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

"Rehabilitation of the District Heating System in Donetsk Region"

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SECTION A. General description of the project

A.1. Title of the project:

"Rehabilitation of the District Heating System in Donetsk Region"
PDD Version: 08, dated March 28, 2008

A.2. Description of the project:

The project main goal is fuel consumption reduction, in particular reduction of natural gas (which is imported to Ukraine), coal and oil consumption, by means of district heating system rehabilitation in Donetsk Region, including boiler and distribution network equipment replacement and rehabilitation, and installation of combined heat and power production plants. Such reduction of fuel consumption will result in decrease of greenhouse gas emissions (CO_2 and N_2O). The purpose of the project is sustainable development of the region through implementation of energy saving technologies.

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

The project was initiated in 2004 to rehabilitate Donetsk region's district heating system, including boiler and distribution network equipment replacement and rehabilitation, and installation of combined heat and power production plants (CHP). The project "Rehabilitation of the District Heating System in Donetsk Region" consists of two parts: Rehabilitation of Donetsk Region and Rehabilitation of Donetsk City. 286 boiler-houses with 1297 boilers and 1026 km of heat distributing networks are involved in the rehabilitation of Donetsk Region and 39 boiler-houses with 193 boilers and 248 km of heat distributing networks are involved in the rehabilitation of Donetsk City. In total: 325 boiler-houses with 1490 boilers and 1274 km of heat distributing networks are involved in the project. This is the large part of Donetsk regional DH system, and project may be expanded by including the other DH objects in the region.

Installation of cogeneration units at 10 boiler houses (12 gas engines, 0.5-0.63 MW each) in Donetsk region with total installed capacity 7.3 MW and at 6 boiler houses in Donetsk city (6 gas engines, 0.38 - 0.5 MW each) with total installed capacity 2.88 MW, in sum 18 gas engines with total installed capacity 10.18 MW, is incorporated into the project. Machines made by JSC "Pervomaiskdieselmash" (Ukraine), Deutz (Germany) and Jenbacher (Austria) are considered as potential candidates for installation.

The project employs the increase in fuel consumption efficiency to reduce greenhouse gas emissions relative to current practice. After complete project implementation over 15 million Nm^3 of natural gas and 50 thousand ton of coal will be saved annually. Such reduction of fuel consumption is based on increase of the boiler efficiencies, reduction of heat losses in networks and CHP installation. The following activities will ensure fuel saving:

- Replacement of old boilers by the new highly efficient boilers;
- Upgrading of boilers,
- Upgrading of boilers' burners;
- Installation of heat utilizers, including condensation ones;
- Switching of boiler-houses from coal and fuel oil to natural gas;
- Improving of the network organization, application of the new insulation and the pre-insulated pipes;
- Installation of combined heat and power plants;
- Installation of frequency controllers at smoke exhauster and hot water pumps engines.

Estimated project annual reductions of GHG emissions, in particular CO_2, are from 6.4 thousand tons to 123.9 thousand tons in 2005 – 2008, and are over 181.5 thousand tons per year starting from 2009 comparing to business-as-usual or baseline scenario.

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

RME "Donetskteplocomunenergo" fulfils annual minimal repairing of the DH system to keep it working. Particularly it executes repairing of network's parts and boilers that might cause accidents. More economically feasible and realistic scenario without carbon credits sales is a baseline scenario with very slow reconstruction activities than to make a major overhaul of the heating system. Tariffs for heat do not include the resources for prospective reconstruction of the district heating system, only the resources for probable necessary repairing after possible accidents. Minimal annual repairing doesn't lead to drooping of baseline emissions because of degradation of the whole system with efficiency droop at other objects, the overall actual emissions of Supplier would stay on the same level. This scenario is less environmentally favorable for the near future (including first commitment period 2008-2012), since GHGs emissions of Supplier will continue to be kept at the same level or even higher, but economically such scenario is more attractive.

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

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host Party)	RME "Donetskteplocomunenergo"; Institute of Engineering Ecology, Ltd	No
Netherlands	E-Energy B.V.	No

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

- ***RME "Donetskteplocomunenergo":*** is a project implementation agency (**Supplier**), which represents heat supply enterprises of Donetsk region. It operates equipment for heat production and distribution, and renders the heat supply services. As far as this organization purchases all the necessary inputs, including fuel, electricity, water, etc., it has the primary interest in the reduction of specific fuel consumption that can be achieved by the implementation of the project. Besides, this enterprise has all licenses and permissions, required under Ukrainian legislation, to perform designing and rehabilitating of the equipment. It is responsible for designing, engineering and installation works execution by its own personnel or with the aid of subcontractors. It finances this project (partly on credit base) and receives profits.

Historical details:

The Regional production association "Donetskteploset" was organized in April, 1978, on the base of 13 enterprises in Donetsk Region. Since this time the enterprise had undergone some structural changes – the amount of productive units and the name was changed (nowadays the Regional (oblast) municipal enterprise "Donetskteplocomunenergo" includes 24 industrial units) as well as the amount of workers.
Today the Regional Municipal Enterprise (RME) "Donetskteplokomunenergo" is a powerful complex, which is a huge heat supply enterprise in Ukraine. It supplies heat to over 270 thousands of personal accounts in Donetsk Region. The stuff of the enterprise consists of about 6 ths workers. They provide continuous operation of the heat generating, transporting and distributing equipment. The enterprise characteristics is given in Table 1.

	01.01.2004	01.01.2006
Total amount of the boiler-houses	318	372
Length of the heat supply networks in the 2-pipe calculation, km	1187.4	1288.1
Total enterprise capacity, Gkal per hour	2736.6	2995.0
Connected heat load, Gkal per hour	1680.0	1686.7
Heating area (living), 1000*m^2	11701.1	11875.7
Amount of personal accounts	260785	273049

Table 1. Enterprise characteristics

The heating area for the population makes 81.1 %, for the legal entities – 18.9 %.

Today 24 productive units are the members of Regional municipal enterprise "Donetskteplokomunenergo". They supply the Donetsk Region residents with heat and hot-water.

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

Historical details:

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

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

Among the Institute's developments there are such new technologies and equipment as hot water boilers (with heat capacity of 0.63 and 2.0 MW), heat utilizers (condensation, contact, contact-surface), air-

heaters, modernized hearth radiation burners, intensification of furnace heat-exchange, increasing of dust and gas-cleaning efficiency, etc.

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

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

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

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

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

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

- ***E-Energy B.V.:*** is the purchaser of emission reduction units generated from this project. It is a company registered in the Netherlands, and is one of subsidiaries belonging to the E energija group.

Having started its activity in 1994, E energija group has expanded from its first established company Energijos taupymo centras (Energy saving center).

The rising work range and economical-social conditions caused the creation of vertically integrated company’s structure, with the separation of group’s operation fields. For this purpose, the company E energija UAB, which now is the management company of the whole E energija group, was established.

E energija, UAB is an energy planning and management company, which implements turnkey projects from conceptual development and owns companies generating and supplying energy for industries and residents of the cities.

One of key aims of E energija specialists is to prepare energy plans to meet energy needs for subsistence and development of alternate energy sources and the increase of energy efficiency at least cost to the economy and environment.

Since 2005 E energija group, one of the first companies in the Baltic countries has been involved in the project development under Kyoto Protocol flexible mechanisms and started trading activities with EU allowances as specified by EU Emission Trading Scheme.

E-Energy B.V. is a company responsible for E energija group carbon credit procurement for its own purposes and all business related with carbon credit trade. E-Energy B.V. is active investor in the market of Eastern European countries in a number of JI projects.

A.4. Technical description of the project:

A.4.1. Location of the project:

The Project is located in Donetsk Region in the South-Eastern part of Ukraine (**Fig.1**).

Fig. 1. The map of Ukraine with neighboring countries

A.4.1.1. Host Party(ies):

Ukraine.

Ukraine is an Eastern European country that ratified the Kyoto Protocol to UN FCCC on February 4th, 2004, and is eligible for the Joint Implementation projects.

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

Donetsk Region.

Donetsk region is located in the South-Eastern part of Ukraine. Its territory is 26500 km^2 (about 4.4% of the total area of Ukraine), its longitude from north to south is 270 km, from east to west – 190 km. Its population (as of 2004) is about 4.7 million constitutes 10% of the overall Ukrainian population, making it the most populous and most densely populated region of the country. Its large population is due to the presence of several big industrial cities and numerous villages agglomerated around them. About 4.3 ml people live in cities and towns (90%), about 0.4 ml people (9,1%) – in villages.

The Donetsk region's climate is mostly continental, which is characterized by hot summers and relatively cold winters with changeable snow surfaces. The average temperatures are: -7 ^{0}C in January, and +19 ^{0}C in July, with average annual rainfall of 524 mm. Thus the heating period is 183 days. The average outside temperature over the heating period is -1.8 ^{0}C.

On January 1st, 2004, Donetsk region accounted for 23.7 mln m^2 residential buildings, 514 boiler houses and about 2000 km of heat and steam networks that belong to the communal property. Besides the RME "Donetskteplocomunenergo", there are also other district heating enterprises in Donetsk region, but the networks are separated, not conjuncted, and no conjunction of the networks is planned.

Donetsk region borders in the south-west and west – upon Zaporizhzhya and Dnipropetrovsk regions, in the north-west upon Kharkiv region, in the north-east – upon Lugansk region, in the east – upon Rostov region of Russian Federation. On the south Donetsk region is washed by Azov Sea. There are 28 cities of regional submission in Donetsk region: Donetsk, Avdiyivka, Artemivsk, Gorlivka, Debaltseve, Dzerzhynsk, Dmytrov, Dobropillya, Dokuchayevsk, Drushkivka, Enakiyeve, Zhdanivka, Kirovske, Kostyantynivka, Kramatorsk, Krasnoarmiysk, Krasniy Lyman, Makiyivka, Mariupol, Novogrodivka, Selidove, Slov'yansk, Snizhne, Torez, Vugledar, Chartsyzsk, Shahtarsk, Yasinuvata. The territory is divided into 18 districts: Amvrosijivsky, Artemivsky, Velykonovoselkivsky, Volnovakhsky, Volodarsky, Dobropilsky, Konstyantynivsky, Krasnoarmijsky, Krasnolymansky, Mar'jinsky, Novoazovsky, Oleksandrivsky, Pershotravnevy, Slov'yansky, Starobeshevsky, Telmanivsky, Shakhtarsky, Yasynuvatsky.

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

Cities, towns and villages of the Donetsk Region (see the next issue).

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

It should be noted that the district heating systems from the majority of territorial districts of the Donetsk Region are involved in the project in question. The majority of places involved in the project (inscribed on the map) are marked with blue circles (**Fig. 2**).

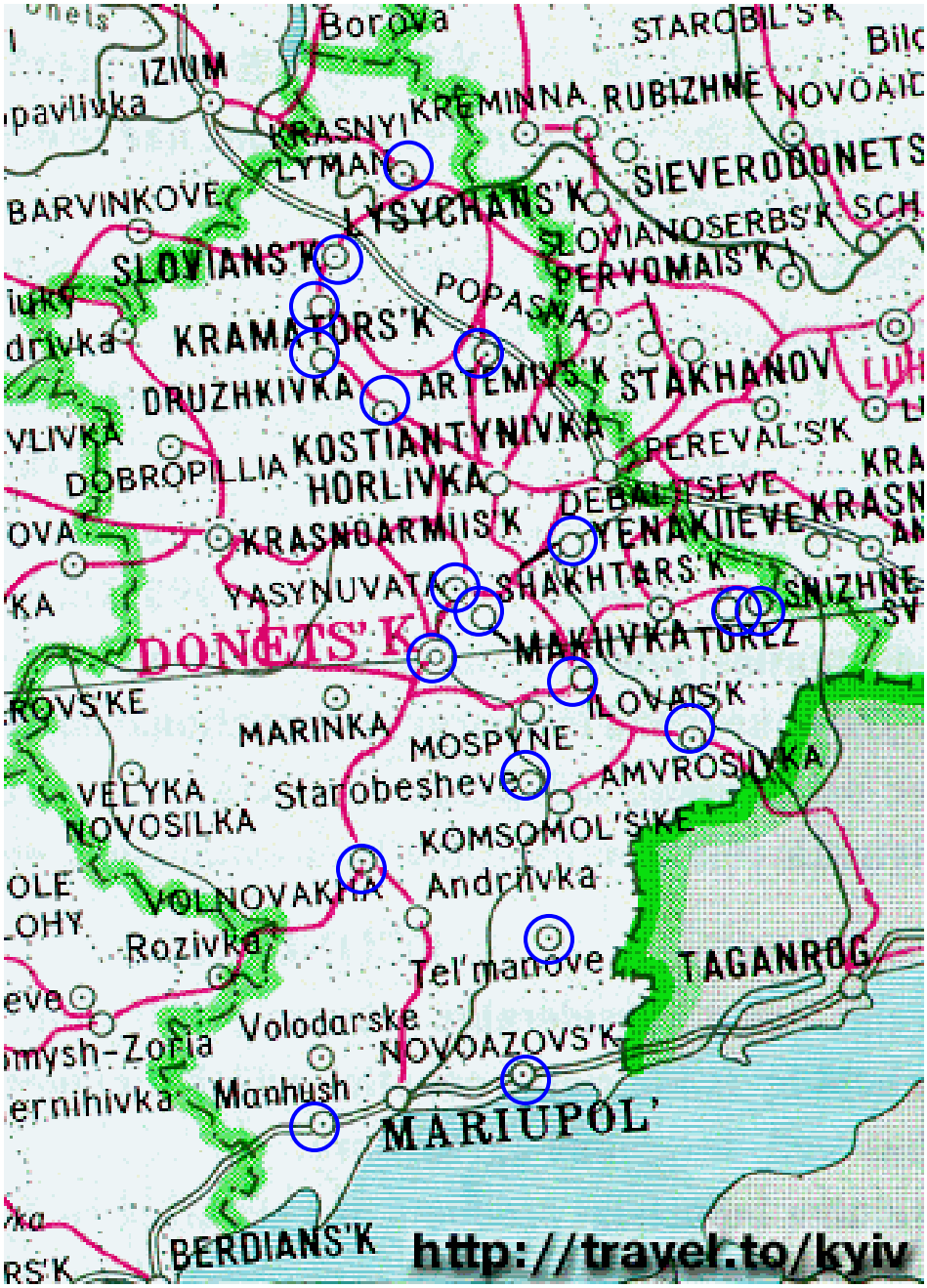

Fig. 2. Location of Donetsk region's major cities and towns where project will be implemented.

By the organizing structure, 24 district heating productive units are the members of regional municipal enterprise "Donetskteplokomunenergo" (Project Supplier), and belong to it. They are situated in the following cities, towns and urban villages (see Table 2). Besides, the RME "Donetskteplokommunenergo" is empowered to represent the owners (managers) of boiler-houses in Artemivsk ("Termoservise" Ltd) and Donetsk (MCE "Donetskteplomerezha") cities, for all activity associated with this JI project.

№	City	Number of boiler houses	Number of boilers	Number of boiler houses included in project	Number of boilers included in project	Scheduled GHG emissions reduction after complete implementation of the project, t CO_2
1	Amvrosiivka t.	8	36	7	33	1834.0
2	Volnovaha t.	21	79	16	65	2624.7
3	Vuglegirsk t.	5	12	5	12	3573.7
4	Vugledar t.	1	2	1	2	2354.4
5	Debaltseve t.	7	21	0	0	0.0
6	Dzerzhynsk t.	22	77	22	77	5005.1
7	Dmytrove t.	13	59	13	59	12361.8
8	Dokuchaevsk t.	4	17	4	17	569.4
9	Druzhkivka t.	16	75	12	39	6272.3
10	Enakieve t.	66	198	57	175	10946.0
11	Zhdanivka t.	7	21	7	21	1147.1
12	Ilovaysk t.	5	31	5	31	2426.5
13	Kirovske t.	8	46	8	46	5514.2
14	Kostyantinivka t.	28	90	28	90	7099.8
15	Kramatorsk t.	13	34	9	28	5793.0
16	Krasniy Lyman t.	14	52	12	48	3711.1
17	Mangush uv.	3	7	1	2	28.4
18	Novoazovsk t.	6	22	4	15	450.5
19	Selidove t.	8	29	5	13	12654.0
20	Slov'yansk t.	38	143	21	86	16826.9
21	Snizhne t.	14	62	9	41	4342.1
22	Starobesheve uv.	3	14	2	12	596.4
23	Telmanove uv.	2	5	2	5	300.8
24	Torez t.	20	70	10	50	4716.7
25	Ukrayinsk t.	5	37	5	37	16287.3
26	Chartsyzsk t.	19	103	14	73	6308.9
27	Chasiv-Yar t.	10	25	7	19	387.4
28	Shahtarsk t.	19	107	17	96	5111.6
29	Yasynuvata t.	15	60	11	48	5868.8
30	Artemivsk t.	14	57	14	57	4324.1
31	Donetsk c.	141	567	39	193	32057.0
	Total	555	2158	367	1490	181493.6

Table 2. Organizing structure of RME "Donetskteplocomunenergo" and other heat-supply enterprises included in the project

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

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

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

Measures that will be used to improve the efficiency of Donetsk Region DH utility are as follows:

- Old operating but low efficient boilers will be replaced by the new highly efficient ones that will result in efficiency increase from 40-85% up to 90-92%.
- Old operating low efficient coal-fired and fuel oil-fired boilers will be partially switched to or replaced by the new gas-fired boilers.
- Upgrading of boilers' burners will increase the efficiency by 3-5% due to improved combustion with excess air coefficient decreasing and reducing CO and NO_x emissions.
- The efficiency of the heat distribution networks system will be considerably increased by:
  - decreasing pipelines length (moving heat generating source closer to consumer);
  - improving of network organization (replacing 4-pipe lines by 2-pipe ones with simultaneous installation of heat exchangers directly at the consumers);
  - replacing of the main network pipes with diameter 57 mm and more by the pre-insulated ones and renovation pipe insulation with using of foamed polyurethane.

  These measures will substantially reduce heat losses from existing 20-35% and even more, down to 1-2 % per km.
- Installation of cogeneration units will result in increasing the fuel consumption efficiency, decreasing of dependence on the power supply and improvement of operational stability and reliability, decreasing of power consumption from power stations, decreasing of power transfer losses, and decreasing of environmental pollution.
- Installation of frequency controllers at smoke exhauster and hot water pumps engines will result in energy saving. Power consumption of boiler houses will be decreased at least by 10-20% from total annual boiler house power consumption.

The measures from this list will be implemented at boiler houses subject to rehabilitation.
The generalised schedule of their implementation will be the following:

- boiler houses rehabilitation - 2004 - 2008;
- network rehabilitation – 2004 - 2008;
- installation of CHP units – 2006 - 2008;
- installation of frequency controllers – 2007 - 2008.

Achieved results of employing of these technologies and measures are listed in the Appendixes 1 – 6 and Appendixes 9 – 10.

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

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

The project activities including rehabilitation of boilers, heat distribution networks and installation of combined heat and power coupling plants will increase energy efficiency of Donetsk Region DH system thus enabling it to produce the same amount of heat energy with less fuel consumed. Additionally it will produce electric power with less specific fuel consumption. Reduced fuel consumption will make lower CO_2 emissions.

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

Ukraine has claimed district heating and municipal energy sector as a priority of the national energy-saving development. This is pointed out in the State Program for Reformation and Development of municipal economy for 2004-2010 (Law of Ukraine from 24.06.2004 № 1869-IV), The Law of Ukraine from 01.07. 1994 № 74/94-VR "On energy saving" and The Law of Ukraine from 22.12.2005 №3260-IV "On changes in The Law of Ukraine "On energy saving". The law of Ukraine "On heat energy supply" (№ 2633-IV from 02.06.2005) regulates all relations in the heat supply market. It does not considerably change the previously existing practices in the market, but stimulates the more rigid energy saving and implementation of energy-efficient technologies.

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

In course of project implementation, the following emission reductions will be achieved, at the stages of project implementation:

Length of the crediting period	**Years**
2005-2024	20
Year	**Estimate of annual emission reduction in tonnes CO_2 equivalent**
2005	6350
2006	19428
2007	60133
Subtotal 2005 - 2007	**85911**
2008	123897
2009	186056
2010	184104
2011	183041
2012	181494
Subtotal 2008 - 2012	**858593**
2013	181494
2014	181494
2015	181494
2016	181494
2017	181494

2018	181494
2019	181494
2020	181494
2021	181494
2022	181494
2023	181494
2024	181494
Subtotal 2013 - 2024	**2177923**
Total estimated emission reduction over the crediting period (tones of CO_2 equivalent)	**3122427**
Annual average of estimated emission reduction over the crediting period (tones CO_2 equivalent)	**156121**

Table 3.Estimated total amount of CO_2e Emission Reductions

Thus the estimated amount of emission reductions over the commitment period (2008-2012) is **858 593** tons of CO_2e. Over the crediting period (2005-2024) - is **3 122 427** tons of CO_2e.For more detailed information see Appendixes 1 – 6, Appendixes 9 – 10 and Appendix 13.

Average annual amount of ERUs will be the following:
During commitment period 2008-2012 years – 171719 t CO_2e;
After commitment period 2013-2017 years – 181 494 t CO_2e.

Description of formulae used to estimate emission reductions is represented in paragraph D.1.4.
The example of emissions reduction calculation is presented in Appendix 11.

The amounts of ERUs and AAUs that is proposed by **Supplier** to the potential buyer are:

AAUs 2007 – 40 ths tons of CO_2e

Subtotal: 40 ths tons of CO_2e

ERUs 2008 – 90 ths tons of CO_2e
2009 – 140 ths tons of CO_2e
2010 – 140 ths tons of CO_2e
2011 – 140 ths tons of CO_2e
2012 – 140 ths tons of CO_2e

Subtotal: 650 ths tons of CO_2e
Total: 690 ths tons of CO_2e

Selling of the AAUs will be possible in case of approving the corresponding procedure by Ukrainian government. As the alternative, the possible selling of the Voluntary Emission Reductions (VERs) is under discussion.

A.5. Project approval by the Parties involved:

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

The project was initiated in 2004.

December, 2003 - Institute of Engineering Ecology suggested RME "Donetskteplocomunenergo" to develop Joint Implementation Project on Green House Gas Emissions Reduction.

March, 2004 – Decision of the Technical Council meeting of RME "Donetskteplocomunenergo"to make an Agreement with the Institute of Engineering Ecology on the Joint Implementation Project development.

April, 2004 - Agreement with the Institute of Engineering Ecology on the Joint Implementation Project development.

May, 2004 - Approval by the Technical Council meeting of RME "Donetskteplocomunenergo of the activity schedule for reconstruction of boilers and heat networks, and starting of project implementation.

December, 2004 - Decision of the Technical Council meeting of RME "Donetskteplocomunenergo" to re-examine the schedule of work execution on reconstruction of objects included into the Joint Implementation Project.

November, 2005 - Decision of the Technical Council meeting to include implementation of the CHP units in the Joint Implementation Project.

2006 - Agreement with ME "Donetskgorteploset" and Artemivsk to delegate their permissions to RME "Donetskteplocomunenergo".

March, 2006 - Agreement with "SVT" (Gemany), to fulfill the preparation of the project proposal for the JI project for submission to potential buyer.

2006 – Agreement with E-Energy B.V. (Netherlands), potential buyer of the ERUs to be generated from this project.

October 16, 2006 - Ministry for Environmental Protection of Ukraine has issued the Letter of Endorsement for this JI project.

June 08, 2007 – Positive Final Determination report (by TÜV SÜD, Germany) for the Project.

August 10, 2007 - Ministry for Environmental Protection of Ukraine has issued the Letter of Approval for this JI project.

SECTION B. Baseline

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

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

The main cause of impossibility of methodology AM0044 using for baseline calculation is no data for thermal energy output, because of thermal energy meters absence on the majority of boiler houses included in the project. That's why "SVT e.V." (Germany) and Institute of Engineering Ecology invented 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 by IAE for the similar JI Projects for Chernihiv region and Republic of Crimea .

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

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

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

The developed "Methodology" is the Project specific approach for the district heating sector in Ukraine, and may be applied to the other countries of previous USSR in view of the similarity of the main features of their district heating systems. It takes into consideration all aspects of the district heating system functioning – heat and hot water production and supply, electricity generation by CHP units belonging to this system, fuel and power saving in course of its operation.

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

The developed "Methodology" has two important advantages in comparison with the methodology AM0044 (at least for Ukrainian conditions):

- It takes into account the quality of heat supply (heating and hot water supply). Almost annually for the various reasons (receiving of less amount and high price of the fuel, in particular natural gas which is nearly 95 % of fuel type used in Ukraine for the needs of the municipal heat supply), the consumers receive less than necessary amount of heat, in the result of which the temperature inside the buildings is much lower than normative one, and hot water supply is insufficient or absent. As the purpose of JI projects, including the current project, is the GHG (CO_2) emission reduction under the conditions of not worsening in any circumstances of the social conditions of population, the issue of approaching of the heat supply quality to the

normative one is extremely important. Therefore, the amount of the fuel consumption for the after project implementation period is calculated for the conditions of providing the normative parameters of heat supply and at least partially of hot water supply, and in accordance with the monitoring plan, the implementation of continuous control (monitoring) of its quality (measurement of internal temperature in the specific buildings as well as registration of residents' complaints for the poor-quality heat supply) is foreseen. This increases the control for the qualitative heat supply for the consumers and excludes deliberate reduction of heat consumption, and, in such a way, of fuel consumption with the purpose of increasing of generation of GHG emissions reduction units (ERUs) at the project verification.

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

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

However, as it was mentioned before in this PDD, the majority of boiler-houses in Ukraine are not equipped with devices for heat-carrier expenditure definition or heat meters. There is only one parameter, that is regularly and with high precision defined in the boiler houses – fuel consumption.

For this reason, the own project specific methodology was developed, that is based on the permanent measuring of the fuel consumption and amendments for possible parameters changes in baseline in comparison with reporting year. The variable parameters may be the changes in lower heating value of fuels, quality of heating service, weather changes, changes in customers number, etc. Taking into account only equipment efficiency does not eliminate the possibilities of undersupply of heat to customers (deterioration of heat supply service), and possible weather warming in reported year, change in fuel quality, disconnection of some consumers, and other factors, and could lead to artificial overestimation of ERUs amount.

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

Approved Methodology AM0048 "New cogeneration facilities supplying electricity and/or steam to multiple customers and displacing grid/off-grid steam and electricity generation with more carbon-intensive fuels" already in its title shows the scope of applicability, that is different from the scope of the "District Heating" projects. In our projects, the cogeneration facilities produce hot water and not steam. Beside this, in according to AM0048 (page 22) and its monitoring plan (pages 23-30), it is necessary to realize, among other measurements, monthly measurement of $SC_{PCSG,i,y}$ (Total steam self-generated by project customer 'i' during year 'y' of the crediting period, TJ), measured by the steam meter at the customer 'i' (page 25). Thus Methodology AM0048 couldn't be implemented in original. In principle, it could be modified for conditions of hot water production for heating and hot water supply systems, but this will require modification of monitoring plan with introduction of other parameters that it is necessary to measure and register. But it would be the another methodology, that would require to measure such parameters as heat output, or hot water output with its temperature (in analogy with requirements of Methodology AM0048 to measure steam output, its pressure and temperature.

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

In view of the above mentioned, in contrast to the methodologies AM0044, ACM0009 and AM0048, our Methodology, developed for "District Heating" projects in Ukrainian conditions and used in JI Projects "Rehabilitation of the District Heating System in Donetsk Region", "Rehabilitation of the District Heating System in Chernihiv Region", "Rehabilitation of the District Heating System in Crimea" and others, is the most appropriate, precise, corresponding to the principle of conservatism, and the most closely reflects the aims, goals and spirit of Kyoto Protocol.

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

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

The first version of Baseline scenario was a business-as-usual scenario with minimum reconstruction works balanced by overall degradation of DH system.

The second version of Baseline scenario was to make reconstruction works without JI mechanism. This alternative baseline scenario was not accepted as feasible because in this case the project is not attractive for investments.

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

Thus, the first version was chosen for Baseline scenario.

Status and adequacy of the current delivery system

Current supply of Donetsk region DH systems is primarily based on Ukrainian and Russian made gas, fuel oil and coal fired boilers including DKVR-20/13, DKVR-10/13, DKVR-6.5/13, DKVR-4/13, DE-4/13, Fakel, BGV-50e, KVGM-20, KVGM-6.5, TG-3, TVG-8, TVG-4, Universal, Nadtochiya, NIKA-0.5, NR-18, KVGM-1.25, NIISTU-5, E-1/9G, RL-70, KSVa-0.63, KSV-2.0, KSVa-1.25, Minsk-1,

Tutunnika, Revokatova and few other types. Detailed information is presented in **Appendix 1 (Boilers)** and **Appendix 4 (Boilers City)**. Current efficiencies of those boilers are in the range of 40 - 90%.

Current distribution networks are characterized by heat losses from 20-30% to 35%. Detailed information is presented in **Appendix 2 (Networks)** and **Appendix 5 (Networks City)**.

Current power consumption at the boiler houses where frequency controllers will be installed is presented in **Appendix 9 (FC) and Appendix 10 (FC)**.

Construction of the Baseline Scenario

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

Project also provides electric power production on the new cogeneration units. This power will replace consumption from the national power system, that's why we take into account national standard of power system emissions for Baseline definition.

Calculation of Baseline Carbon Emission Factors

For all fuels we used CO_2 emission factors from the data table provided in Annex C of the Operational Guidelines for Project Design Documents of Joint Implementation Projects (Volume 1: General guidelines; Version 2.2).

Cef (natural gas) = 0,0561 $KtCO_2/TJ$;
Cef (fuel oil) = 0,0774 $KtCO_2/TJ$; (taken as "Residual fuel oil").
Cef (coal) = 0,0946 $KtCO_2/TJ$; (taken as "Other bituminous coal").

We assume that CO_2 emission factors for the fuels will be the same for period 2003-2012. For our calculations we assume that the Lower Heating Value of a fuel (LHV) doesn't change during that time, however in the Monitoring Plan the LHV factor will be taken into account for the baseline correction for any reported year until 2012.

Lower Heating Values of fuels used by RME "Donetskteplocomunenergo" are slightly different in different towns from year to year. Table 2 gives the averaged LHV for fuels that were used by the Applicant in 2003:

Type of fuel	Average lower heating value of fuel	
	kcal/m^3 (kcal/kg)	MJ/m^3 (MJ/kg)
Natural gas		
Amvrosiivka	7989	33.5
Volnovaha, Dokuchaevsk	7990	33.5
Dzerzhynsk	7970	33.4
Druzhkivka	7967	33.4
Dmytrove	7965	33.4
Enakieve, Vuglegirsk	7960	33.4
Kirovske,	7959	33.3

Zhdanivka		
Kostyantinivka	7964	33.4
Kramatorsk	7969	33.4
Krasniy Lyman	7991	33.5
Novoazovsk, Mangush	8008	33.6
Selidove, Ukrayinsk	7950	33.3
Slov'yansk	7967	33.4
Snizhne	7976	33.4
Starobesheve	7981	33.4
Telmanove	7995	33.5
Torez	7969	33.4
Vugledar	7974	33.4
Chartsyzsk, Ilovaysk	7970	33.4
Chasiv-Yar	7958	33.3
Shahtarsk	7963	33.4
Yasynuvata	7968	33.4
Artemivsk	7980	33.4
Donetsk	7979	33.4
Coal	4333	18.1
Light fuel oil	8738	36.7
Heavy fuel oil	9571	40.2

Table 4. Lower heating value for fuels used by the Applicant

Calculation OF CO_2 Conversion Factor (CF)

CF (Conversion Factor) = LHV (Lower Heating Value)* Cef (Carbon Emission Factor)

1000 m^3 of natural gas input = 33.4 [MJ/m^3]*0.0561 [KtCO_2/TJ] = 1.874 tCO_2

1t of Heavy fuel oil input = 40.2 [MJ/kg]*0.0774 [KtCO_2/TJ] = 3.11 tCO_2

1t of Light fuel oil input = 36.7 [MJ/kg]*0.0774 [KtCO_2/TJ] = 2.84 tCO_2

1t of Coal input = 18.1 [MJ/kg]*0.0946 [KtCO_2/TJ] = 1.712 tCO_2.

Calculation of Activity Level

Activity level is represented by annual fuel consumption. For calculation of Baseline emissions, the 2003 was taken as the Base year. This year is one of the typical years concerning the outside temperature in

heating period, as well as concerning the conditions of production and consumption of the heat. The fuels consumption in base year is represented in Table 5.

	Baseline Natural Gas Consumption, ths Nm^3/yr	Baseline coal Consumption, t/yr	Baseline Light Fuel Oil Consumption, t/yr	Baseline Heavy Fuel Oil Consumption, t/yr
RME "Donetskteplocomunenergo"	375208.5	49881.0	997.0	1183.0
Artemivsk t.	24028.6	0	0	0
Donetsk city	224773.6	599.0	0	0
Total	**624010.7**	**50480.0**	**997.0**	**1183.0**

Table 5. Fuel consumption in the base year

Detailed information is presented in **Appendix 1 (Boilers)** and **Appendix 4 (Boilers City)**.

Calculation of Baseline Carbon Emissions

There are 3 types of GHG emissions involved in the baseline scenario:

1) CO_2 emissions from boilers operated by Donetsk region DH systems. Baseline calculations were based on the assumption that baseline emissions during any report year (2008-2012) remain the same as in the basis year 2003.
2) CO_2 emissions due to electricity consumption from the grid, which will be replaced after installation of CHP units.
3) CO_2 emissions due to electricity consumption from the grid, which will be saved at the boiler houses after frequency controllers installation.

Carbon Emission factors (CEF) for 2008-2012 are taken from Table B1 "Baseline carbon emission factors for JI projects generating electricity" and Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of operational Guidelines for PDD's of JI projects (ERUPT 4, Senter, the Netherlands).

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CEF_g tCO_2e/MWh	0.77	0.755	0.74	0.725	0.71	0.695	0.68	0.66	0.651	0.636

Table 6. Carbon Emission factors (CEF) for electricity generation in Ukraine

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CEF_c tCO_2e/MWh	0.94	0.92	0.90	0.88	0.856	0.836	0.816	0.796	0.776	0.756

Table 7. Carbon Emission factors (CEF) for reducing electricity consumption in Ukraine

Calculation of resulting annual Baseline Carbon Emissions, that would take place during typical heating season if Donetsk region DH systems remains unchanged, see in **Appendix 7 (Baseline)**. They consist of an exact amount of total CO_2 emissions that took place during the base (2003) year, and additionally of

emissions due to electricity consumption for own needs from the grid in amount that will be replaced after installation of CHP units by the own-produced one, and electricity which will be saved after frequency controllers installation.

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

The anthropogenic emissions of GHG will be reduced due to complex modernization of heat generating and distributing equipment by application of the technologies proposed in the project activities and described above, which include replacement of old obsolete boilers by new ones with higher efficiency, replacement of obsolete coal-fired and fuel oil-fired boilers by the modern gas-fired ones, installation of new modern burners, frequency controllers installation, installation of cogeneration units at 14 boiler houses, renovation of degraded heat distribution networks with using the new insulation and the pre-insulated pipes.

For more obvious description of how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the JI project, we have built a dynamic baseline, which is the function of the stage of project implementation (see **Fig. 3**).

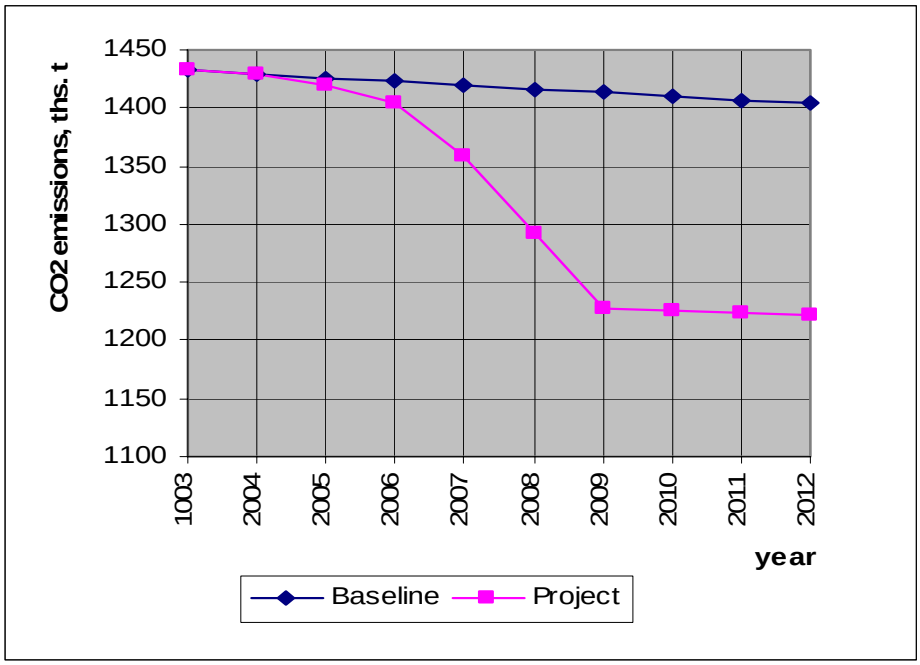

Fig. 3. Dynamic baseline and project emissions of GHG

Additionality of the project

The additionality of the project activity is demonstrated and assessed below with using the latest version of the "Tool for the demonstration and assessment of additionality" (Version 04). This tool was originally developed for CDM projects but may be applied to JI projects as well.

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

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

There are three alternatives to this project.
1. The first alternative is business-as-usual scenario with minimum reconstruction works, approximately balanced by overall degradation of the DH system. This is the common practice for DH sector in Ukraine.
It should be noted that there is no local legislation regarding the time of boilers replacement and maximum lifetime permitted for boilers. It is common practice to exploit boilers which was installed in 70 th. and even 50-60 th. and earlier in Ukraine, if they pass the technical examination pass by the authorized body ("Derzhnagliadohoronpratsi").

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

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

There may be noted also several other alternatives, for example, using of the renewable energy sources such as wind power or biomass and biofuel for boiler operation, etc., but these alternatives can not be realised in Ukraine at least at present.

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

According to The Laws of Ukraine "On licensing of the separate types of activity" (№ 1775-III, from June 01, 2000) and "On heat energy supply" (№ 2633-IV from 02.06.2005); Ukrainian Government Regulation "On introduction of changes to the Government Regulations №1698 from 14.11.2000 and №756 from 04.07.2001" №549 from 19.04.2006 and "On approval of the list of licensing bodies" №1698 from 14.11.2000, execution of economic activity in fields of heat energy production, distribution and supply require a license that is issued by Ministry of Housing and Municipal Economy of Ukraine.

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

The Project "District Heating System Rehabilitation of Donetsk Region" has been prepared according to The Law of Ukraine from 01.07. 1994 №74/94-VR "On energy saving" and The Law of Ukraine from 22.12.2005 №3260- IV "On changes in The Law of Ukraine "On energy saving".
Also the alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.
Hence, the Step 1 is satisfied.

Step 2: Investment analysis

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

Step 3: Barrier analysis

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

Investment barrier

The financial indicators Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated for two cases of project implementation – with and without the JI mechanism (see **Appendix 8**). The discount rate of 12 % was used for calculations, which is typical to average in Ukrainian banks. Calculations were made with the help of Microsoft office Excel financial functions.

The simple pay back period without JI mechanism will be 9.1 years, with JI mechanism – 8.6 years.

NPV and IRR of the project for 2013 year without using of JI mechanism will be:

NPV: – 4535.7 ths EUR,
IRR: 5.1 %.

NPV and IRR of the project for 2013 year with using of JI mechanism will be:

NPV: – 2344.2 ths EUR,
IRR: 8.3 %.

In both cases the project is not attractive for investments, credit percentages of Ukrainian banks are very high. But using of JI mechanism enables to improve its attractiveness.

All project activities require substantial investment – about 38 million EUR (The prices for the new equipment, that is planned to be installed in the project, are represented on the sheets Parameters in the Appendixes 1-2 and Appendixes 4-5 in Excel format, based on the averaged prices of the manufacturers. These prices are used for future calculations of investment costs, and should be corrected in future according to actual manufacturer's prices (changed due to inflation, etc.). The final table with necessary investments for each year is available in the Appendix 13 (Total). Operational and maintenance costs are not included in the project because it is assumed that they will remain at the previous level or even decreased due to less such costs for the new equipment).

Without carbon credits sales the project is not economically favorable for a Supplier, which makes implementation of most activities impossible. More economically feasible and realistic scenario without carbon credits sales is the baseline scenario with very slow reconstruction activities. However, considering degradation of the whole system with efficiency droop at other objects, the overall actual emissions from Supplier's enterprise would remain at the same level.

Technological barrier

1. Not all proposed technologies are widely approved already. Qualification of operational personal for implementation of the new technologies may be not sufficient to provide project implementation in time.
2. Efficiency of installed equipment could be lower than was claimed by producers or equipment may have substantial defects.

3. Available amount of natural gas. Last years Ukraine faced with incomplete delivery of natural gas from Russian Federation. Ukrainian Government realized attempts to decrease dependence from Russian natural gas delivery. Unfortunately it could lead to impossibility of boiler houses fuel switch from coal to natural gas.

Organizational barrier

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

Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity.

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

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

Step 4: Common practice analysis

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

It should be noted that the district heating systems from almost all territorial districts (excluding Gorlivka, Makiyivka, Mariupol, Novogrodivka) of the Donetsk Region are involved in the project. RME "Donetskteplokomunenergo"is the main heat supply service enterprise in Donetsk Region. MCE "Donetskteplomerezha" and CME "Artemivskteplomerezha" are the main heat-supply enterprises in their towns. RME "Donetskteplokomunenergo" is empowered to represent the interests of other heat-supply enterprises involved in project. Besides RME "Donetskteplokomunenergo", MCE "Donetskteplomerezha" and CME "Artemivskteplomerezha" the heat supply service in Donetsk Region is provided by ME "Volodarskteplovodomerezha" (Volodarsk), JSC "Gorlicskteplomerezha", ME "Vuglyk"(Gorlivka), ME "Teplomerezha" (Donetsk), ME "Zugresteplomerezha" (Zugres), KPE "Kramatorskteplomerezha" (Kramatorsk), ME "Krasnoarmiyskteplomerezha" (Krasnoarmiysk), CME "Mariupolteplomerezha" (Mariupol), ME "Makiivkateplomerezha" (Makiivka), DE "Selidivvygillya" (Selidovo). But the similar projects are not observed in the Donetsk region.
At present there are at least 4 DH Projects with JI in Ukraine beside this project: for Chernihiv region, AR Crimea, Kharkiv city and Lugansk city. But other CDM (JI) project activities are not to be included in Common practice analysis.
Since the similar projects are not observed in the region, there is no basis for an analysis of similar activities.

Conclusion

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

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

Greenhouse Gas Sources and Project Boundaries:

Project boundaries for Baseline scenario are represented by black rectangle on the graphical picture on the **Fig.4.**

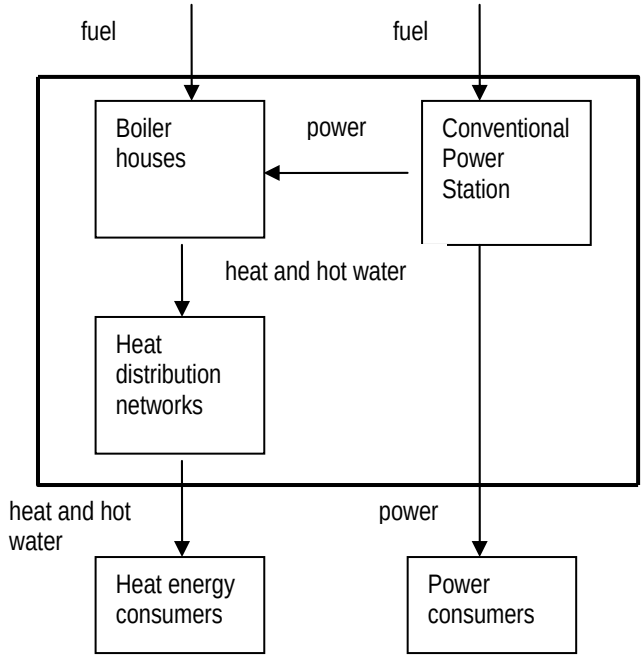

Fig.4. Flowchart of Project boundaries for Baseline scenario

Project boundaries for Project scenario are represented by black rectangle on the graphical picture on the **Fig.5.**

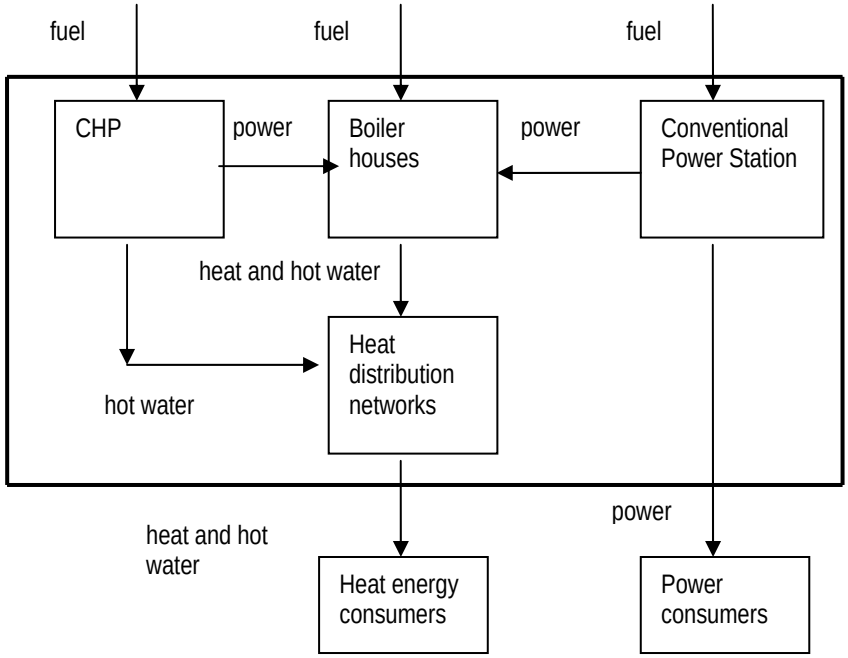

Fig.5. Flowchart of the Project boundaries for Project scenario

Direct and Indirect Emissions

Direct on-site emissions: CO_2 from natural gas combustion in boilers (in some cases coal and fuel oil are used as a fuel), NO_x and CO emission from combustion in the existing boilers/ burners, CO_2 emissions from fuel combustion in gas engines on the new CHP units, additional CO_2 emissions from fuel combustion in boilers on the boiler houses due to the too large heat losses in the distribution networks.

Direct off-site emissions: CO_2 emissions from power plant(s) due to electricity consumption from the grid, which will be replaced after installation of CHP units, CO_2 emissions from power plant(s) due to ineffective electricity consumption from the grid, which will be saved after installation of frequency controllers, CO_2 emissions from power plant(s) due to power consumption used for heating by Donetsk region customers. It takes place due to inefficiencies of heat supply service quality for many consumers in the current situation. Exploitation of power heaters is quite typical and widespread.
CO_2 emissions from power station(s) due to heat networks power consumption. It is not efficient due to water leakages, and extended networks' distance.

Indirect on-site emissions: none.

Indirect off-site emissions: CO_2 emissions from fuel extraction and transportation.

On-site emissions			
Current situation	Project	Direct or indirect	Include or exclude
CO_2 emissions from fuel combustion in boilers	Reduced CO_2 emissions from fuel combustion in boilers due to increased efficiency and fuel saving. Additional CO_2 emissions on the boiler houses where the new CHP units will be installed due to additional fuel consumption for CHP	Direct	Include
NO_x and CO emission from combustion in existing boilers/ burners	Reduced NO_x and CO emissions from fuel combustion after boiler / burners' replacement	Direct	Exclude. NO_x and CO are not GHGs.
CO_2 emissions from fuel combustion in boilers on the boiler houses due to the too large heat losses in the networks	Reduced CO_2 emissions from boiler houses due to decreasing of heat losses in the network's pipes	Direct	Include
Off-site emissions			
Current situation	Project	Direct or indirect	Include or exclude
CO_2 emissions from power plant(s) due to electricity consumption (for own needs, etc.) from the grid, which will be replaced after installation of CHP units	Reduced CO_2 emissions from power plant(s)	Direct	Include
CO_2 emissions from power plant(s) due to ineffective electricity consumption from the grid, which will be saved after frequency controllers installation	Reduced CO_2 emissions from power plant(s)	Direct	Include
CO_2 emissions from power plant(s) due to power consumption used for heating by Donetsk region customers. It takes place due to inefficiencies of heat supply service quality for many consumers in the current situation. Exploitation of power heaters is quite typical and widespread.	Reduced CO_2 emissions from power plant(s) due to reduction of power consumption for heating by Donetsk region customers. This will take place after project implementation when heat supply service will become more efficient. Exploitation of power heaters will decrease substantially.	Direct	Exclude, not under control of project developer
CO_2 emissions from power	Reduced CO_2 emissions from	Direct	Exclude, not under

station(s) due to heat networks power consumption. It is not efficient due to water leakages, and extended networks' distance.	power station(s) due to reduction of power consumption of rehabilitated heat networks. This will take place due to water leakage decreasing, replacing 4-pipe lines by 2-pipe lines, and reduction of the total network length.		control of project developer
CO_2 emissions from fuel extraction and transportation.	Reduced CO_2 emissions from fuel extraction and transportation.	Indirect	Exclude, not under control of project developer

Table 8. Project boundaries and sources of emissions

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

Date of baseline setting: 30/05/2004

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

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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The starting date of the project is: 01/04/2004

C.2. Expected operational lifetime of the project:

Minimum - 20 years (the nominal lifetime of the new boiler and network equipment). The real average lifetime of the new boiler and network equipment is estimated to be up to 30 – 40 years. Thus the expected operational lifetime of the project may be about 30 years. According to conservatism principle, for further calculations we assume lifetime and corresponding crediting period for the project equal to 20 years (2005 – 2024).

C.3. Length of the crediting period:

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

The starting date of the crediting period is set to the date where the first emission reduction units are expected to be generated from the project, that is January 1, 2005. The end of the crediting period is the end of the lifetime of the main equipment, that is minimal December 31, 2024. Thus the length of the crediting period is 20 years (240 months).

If the post-first commitment period under the Kyoto Protocol will be applicable, the commitment period may be expanded up to the end of the expected operational lifetime of the project (20 years, 2005 – 2024).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

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

Indicator of project performance

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *fuel saving*. It can be identified as a difference between baseline fuel consumption and fuel consumption after project implementation. If boilers consume fuel at the projected level, than all other relevant indicators such as efficiencies of new boilers and burners, specific gas consumption of CHP units, as well as heat losses in pre-insulated pipes are adequate.

Verification of project performance indicators

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

Verification of Emission Reduction Units and Baseline Scenario

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

The following methodology is proposed to be used.

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

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

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

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

$E_1^b = LHV_b * Cef_b * [B_b * a_b * K_1 * K_2 * K_3 * K_4 * K_5 + B_b * (1-a_b) * K_1 * K_6 * K_7 + B_b * (1-a_r) * K_1 * K_8]$
$E_1^r = LHV_r * Cef_r * B_r$
$E_{gen}^b = W_{gb} * CEF_g + Q_{gb} * f_b/1000 * LHV_r * Cef$
$E_{gen}^r = (W_{gb} - W_{gr}) * CEF_g + [(Q_{gb} - Q_{gr}) * f_b/1000 + B_g] * LHV_r * Cef$
$E_{cons}^b = P_b * CEF_c$
$E_{cons}^r = P_r * CEF_c$

If any boiler-house consumes more than one type of fuel, the calculations of E are to be made for each type of fuel separately, and results are to be summed.

where:
LHV – lower heating value, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, KtCO_2/TJ;
B – amount of fuel consumed by a boiler-house, ths m^3 or tons;
K_1, K_2, K_3, K_4, K_5, K_6, K_7, K_8– adjustment factors;
a – portion of fuel (heat), consumed for heating purposes;
(1-a) – portion of fuel (heat), consumed for hot water supply services;
W_{gb} – scheduled electric power production by the all new CHP units, MWh;
W_{gr} – electric power production by the installed new CHP units in reported year, MWh;
CEF_g – Carbon Emission factor for electricity generation in Ukraine, tCO_2e/MWh;
P_b – electric power consumption by the boiler-houses where energy saving measures are scheduled to be implemented, MWh;
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;
Q_{gb} – scheduled heat energy production by the all new CHP units, MWh;
Q_{gr} – heat energy production by the installed new CHP units, MWh;

f_b – specific natural gas consumption by the boiler-house, where CHP units are scheduled to be installed, m^3/MW;
B_g – amount of fuel (gas) consumed by the installed CHP units for generation, ths m^3;
[$_b$] index – related to the base year;
[$_r$] index – related to the reporting year.

$a_b = L_h^b * q * N^b / (L_h^b * q * N^b + L_w^b * N_w^b)$;
$a_r = L_h^r * q * N^r / (L_h^r * q * N^r + L_w^r * N_w^r)$

where:
L_h, L_w – maximum connected load required for heating and for hot water supply service, MW;
q – recalculating factor for average load during heating period (usually 0,5-0,8);
N, N_w – duration of heating period and period of hot water supply service, hours.

Adjustment factors

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

$K_1 = LHV_b / LHV_r$

2. K (averaged adjustment factor for heating):

Heat losses from the buildings are:

$Q = F * k * (T_{in} - T_{out}) * N$,
where:
Q – required amount of heat, kWh
k – average heat transfer factor of buildings, (kW/m^2*K);
F – heated area, m^2;
T_{in} – average inside temperature for the heating period, K;
T_{out} – average outside temperature for the heating period, K;
N – duration of the heating period, hours.

$Q_{db} = Q_b * K = Q_r$

where:
Q_{db} – required heat for Dynamic Baseline, is assumed equal to Q_r – required heat in reported year,
Q_b – required heat in base year,
K – averaged adjustment factor for heating,
$K = Q_r/Q_b$.

$K=(F_b*k_b+(F_r - F_b)*k_{r(b)})*(T_{in\,r} - T_{out\,r})*N_r / F_b*k_b*(T_{in\,b} - T_{out\,b})*N_b$
If $F_r > F_b$, $k_{r(b)}=k_r$; if $F_r < F_b$, $k_{r(b)}=k_b$
If the heating area is increased, we will add it with the new heat transfer factor - k_r, if heating area is decreased, we will subtract it with the old heat transfer factor - k_b.

Detailed components of K:
$K = K_2* K_3* K_4* K_5$

3. K_2 (temperature change factor):
$K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b})$

4. K_3 (heating area change factor):

$K_3=(F_b*k_b+(F_r - F_b)*k_{r(b)}) / F_b*k_b = 1+(F_r - F_b)* k_{r(b)}/ F_b*k_b$
where:
F_b, F_r – heated area in base year and reported year, m^2;
k_b – average heat transfer factor of heated buildings in base year, (kW/m^2*K);
k_r – average heat transfer factor of connected buildings in the reported year, (kW/m^2*K).

5. K_4 (building thermal insulation improvement factor):

$K_4 =((F_b - F_i)*k_b + F_i*k_i)/F_b*k_b = 1 + F_i*(k_i - k_b)/(F_b*k_b)$
where:
F_b and F_i – heating area in base year and heating area of buildings with the new (changed) thermal insulation, m^2;
k_b – average heat transfer factor of heated buildings in base year, (kW/m^2*K);
k_i – heat transfer factor of heated buildings with the new thermal insulation, (kW/m^2*K).
If there is no buildings with improved thermal insulation in reporting year ($F_i=0$),

K_4=1.

6. K_5 (heating period duration change factor):

$K_5=N_r/N_b$

7. K_6 (number of customers change factor):

$K_6 = n_r / n_b$
If there was no hot water supply service customers in base year (n_b=0),
K_6=0

8. K_7 (hot water supply period duration change factor):

$K_7 = N_w^r / N_w^b$
If there was no hot water supply service in base year ($N_w^b = 0$),
K_7=0

9. K_8 (hot water supply service quality improvement factor):

If there was no hot water supply service in the base year ($N_w^b = 0$), and it appeared in the reporting year:
$K_8 = N_w^r / 8400$

If hot water supply service was provided in the base year ($N_w^b > 0$):
$K_8 = 0$
In this case, the change in hot water supply service quality is considered by K_7.

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

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	Fuel consumption at boiler houses: (**B_r**)	Every Boiler house		m	Every two hours	100%	Registered in the journal (electronic and/or paper)	Fuel consumption at boiler houses is the main data which allows to calculate GHG emissions in the report year
1.1	Natural Gas		1000 m^3					
1.2	Coal		ton					
1.3	Heavy oil		ton					
1.4	Light oil		ton					
2	Average annual Heating Value of a fuel calculated by Lower Heating Value (**LHV_r**)	Fuel Supplier's Report or Chem. Lab Analysis Report, Every town		m, c	Once per month	100%	Registered in the journal (electronic and/or paper)	
2.1	Natural Gas		MJ/m^3					
2.2	Coal		MJ/kg					
2.3	Heavy oil		MJ/kg					
2.4	Light oil		MJ/kg					
3	Power	Boiler houses	MW*hour	m	Every month	100%	Registered in	

	consumption ($\mathbf{P_r}$)	where frequency controllers will be installed					the journal (electronic and/or paper)	
4	Power production ($\mathbf{W_{gr}}$)	New CHP units	MW*hour	m	Every day	100%	Registered in the journal (electronic and/or paper)	
5	Heat energy production ($\mathbf{Q_{gr}}$)	New CHP units	MW*hour	m	Every day	100%	Registered in the journal (electronic and/or paper)	
6	Fuel consumption at the CHP units: ($\mathbf{B_g}$)	Every CHP units	1000 m^3	m	Every two hours	100%	Registered in the journal (electronic and/or paper)	

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

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

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

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

$E^r = \sum[E_{1i}{}^r - E_{gen\ i}{}^r - E_{cons\ i}{}^r]$,

where:
E^r – CO_2 emissions in the reported year, 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;
$E_{gen\ i}{}^r$ – CO_2 emissions due to electric power generation associated to the project for an i boiler-house in the reported year, t CO_2e;
$E_{cons\ i}{}^r$ – CO_2 emissions due to electric power consumption for an i boiler-house in the reported year, t CO_2e.

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

$E_1{}^r = LHV_r * Cef_r * B_r$

$E_{gen}{}^r = (W_{gb} - W_{gr}) * CEF_g + [(Q_{gb} - Q_{gr}) * f_b/1000 + B_g] * LHV_r * Cef$

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

LHV – lower heating value, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, KtCO_2/TJ;
B – amount of fuel consumed by a boiler-house, ths m^3 or tons;
W_{gb} – scheduled electric power production by the all new CHP units, MWh;
W_{gr} – electric power production by the installed new CHP units in reported year, MWh;
CEF_g – Carbon Emission factor for electricity generation in Ukraine, tCO_2e/MWh;
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;
Q_{gb} – scheduled heat energy production by the all new CHP units, MWh;
Q_{gr} – heat energy production by the installed new CHP units, MWh;
f_b – specific natural gas consumption by the boiler-house, where CHP units are scheduled to be installed, m^3/MW;
B_g – amount of fuel (gas) consumed by the installed CHP units for generation, ths m^3;
[$_b$] index – related to the base year;
[$_r$] index – related to the reporting year.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	Fuel consumption at boiler houses($\mathbf{B_b}$)	Every Boiler-house		m	Every two hours	100%	Registered in the journal (electronic and/or paper)	Fuel consumption at boiler houses is the main data which allows to calculate GHG emissions in the base year
1.1	Natural Gas		1000 m^3					
1.2	Coal		ton					
1.3	Heavy oil		ton					
1.4	Light oil		ton					
2	Average annual Heating Value of a fuel calculated by Lower Heating Value ($\mathbf{LHV_b}$)	Fuel Supplier's Report or Chem. Lab Analysis Report, Every town		m, c	Once per month	100%	Registered in the journal (electronic and/or paper)	Data which allows to calculate GHG emissions in the base year
2.1	Natural Gas		MJ/m3					
2.2	Coal		MJ/kg					
2.3	Heavy oil		MJ/kg					
2.4	Light oil		MJ/kg					

3	Daily outside temperature during the heating season ($\mathbf{T_{out\ r}}$) and ($\mathbf{T_{out\ b}}$)	Meteorological Service	^{0}C (K)	m, c	Every day	100%	Meteorological Service Report (electronic file)	Auxiliary data which allows correcting the dynamic baseline
4	Average inside temperature during the heating season ($\mathbf{T_{in\ r}}$) and ($\mathbf{T_{in\ b}}$)	3 Typical Buildings for all boiler houses	^{0}C (K)	m, c	Once per week	100%	Paper and electronic	Auxiliary data which allows correcting the dynamic baseline
5	Number of Customers ($\mathbf{n_b}$ and $\mathbf{n_r}$)	RME "Donetskteplocomunenergo"		Statistics	Once per Quarter	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
6	Heating area ($\mathbf{F_b}$ and $\mathbf{F_r}$)	RME "Donetskteplocomunenergo"	m^2	Statistics	Once per Quarter	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
7	Heat transfer factor of buildings ($\mathbf{k_b}$ and $\mathbf{k_r}$)	RME "Donetskteplocomunenergo"	kJ/m^2*K	c	Once per Quarter			Auxiliary data which allows correcting the dynamic baseline

8	Heating area of buildings with heat insulation improvement ($\mathbf{F_i}$)	RME "Donetskteplocomunenergo"	m^2	Statistics	Once per Quarter	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
9	Heat transfer factor of buildings with new thermal insulation ($\mathbf{k_i}$)	RME "Donetskteplocomunenergo"	kJ/m^2*K	Statistics	Once per Quarter	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
10	Heating period duration ($\mathbf{N_r}$ and $\mathbf{N_b}$)	RME "Donetskteplocomunenergo"	Hours	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
11	Duration of period of hot water supply service ($\mathbf{N_w}$)	RME "Donetskteplocomunenergo"	Hours	Statistics	Once per year	100%	Special Reports (electronic files)	Auxiliary data which allows correcting the dynamic baseline
12	Scheduled electric power production ($\mathbf{W_{gb}}$)		MW	c				Data which allows to calculate GHG emissions due to power consumption from the grid in the baseline scenario

13	Scheduled heat energy production ($\mathbf{Q_{gb}}$)		MW	c				Data which allows to calculate GHG emissions in the baseline scenario
14	Power consumption ($\mathbf{P_b}$)	Boiler houses where frequency controllers will be installed	MW*hour	m	Every month	100%	Data journal, (electronic file)	Data which allows to calculate GHG emissions due to power consumption from the grid in the baseline scenario

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

$E_b = \sum [E_{1i}{}^b + E_{gen\ i}{}^b + E_{cons\ i}{}^b]$,

where:
E_b – baseline emissions, t CO_2
$E_{1i}{}^b$ – CO_2 emissions due to fuel consumption for heating and hot water supply service for an i boiler-house in the base year, t CO_2e;
$E_{gen\ i}{}^b$ – CO_2 emissions due to electric power generation associated to the project for an i boiler-house in the base year, t CO_2e;
$E_{cons\ i}{}^b$ – CO_2 emissions due to electric power consumption for an i boiler-house in the base year, t CO_2e.

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

$E_1^b = LHV_b * Cef_b * [B_b * a_b * K_1 * K_2 * K_3 * K_4 * K_5 + B_b * (1-a_b) * K_1 * K_6 * K_7 + B_b * (1-a_r) * K_1 * K_8]$

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

where:
LHV – lower heating value, MJ/m^3 (MJ/kg);
Cef – carbon emission factor, $KtCO_2/TJ$;
B – amount of fuel consumed by a boiler-house, ths m^3 or tons;
K_1, K_2, K_3, K_4, K_5, K_6, K_7, K_8– adjustment factors;
a – portion of fuel (heat), consumed for heating purposes;
(1-a) – portion of fuel (heat), consumed for hot water supply services;
W_b – scheduled electric power production by the all new CHP units, MWh;
CEF_g – Carbon Emission factor for electricity generation in Ukraine, tCO_2e/MWh;
P_b – electric power consumption by the boiler-houses where energy saving measures are scheduled to be implemented, MWh;
CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh;
Q_b – scheduled heat energy production by the all new CHP units, MWh;
f_b – specific natural gas consumption by the boiler-house, where CHP units are scheduled to be installed, m^3/MW;
[b] index – related to the base year;
[r] index – related to the reporting year.

. $a_b = L_h^b * q * N^b / (L_h^b * q * N^b + L_w^b * N_w^b)$;
$a_r = L_h^r * q * N^r / (L_h^r * q * N^r + L_w^r * N_w^r)$

where:
L_h, L_w – maximum connected load required for heating and for hot water supply service, MW;
q – recalculating factor for average load during heating period (usually 0,5-0,8);
N, N_w – duration of heating period and period of hot water supply service, hours.

Adjustment factors

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

$K_1=LHV_b/LHV_r$

2. K_2 (temperature change factor):
$K_2 = (T_{in\ r} - T_{out\ r}) / (T_{in\ b} - T_{out\ b})$

3. K_3 (heating area change factor):

$K_3=(F_b*k_b+(F_r - F_b)*k_{r(b)}) / F_b*k_b = 1+(F_r - F_b)* k_{r(b)}/ F_b*k_b$
where:
F_b, F_r – heated area in base year and reported year, m^2;
k_b – average heat transfer factor of heated buildings in base year, (kW/m^2*K);
k_r – average heat transfer factor of connected buildings in the reported year, (kW/m^2*K).

4. K_4 (building thermal insulation improvement factor):

$K_4 =((F_b - F_i)*k_b + F_i*k_i)/F_b*k_b = 1 + F_i*(k_i - k_b)/(F_b*k_b)$
where:
F_b and F_i – heating area in base year and heating area of buildings with the new (changed) thermal insulation, m^2;
k_b – average heat transfer factor of heated buildings in base year, (kW/m^2*K);
k_i – heat transfer factor of heated buildings with the new thermal insulation, (kW/m^2*K).
If there is no buildings with improved thermal insulation in reporting year ($F_i=0$),
$K_4=1$.

5. K_5 (heating period duration change factor):

$K_5=N_r/N_b$

6. K_6 (number of customers change factor):

$K_6 =n_r / n_b$

If there was no hot water supply service customers in base year (n_b=0),
K_6=0

7. K_7 (hot water supply period duration change factor):

$K_7 = N_w^r / N_w^b$
If there was no hot water supply service in base year ($N_w^b = 0$),
K_7=0

8. K_8 (hot water supply service quality improvement factor):

If there was no hot water supply service in the base year ($N_w^b = 0$), and it appeared in the reporting year:
$K_8 = N_w^r / 8400$

If hot water supply service was provided in the base year ($N_w^b > 0$):
$K_8 = 0$
In this case, the change in hot water supply service quality is considered by K_7.

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

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

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

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

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

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

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

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

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

No leakage is expected. Dynamic baseline (based on collected monitoring data) will exclude all possible leakages.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

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

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

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

No leakages are expected.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

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

$ERUs = E_b - E_r$.

where:
ERUs – emission reduction units, t CO_2e;
E_r – project emissions, t CO_2e
E_b – baseline emissions, t CO_2e

Baseline emissions
Baseline emissions consist of three types of GHG emissions:

1) CO_2e emissions from boilers operated by the Applicant.
2) CO_2e emissions due to electricity consumption from the grid, which will be replaced after installation of CHP units.
3) CO_2e emissions due to electricity consumption from the grid, which will be saved due to decreasing of electricity consumption at the boiler houses after frequency controllers installation.

$E_b = E_{heat} + E_{el} + E_{fc}$

Where:
E_{hea} – emissions from boilers operated by the Applicant, t CO_2e;
E_{el} – emissions due to electricity consumption from the grid, which will be replaced after installation of CHP units, t CO_2e.
E_{fc} – emissions due to electricity consumption from the grid, which will be saved after frequency controllers installation, t CO_2e.

1) Emissions from heat generating sources operated by an Applicant:
$E_{heat} = \sum (B_{b(i)}) * LHV_{b(i)} * Cef_i)$,
where:
$B_{b(i)}$ – fuel consumption in the baseline scenario (for each fuel), 1000 m^3 (t);
$LHV_{b(i)}$ – Lower Heating Value for each fuel, MJ/m^3 (MJ/kg);
Cef_{i-} – Carbon Emission Factors for each fuel, Kt CO_2/TJ.

2) Baseline emissions due to electricity consumption from the grid, which will be replaced after installation of CHP units:

$E_{el} = W_g * CEF_g$,

where:
W_g – annual power production of CHP units which will be installed by the Applicant, MWh;
CEF_g – Carbon Emission factors for electricity generation in Ukraine, tCO_2e/MWh, see **Table 6**.

The heat that will be generated on these CHP units will be used for hot water supply service. For more detailed information see **Appendix 3 (CHP), Appendix 6 (CHP City)** and **Appendix 7 (Baseline)**.

3) CO_2 emissions due to electricity consumption from the grid, which will be saved due to decreasing of electricity consumption at the boiler houses after frequency controllers installation.

$E_{fc} = P * CEF_c$,

where:
P – annual power consumption of boiler houses where frequency controllers will be installed by the Applicant, MWh;
CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh, see **Table 7**.

For more detailed information see **Appendix 9 FC and Appendix 10 FC**.

Project emissions

Project scenario emissions from boiler-houses and new CHP units are a sum of actual fuel amounts to be used in any report year (starting from 2009) multiplied by corresponding conversion factors (CF). Actual – means with subtracted fuel saving due to improving of the network efficiency:

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

where:
E_r – project emissions in any reported year, t CO_2e

$B_{r(i)}$ – fuel consumption in the project scenario (for each fuel), 1000 m^3 (t);
$V_{(i)}$ –fuel saving due to network rehabilitation for each fuel, 1000 m^3 (t);
$LHV_{r(i)}$ – Lower Heating Value for each fuel, MJ/m^3 (MJ/kg);
Cef_{i-} – Carbon Emission Factors for each fuel, Kt CO_2/TJ.
P_r – Power consumption of the boiler houses with frequency controllers, MWh;
CEF_c – Carbon Emission factors for reducing electricity consumption in Ukraine, tCO_2e/MWh.

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

$V_{(i)} = B_{b(i)} - B_{b(i)} * (100-L_b)/(100-L_r)$,

where:
$B_{b(i)}$ – fuel consumption in the baseline scenario (for each fuel), 1000 m^3 (t);
L_b – heat losses in the network in the baseline scenario, %;
L_r – heat losses in the network in the project scenario, %.

For more detailed information see **Appendix 1 (Boilers), Appendix 2 (Networks)** and **Appendix 4 (Boilers City), Appendix 5 (Networks City).**

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

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

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Quantity of natural gas consumed by boiler houses.	Low for gas.	Measuring instruments must be calibrated according to national regulations
Amount of fuel oil consumed by boiler houses.	Low for fuel oil	
Amount of coal consumed by boiler houses.	Low for coal	
Outside temperature.	Low	Measuring instruments must be calibrated according to national regulations
Inside temperature.	Low	Measuring instruments must be calibrated according to national regulations

Fuel quality (Lower Heating Values).	Low	Measuring instruments must be calibrated according to national regulations
Number of customers (heating area).	Low	Statistic data. No quality assurance is needed.

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

The operational structure will include operation departments (adjustment and alignment, etc.) of Supplier (RME "Donetskteplocomunenergo") and boiler house operation personnel.
The management structure will include management departments of Supplier and specialists of project developer (Institute of Engineering Ecology).

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

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

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SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

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

Calculation of Project Activity Level

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

	Project Natural Gas Consumption, ths Nm^3/year	Project coal Consumption, t/yr	Project Natural Gas Saving due to network rehabilitation, ths Nm^3/year	Project coal Saving due to network rehabilitation, t/year
RME "Donetskteplocomunenergo"	380565.4	2599.6	20102.6	259.0
Artemivsk t.	23 218.7	0	1497.8	0
Donetsk city	226556.5	0	8924.7	0
Total	**630340.6**	**2599.6**	**30525.2**	**259.0**

Table 9. Project fuel consumption

Detailed information is presented in **Appendix 1 (Boilers), Appendix 2 (Networks)** and **Appendix 4 (Boilers City), Appendix 5 (Networks City).**

Estimation of Direct Project Emissions

	Project Emissions, t CO_2	Project Emissions Reduction due to network rehabilitation, t CO_2	Total Project Emissions, t CO_2
RME "Donetskteplocomunenergo"	**778021**	**38 197**	**739 824**
Boiler houses	717493		
CHP units	34 157		
Conventional Power Station	26 371		
Artemivsk t.	**43 507**	**2 807**	**40 700**
Donetsk city	**458 424**	**16 723**	**441 701**
Boiler houses	411 426		
CHP units	13 412		
Conventional Power Station	33 586		
Total	**1279951**	**57 726**	**1 222 225**

Table 10. Project Emissions of CO_2e after project implementation

Project emissions are ~ **1 222 225 t**CO_2.

E.2. Estimated leakage:

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

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

Project Emissions + Leakages = **1 222 225** + 0 = **1 222 225 t**CO_2.

E.4. Estimated baseline emissions:

Baseline emissions consist of three types of GHG emissions:

1) CO_2 emissions from boilers operated by the Applicant.
2) CO_2 emissions due to electricity consumption from the grid, which will be replaced after installation of CHP units.
3) CO_2 emissions due to electricity consumption from the grid, which will be saved due to decreasing of electricity consumption at the boiler houses after frequency controllers installation.

	Baseline Emissions, t CO_2e
RME "Donetskteplocomunenergo"	812 456
Artemivsk town	45023
Donetsk city	422193
Subtotal	**1 279672**
Emissions due to electricity production to the grid, which will be replaced after installation of CHP units at boiler houses belonging to RME "Donetskteplocomunenergo".	37 143
Emissions due to electricity production to the grid, which will be replaced after installation of CHP units at boiler houses belonging to MCE "Donets'kteplomerezha".	14 292
Subtotal	**51 435**
CO_2 emissions due to ineffective electricity consumption from the grid by boiler houses belonging to RME "Donetskteplocomunenergo"where frequency controllers will be installed	35 338
CO_2 emissions due to ineffective electricity consumption from the grid by boiler houses belonging to MCE "Donets'kteplomerezha" where frequency controllers will be installed	37 273
Subtotal	**72 611**
Total	**1403718**

Table 11. Baseline Emissions of CO_2

Baseline emissions ~ **1403718 t**CO_2.

More detailed calculation of resulting annual Baseline Carbon Emissions, that would take place during typical heating season if RME "Donetskteplocomunenergo" DH system, remains unchanged, see in **section B** and **Appendix 7 (Baseline)**.

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

Project Emission Reduction = Baseline emission-(Project emission +Estimated leakage) = **1 403 718 - 1 222 225 = 181 493 t CO_2 / yr**

In course of the project implementation, the different emission reduction will be achieved at the different stages of project implementation. The amounts of emission reduction are represented in the Table 12, 13**,** 14.

Year	GHG emissions reduction, t CO_2e				
	Due to boiler houses rehabilitation	Due to CHP units installation	Due to network rehabilitation	Due to frequency controllers installation	Total
2005	1722		3151		4873
2006	6626		4323		10949
2007	32616		11659		44275
Subtotal	**40964**	**0**	**19133**	**0**	**60097**
2008	63793		26331		90124
2009	79005	23030	41003	9679	152718
2010	79005	21862	41003	9442	151313
2011	79005	21336	41003	9205	150550
2012	79005	20460	41003	8967	149437
Subtotal	**379814**	**86689**	**190345**	**37293**	**694141**
Annual average 2008-2012					**138828**
Total	**420778**	**86689**	**209479**	**37293**	**754238**

Table 12.Estimated amount of CO_2e Emission Reductions in Donetsk Region

Year	GHG emissions reduction, t CO_2e				
	Due to boiler houses rehabilitation	Due to CHP units installation	Due to network rehabilitation	Due to frequency controllers installation	Total
2005	1478				1478
2006	2126		6353		8478
2007	3153		12705		15858
Subtotal	**6756**	**0**	**19058**	**0**	**25814**
2008	3907	9066	16722	4077	33773
2009	3907	8729	16722	3980	33338
2010	3907	8280	16722	3882	32791
2011	3907	8077	16722	3785	32492
2012	3907	7740	16722	3687	32057
Subtotal	**19535**	**41893**	**83612**	**19412**	**164452**
Annual average 2008-2012					**32890**
Total	**26291**	**41893**	**102670**	**19412**	**190266**

Table 13.Estimated amount of CO_2e Emission Reductions in Donetsk City

Year	GHG emissions reduction, t CO_2e		
	Donetsk Region	Donetsk City	Total
2005	4873	1478	6350
2006	10949	8478	19428
2007	44275	15858	60133
Subtotal	**60097**	**25814**	**85911**
2008	90124	33773	123897
2009	152718	33338	186056
2010	151313	32791	184104
2011	150550	32492	183041
2012	149437	32057	181494
Subtotal	**694141**	**164452**	**858593**
Annual average 2008-2012			**171719**
Total	**754238**	**190266**	**944504**

Table 14.Estimated total amount of CO_2e Emission Reductions

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

Tables providing values obtained when applying formulae above are in **Appendixes 1 – 6.**

Year	Estimated project emissions (tones of CO_2 equivalent)	Estimated leakage (tones of CO_2 equivalent)	Estimated baseline emissions (tones of CO_2 equivalent)	Estimated emission reduction (tones of CO_2 equivalent)
2005	1419610	0	1425960	6350
2006	1403398	0	1422826	19428
2007	1359174	0	1419308	60133
Subtotal	**4182182**	**0**	**4268094**	**85911**
2008	1292277	0	1416174	123897
2009	1226983	0	1413040	186056
2010	1225397	0	1409501	184104
2011	1223811	0	1406852	183041
2012	1222225	0	1403718	181494
Subtotal	**6190693**	**0**	**7049285**	**858593**
2013	1222225	0	1403718	181494
2014	1222225	0	1403718	181494
2015	1222225	0	1403718	181494
2016	1222225	0	1403718	181494
2017	1222225	0	1403718	181494
2018	1222225	0	1403718	181494
2019	1222225	0	1403718	181494
2020	1222225	0	1403718	181494
2021	1222225	0	1403718	181494
2022	1222225	0	1403718	181494
2023	1222225	0	1403718	181494
2024	1222225	0	1403718	181494
Subtotal	**14666698**	**0**	**16844621**	**2177923**
Total (tones of CO_2 equivalent)	**25039573**	**0**	**28162000**	**3122427**

Table 15. Table providing values obtained when applying formulae above

SECTION F. Environmental impacts

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

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

RME "Donetskteplocomunenergo" has the necessary Environmental Impact Assessment for its activity according to Ukrainian legislation.

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

1. Project implementation will allow saving over 15 million Nm^3 of natural gas and over 50 thousand ton of coal per year starting from 2009. Natural gas and coal are a non-renewable resources and its economy is important.

2. Project implementation will reduce direct CO_2 emissions from city and regional boilers by 116 thousand tons per year starting from 2009 due to increased boilers efficiencies, achieved through installation of up-to-date boiler equipment, particularly new boilers, CHP units and installation of pre-insulated networks pipes (141 km) instead of existing regular networks pipes.

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

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

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Impact on the water medium

Impact on the water medium is present. Impact on water resources is will be the same as in baseline scenario. The existing technology of heat energy production exploited at the objects of RME "Donetskteplocomunenergo" foresees discharging of waste water to the sewage network with obligatory chemical control in accordance to Water Code of Ukraine, GOST 28.74-82 "Hygienic regulations and quality control", SNiP 4630-92 on determining maximum concentration limits for internal water bodies. Discharge of wastewater to the open water bodies will not take place.

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

Effects on the ambient air

The project implementation will have positive effect on ambient air:

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

Effects on land use

Impact on the land medium is not present.

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

Effects on biodiversity

Impact on biodiversity is not present.

Waste generation, treatment and disposal

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

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

Example of the Environmental Impact Assessment for one of the objects included in the Project is given in **Appendix 12 (EIA).**

SECTION G. Stakeholders' comments

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

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

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

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

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

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

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

See Section B for the Baseline information

Annex 3

MONITORING PLAN

See Section D for the Monitoring plan