ – maximum connected load required for heating in the reported year , MW; $L_{w,r}$ – connected load required for hot water supply service in the reported year , MW; g – recalculating factor for average load during heating period (usually 0.4-0.8); $N_{h,r}$ – duration of heating period in the reported year, hours; $N_{w,r}$ – duration of hot water supply service in the reported year, hours.

Formula 9 – Change in the lower heating value (K_1)	
	$K_1 = LHV_b / LHV_r$
	LHV_b – Average annual lower heating value in the base year, MJ/m^3 (MJ/kg); LHV_r – Average annual lower heating value in the reported year, MJ/m^3 (MJ/kg)

Formula 10 – Temperature change factor (K_2)	
	$K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b})$
	$T_{in\,r}$ – average inside temperature for the heating period in the reported year, K (or ^{0}C); $T_{in\,b}$ – average inside temperature for the heating period in the base year, K (or ^{0}C); $T_{out\,r}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C); $T_{out\,b}$ – average outside temperature for the heating period in the reported year , K (or ^{0}C).

Formula 11 – Heating area and building thermal insulation change factor (K_3)	
	$K_3 = [(F_{h\,r} - F_{h\,t\,r} - F_{h\,n\,r}) * k_{h\,b} + (F_{h\,n\,r} + F_{h\,t\,r}) * k_{h\,n}] / F_{h\,b} * k_{h\,b}$,
	$F_{h\,b}$ – heating area in the base year, m^2; $F_{h\,r}$ – heating area in the reported year, m^2; $F_{h\,n\,r}$ – heating area of new buildings connected to DH system (assumed with the new (improved) thermal insulation) in the reported year, m^2; $F_{h\,t\,r}$ – heating area of buildings (previously existed in the base year) in reported year with the renewed (improved) thermal insulation, m^2; $k_{h\,b}$ – average heat transfer factor of heated buildings in the base year, (kW/m^2*K); $k_{h\,n}$ – heat transfer factor of heated buildings with the new thermal insulation (new buildings or old ones with improved thermal insulation), (kW/m^2*K).

Formula 12 – Heating period duration change factor (K_4)	
	$K_4=N_{hr}/N_{hb}$
	N_{hb},– duration of heating period in the base year, hours; N_{hr} – duration of heating period in the reported year, hours.

Formula 13 – Number of customers change factor (K_5)	
	$K_5 = n_{wr} / n_{wb}$
	n_{wb},– number of customers, personal account in base year; n_{wr} – number of customers , personal account in the reported year.

Formula 14 – Standard specific discharge of hot water per personal account change factor (K_6)	
	$K_6 = v_{w\,r} / v_{w\,b}$
	$v_{w\,r}$ – standard specific discharge of hot water per personal account in the reported year, (in heat units, kWh/h); $v_{w\,b}$ – standard specific discharge of hot water per personal account in the base year, (in heat units, kWh/h).

Formula 15 – Hot water supply period duration change factor (K_7)	
	$K_7 = N_{wr}/ N_{wb}$
	N_{wr}– duration of hot water supply service in the reported year, hours; N_{wb} – duration of hot water supply service in the base year, hours.

Formula 16- CO_2 emissions due to electric power consumption in the base year ($E_{cons\ i,\ b}$)	
	$E_{cons}^{b} = P_b * CEF_c$
	P_b – electric power consumption by the boiler-houses where energy saving measures are scheduled to be implemented in the base year, MWh; CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh.

D.3. Decrease of GHG emission (reference to section B.2 of this document):

D.3.1. Project emissions:

Project CO_2 emissions due to fuel consumption for heating and hot water supply by Municipal commercial enterprise "Donetskmiskteplomerezha" in reporting year.

Table 7. Project emissions

Project emissions , tCO_2e	**2008**	**2009**	**2010**	**Total**
Municipal commercial enterprise "Donetskmiskteplomerezha"	108 288	98 133	69 105	**275 526**

D.3.2. Baseline emissions:

Baseline CO_2 emissions due to fuel consumption for heating and hot water supply by Municipal commercial enterprise "Donetskmiskteplomerezha".

Table 8. Baseline emissions

Baseline emissions, tCO_2e	**2008**	**2009**	**2010**	**Total**
Municipal commercial enterprise "Donetskmiskteplomerezha"	135 409	138 118	94 862	**368 389**

D.3.3. Leakage:

There are no leakages related to this project.

D.3.4. Resume of emission reductions during the monitoring period:

Table 9. Total emissions reductions

Emissions reductions, tCO_2e	**2008**	**2009**	**2010**	**Total**
Municipal commercial enterprise "Donetskmiskteplomerezha"	27 121	39 985	25 757	**92 863**

Actual amount of emission reductions in the project years was different from those values that were obtained by monitoring. This happened due to the fact that during the development of PDD were given the data of expected plan for 2008-2010 years that were impossible to accurately predict the project. The difference between planned and actual values of these two parameters and also caused the difference in expected and actual emission reductions for the project.

Annex 1 – Parameters of Monitoring Plan

Data in this Annex are given in accordance with Parameters of Monitoring Plan.

No. of parameter	Name of parameter
1	Fuel consumption by boiler-houses (natural gas)
2	Heat value is calculated on the basis of the lower heat value (natural gas) (average value per season)
3	Average external temperature during heating season
4	Average internal temperature during heating season
5	Quantity of consumers
6	Total heated area
7	Average heat-transfer factor of the buildings in basic year
8	Heated area of buildings (existed in basic year) with improved heat insulation
9	Heated area of new buildings connected to the heat supply system (it is conceded that such buildings have new improved heat insulation) in reporting year
10	Heat-transfer factor of the buildings with new thermal insulation
11	Duration of heating period
12	Duration of hot water supply period
13	Maximal connected load for heating services
14	Maximal connected load for hot water supply
15	Standard specific discharge of hot water at personal account
16	CO_2 emission factor
17	Conversion factor for average load within heating period

No. and name of the parameter (according to the monitoring Plan)	**1. Fuel consumption by boiler-houses. Natural gas**
Description	Fuel consumption by boiler-houses.
Value in monitoring period	2008 - CUE "Donetskmiskteplomerezha"- 56 802 thous.m^3; 2009- CUE "Donetskmiskteplomerezha" - 51 662 thous.m^3; 2010- CUE "Donetskmiskteplomerezha"- 36 423 thous.m^3; Detailed information about natural gas consumption by each boiler-house is given in the Annex 2
Method of monitoring	Gas meters
Recording frequency	Daily
Confirming documents	Readings of meters shall be registered in special paper logs at each boiler-house
Method of calculation	Does not exist
Comments	According to the monitoring plan the volume of natural gas consumption was adjusted by error of measuring equipment according to the principle of conservatism. Consumption of natural gas in reporting year applied for measurement of Project emissions was adjusted by error of gas meters for each boiler-house. See Annex 2, Annex 3.

No. and name of the parameter (according to the monitoring Plan)	**2. Heat value of natural gas**
Description	Average heat value of natural gas calculated on the basis of the lowest heat value for each city.
Value in monitoring period	See table below:

City	Average heat value of natural gas, MJ/m^3		
	2008	2009	2010
Donetsk	34.0	33.86	33.82

Method of monitoring	It shall be taken according to the telephone message of gas supplier or report of independent chemical laboratory. Analyses of independent chemical laboratory shall be done in case of any disputable cases. They are used rarely.
Recording frequency	Data shall be provided by the gas supplier; 3 times per month as a rule.
Confirming documents	Registered in special paper logs
Method of calculation	Weighted average value
Comments	

No. and name of the parameter (according to the monitoring Plan)	**3. Average external temperature during heating season**
Description	Average external temperature during heating season for city
Value in monitoring period	See Annex 2.

Method of monitoring	Average external temperature during heating season shall be calculated by Municipal commercial enterprise "Donetskmiskteplomerezha" on the basis of daily external temperature obtained by dispatcher of Municipal commercial enterprise "Donetskmiskteplomerezha" in Donetsk metrological center within the period from 10:00 to 11:00 a.m. on each day of heating period.
Recording frequency	Daily external temperature shall be registered on every day of heating period.
Confirming documents	Metrological center shall send the reports for each day of heating period of each decade on month. Reports shall be sewed in special files.
Method of calculation	Average value
Comments	

No. and name of the parameter (according to the monitoring Plan)	**4. Average internal temperature during heating season**
Description	Average temperature inside the heated premises during heating season
Value in monitoring period	Standard temperature inside the premises shall be at least 18^{o}C. According to the principle of conservatism average temperature inside the heated premises was taken as 18^{o}C, since during heating period of 2008-2010 there was not insufficient heating in the premises of consumers of Municipal commercial enterprise "Donetskmiskteplomerezha"
Method of monitoring	Thermometers
Recording frequency	Once per week in 3 standard houses for each boiler-house.
Confirming documents	Results of temperature measurement by the thermometers inside the heated premises shall be signed by the chiefs of users' groups and stored in special files
Method of calculation	Average value.
Comments	

No. and name of the parameter (according to the monitoring Plan)	**5. Quantity of consumers of hot water supply service**
Description	Quantity of consumers of hot water supply service for each boiler-house
Value in monitoring period	See Annex 2
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Population renewes the contracts concluded with holders of the books (municipal housing committee offices) once per annum. Municipal housing committee offices provide the Municipal commercial enterprise "Donetskmiskteplomerezha" with personal accounts once per month. Contracts with organizations and legal entities shall be concluded directly with Municipal commercial enterprise "Donetskmiskteplomerezha". They shall be prolonged once per annum.
Confirming documents	Information shall be stored in special electronic files "Registration of earnings from population". As concerns

	organizations and legal entities such information shall be taken from the contracts concluded with them.
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**6. Total heated area**
Description	Heated area for each boiler-house
Value in monitoring period	Detailed information about heated area of boiler-houses is given in Annex 2.
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Recalculation shall be done in case of signing new contracts or cancellation of existing ones
Confirming documents	Information shall be stored in sales department of Municipal commercial enterprise "Donetskmiskteplomerezha" and identified under the certificates of ownership or certificates of holders of the books (municipal housing committee offices) according to the technical certificates of buildings. Total area with balconies and stairs shall be reflected in special logs.
Method of calculation	Data shall be taken on January 01 of each year.
Comments	

No. and name of the parameter (according to the monitoring Plan)	**7. Average heat-transfer factor of the buildings**
Description	Average heat-transfer factor of the buildings for each boiler-house
Value in monitoring period	Heat-transfer factor of the buildings for each boiler-house is given in Annex 2.
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Heat-transfer factor of the buildings shall be recorded once when connecting and disconnecting heated areas to/from boiler-houses involved in project.
Confirming documents	Construction norms and specifications
Method of calculation	For calculation of heat-transfer factor of the buildings for each boiler-house the method of weighted average value was applied, taking into account area of existing buildings and area of new buildings. Value of heat-transfer factor of old buildings was taken from Construction norms and specifications 2-3-79 (1998) – less than 0.63. Value of heat-transfer factor of new buildings was taken from State Building Norms (B.2.6-31:2006) – less than 0.36.
Comments	

No. and name of the parameter (according to the monitoring Plan)	**8. Heated area of buildings (existed in basic year) with improved heat insulation in reporting year**
Description	Heated area of rehabilitated buildings subject to implementation of improved insulation of walls.
Value in monitoring period	There was not any rehabilitation of the buildings subject to

	implementation of new insulation of walls in the area of coverage of Municipal commercial enterprise "Donetskmiskteplomerezha"
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per year
Confirming documents	
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**9. Heated area of new buildings connected to the heat supply system (it is conceded that such buildings have new improved heat insulation) in reporting year**
Description	Heated area of new buildings connected to the heat supply system subject to implementation of improved insulation of walls
Value in monitoring period	There were no new buildings with improved insulation of walls connected to boiler-houses of Municipal commercial enterprise "Donetskmiskteplomerezha" in 2008, 2009 and 2010
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per year
Confirming documents	
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**10. Heat-transfer factor of the buildings with new thermal insulation**
Description	Heat-transfer factor of the buildings with new thermal insulation
Value in monitoring period	Maximum 0,36.
Method of monitoring	Value of heat-transfer factor of new buildings was taken from State Building Norms (B.2.6-31:2006)
Recording frequency	
Confirming documents	State Building Norms
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**11. Duration of heating period**
Description	Duration of heating period for each city
Value in monitoring period	Detailed information about Duration of heating period in 2008, 2009 and 2010 for each city are given in the Annex 2
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per year

Confirming documents	Duration of heating period is taken according to the clause 7.9.4 of "Rules of technical maintenance of heating equipment and heat supply networks". Commencement and termination of heating period shall be determined separately for each city. Heating period commences when daily average temperature of outdoor air reaches 8 ^{o}C or below within 3 days, and terminates when daily average temperature of outdoor air reaches 8 ^{o}C or higher within 3 days. According to the Construction norms and specifications 2.01.01-84 (Climatology in thermal power engineering) duration of heating period for projects' development shall be 183 days, and usually such period lasts from October 15 to April 15.
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**12. Duration of hot water supply period**
Description	Duration of hot water supply period for each boiler-house
Value in monitoring period	Detailed information about hot water supply period for each boiler-house is given in the Annex 2
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per twenty-four-hours.
Confirming documents	Hot water supply is implemented according to the hot water supply schedule for consumers of Municipal commercial enterprise "Donetskmiskteplomerezha", hot water supply schedule – 5.30 – 22.30.
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**13. Maximal connected load for heating services**
Description	Maximal connected load for heating services
Value in monitoring period	Detailed information about maximal connected load for heating services for each boiler-house is given in the Annex 2.
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per year
Confirming documents	Maximal connected load for heating services shall be measured by Municipal commercial enterprise "Donetskmiskteplomerezha" for each heating period. It shall be calculated for necessary heat energy under the temperature of -23 ^{o}C.
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**14. Connected load for hot water supply**
Description	Connected load for hot water supply
Value in monitoring period	Detailed information about connected load for hot water supply

	for each boiler is given in Annex 2.
Method of monitoring	Statistics of Municipal commercial enterprise "Donetskmiskteplomerezha"
Recording frequency	Once per year
Confirming documents	Maximal Connected load for hot water supply shall be calculated by Municipal commercial enterprise "Donetskmiskteplomerezha"according to the contracts concluded with the consumers
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**15. Standard specific discharge of hot water at personal account**
Description	Standard specific discharge of hot water at personal account
Value in monitoring period	Standard specific discharge of hot water for one personal account for various types of consumers is given in KTM 2004 Ukraine 244-94[1]
Method of monitoring	Normative document
Recording frequency	Once per year
Confirming documents	At present such standard specific discharge of hot water is effective, which has been proposed in KTM 204 of Ukraine 244-94[1] in 1993. There is no information about any changes, therefore it is not subject to special monitoring.
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**16. CO_2 emission factor**
Description	CO_2 emission factor for various types of fuel
Value in monitoring period	Normative document
Method of monitoring	Cef: (natural gas)=0,0561 thous. t CO_2 / TJ;
Recording frequency	Once per year
Confirming documents	For all types of fuel we use CO_2 emission factors from the table of data given in the Annex C of Operational Directive for JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT (Section 1: General Directive; Version 2.2)
Method of calculation	
Comments	

No. and name of the parameter (according to the monitoring Plan)	**17. Conversion factor for average load within heating period**
Description	Conversion factor for average load within heating period
Value in monitoring period	Statistics
Method of monitoring	Conversion factor is 0.4
Recording frequency	Once per year
Confirming documents	Conversion factor for average load within heating period (it shall be determined for each boiler-house on historical basis (usually 0.4-0.8);

Method of calculation	$g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$ where: g – Conversion factor for average load within heating period; F_h – heated area of premises, m^2; k_h – Heat-transfer factor of the buildings,(W/m^2*K); T_{in} – Average internal temperature during heating season, K (or ^0C); $T_{out\ av}$ – Average external temperature during heating season, K (or ^0C); $T_{out\ min}$ – minimal external temperature during heating period, K (or ^0C).
Comments	