JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
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CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Rehabilitation of the heat supply system of the JSC 'Donenergo' in the Rostov region, Russian Federation

PDD version: 01
Date: 30/04/2008

A.2. Description of the project:

The Joint Stock Company 'Donenergo' (hereinafter - Donenergo) supplies districts of the Rostov region with thermal energy. The heat supply system of Donenergo includes 228 boiler-houses as well as 355.8 trass[1] kilometers of heat networks used for supplying thermal energy to residential consumers around the Rostov region. 157 boiler-houses with a total connected load of 637 Gcal/h (2.67 TJ/h) utilizing natural gas and coal as fuel were involved in the project. The total length of heating pipelines included in the project is 72.2 km.

From 2005 to 2010, Donenergo has been implementing measures to reduce the fuel consumption of these boiler-houses for the generation of thermal energy, and to increase the percentage of boiler-houses utilizing natural gas (a less carbon-intense fuel than coal). The total reduction in the fuel consumption will be 1776 TJ from 2005 to 2012.

To achieve these targets, the following measures are to be carried out:

1. optimization of the heat supply structure
2. retrofit of the boiler-houses
3. reconstruction of the heating pipelines

Activity 1. Optimization of the heat supply structure from 2005-2010.
Optimization of the heat supply structure will be carried out in ten districts of the Rostov region: Gukovo, Donetsk, Zverevo, Salsk, Tsimlyansk, Millerovo, Aksay, Bataysk, Kamensk, Azov.

Optimization refers to the shut-down of boiler-houses and heat load shift to other more efficient boiler-houses (donors) with partially fuel switch from coal to natural gas in 2005-2010 and a reduction in the number of coal-burning boiler-houses.
The total number of boiler-houses prior to shut-down – 73, of which 46 are coal-fired and 27 gas-fired.
The total number of boiler-houses after the implementation of activity 1 will be 39, of which – 5 coal-fired and 34 gas-fired ones.

Boiler-houses to be shut down are to be dismantled. Equipment from them which will not be subsequently used is to be scrapped; buildings are to be used for another purpose or are to be dismantled as well. To cover the heat loads of boiler-houses to be closed the neighboring boiler-houses (donors) will increase the thermal generation. The implementation of activity 1 will lead to a fuel saving in the amount of 378 TJ from 2005-2012.

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[1] Trass kilometer means two lines of heat pipeline (direct and reverse).

The given reduction in fuel consumption will lead to a reduction of CO_2 emissions into the air in the amount of 213,103 tons of CO_2 from 2005-2012.

<u>Activity 2.</u> Retrofit of the boiler-houses from 2005-2010.
Retrofit of the boiler-houses to improve their efficiency and partially fuel switch from coal to natural gas will be carried out in the following ten districts of the Rostov region: Azov, Aksaysk, Tsimlyansk, Bataysk, Belaya Kalitva, Zverevo, Donetsk, Gukovo, Kamensk, Salsk.

The total number of boiler-houses being reconstructed will be 84 after the implementation of activity 2, of which, 1- coal-burning and 83 gas-fired ones. Old boiler and pumping equipment will be replaced and automatic control equipment will be installed in the course of the reconstruction. Upon completion, almost all the boiler-houses will be gas-fired. The connected load of the boiler-houses would be not changed as a result of the activity.

Old low-efficiency boilers of 74% will be replaced by new ones with a much higher efficiency of 94%.
As a result of the implementation of the given activity, the fuel saving will be 385 TJ from 2005-2012.
The above-stated reduction in fuel consumption will lead a reduction of CO_2 emissions into the air in the amount of 199,112 tons of CO_2 over the period of 2005-2012.

The boiler-houses stated in activity 1 shall be not considered in activity 2. These are different boiler-houses with different postal address.

<u>Activity 3.</u> Reconstruction of heat pipelines in 2005-2010 .
The reconstruction of heat pipelines will be carried out in the following eleven districts of the Rostov region: Aksaysk, Bataysk, Belaya Kalitva, Gukovo, Donetsk, Zverevo, Kamensk, Millerovo, Salsk, Tsimlyansk, Azov.

The total extent of the heat traces is 72 trass kilometers.
The implementation of this activity will make it possible to reduce:

1. losses due to heat radiation;
2. water losses.

Treatment of the losses will be achieved through replacement of existing metal pipes with worn-out insulation for glass-fiber and metal pre-insulated pipes with foamed polyurethane insulation. As a result of losses elimination, the fuel consumption would be reduced in the boiler-houses. This will lead to a reduction of CO_2 emissions into the air accordingly.

As a result of the implementation of activity 3, the total fuel saving from 2005-2012 will be 1013 TJ. This reduction of fuel consumption will lead a reduction of CO_2 emissions into the air in the amount of 204,873 t of CO_2 from 2005-2012.

The reduction in the fuel consumption from all three activities will be 1776 TJ. This will lead a reduction in emissions in the amount of 617,088 t of CO_2 . In terms of CO2, reductions achieved by the Project are as follows: 98,240 tCO_2 in 2005-2007 and 518,848 tCO_2 in 2008-2012.

Table A 2.1: Total emission reductions due to the implementation of the Project, tCO_2

Activity	2005-2007	2008-2012	**Total**
Optimization of the heat supply structure	60,458	152,645	**213,103**
Retrofit of boiler-houses	15,065	184,047	**199,112**
Reconstruction of heat pipelines	22,717	182,156	**204,873**
Total	**98,240**	**518,848**	**617,088**

Table A 2.2: Increase of share of gas boiler-houses

Type of boiler-houses	Quantity of boiler-houses	
	Before rehabilitation	After rehabilitation
Coal	69 (44%)	6 (5%)
Gas	88 (56%)	117 (95%)
Total	**157**	**123**

In order to gain additional revenues provided by Joint Implementation mechanism of Kyoto Protocol, the above-stated activities were integrated into one Project. The successful development of this Project depends to a large extent on the opportunities provided by the Kyoto Protocol Joint Implementation. Due to the existing funds deficiency (typical for the housing and utilities sector of Russia on the whole), Donenergo will face significant problems when financing activities within the framework of this Project. Cash inflow from the sale of CO_2 emission reductions will assist in overcoming this barrier and implementing this Project.

A.3. Project participants:

Table A3.1. Project participants

Party involved	**Legal participants of the Project (if applicable)**	**Please indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Party A: (host party) Russian Federation	JSC 'Donenergo' of the Rostov region	No
Party B: Luxemburg	Carbon Trade and Finance SICAR S.A.	No

JSC 'Donenergo' (former State Unitary Enterprise 'Donenergo') was founded at the end of 2007. It was reorganized from the existing governmental heat-supplying enterprise GUP (state-owned enterprise) 'Donenergo', established in 2000. GUP 'Donenergo' was established based on the amalgamation of 18 independent enterprises in the public energy sector which were directly subordinate to the property administration committee of the Rostov region. The main task of JSC 'Donenergo' is to maintain heat supply networks to ensure a high-quality supply of heating power to residents, industrial firms and social facilities.

Carbon Trade and Finance – a joint venture of Dresdener Bank (through the investment of Dresdner Kleinwort bank) and Gazprombank for investing in the fast-growing market for greenhouse gas emissions trading. This joint venture is registered in Luxemburg, invests in projects issuing certificates specified in the Kyoto Protocol, in Russia and CIS countries. Carbon Trade and Finance provides the clients with full assistance in the identification of Joint Implementation Projects and their full support.

A.4. Technical description of the project:

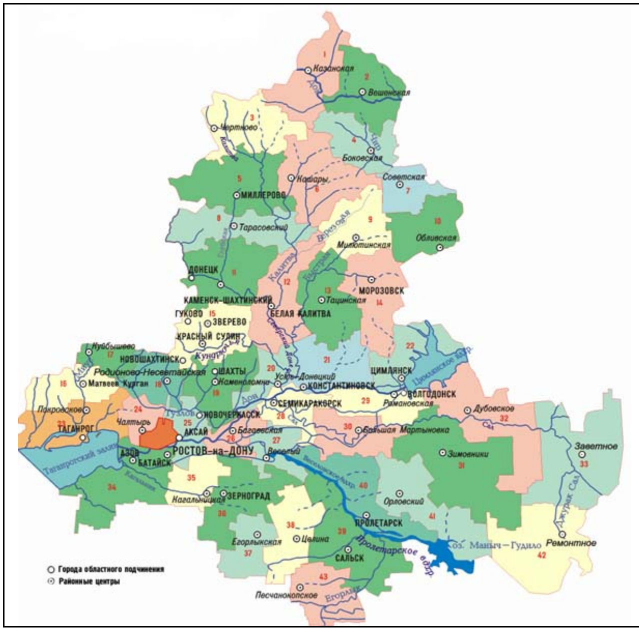
A.4.1. Location of the project:

The Rostov region is a part of the Southern Federal District, the fifth-largest in Russia. The administrative center is the city of Rostov-on-Don (population over 1 000 000), a big industrial, cultural and scientific center, a river port, and important transportation hub. Since 2002, Rostov-on-Don is the capital of the Southern Federal District.

The area of Rostov region is 100 800 km2. The total population of the region is 4 404 013 people, among them city residents are 2, 977,525 people and 1,426,488 people of rural population.
The Rostov region borders the Ukraine in the west, the Volgograd region in the east and the Voronezh region in the the north. In the south it borders Krasnodar and Stavropol Territories and the Republic of Kalmykia.

The Project is being implemented in eleven districts of the Rostov region represented on the following map.

Fig.1 Districts of the Rostov regions where the rehabilitation of JSC 'Donenergo' heat supply networks is being implemented:



5 – Millerovo district (the city of Millerovo);
11 –Kamensk district (the cities of Kamensk, Donetsk)
12 – Belaya Kalitva district (the city of Belaya Kalitva);
15 –Zverevo district (the cities of Zverevo, Gukovo);
34 – Azov district (the cities of Azov, Bataysk);
39 – Salsk district (the city of Salsk);
25 – Aksay district (the city of Aksay);
22 – Tsimlyansk district (the city of Tsimliansk).

A.4.1.1. Host Party(ies):

The host party is the Russian Federation

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

The Rostov region comprises of 42 districts, 16 urban districts (of which, 8 are in the city of Rostov-on-Don), 15 cities of regional subordination, 7 cities of district subordination and 37 industrial settlements.The climate of the region is temperate continental. The mean temperature in January varies from -9C in the north to -5C in the south, in July – +22C +24C. Precipitation – 400-650 mm a year. One of Europe's greatest rivers, the Don (2000 km long) flows through the region. The Tsimlyanskoe water-storage basin (volume 24 000 000 000 m^3) is located there. The main tributaries of the Don, the rivers Severskiy Donets and Manych, are navigable. Lakes occupy just 0.4 % of the region.

Fig.2 The Rostov region on a map of the Russia Federation

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

The heat supply system of JSC ‘Donenergo’ which is currently under rehabilitation within the Project, includes the heat supply networks of eleven districts of the Rostov region: the Gukovo district, Donetsk district, Zverevo district, Salsk district, Belaya Kalitva district, Tsimlyansk district, Millerovo district, Aksay district, Bataysk district, Kamensk district and Azov district.

The city of Azov is situated on the left bank of the Don River, 7 km from its inflow into Taganrog Bay of the Sea of Azov, 42 km south-west of Rostov-on-Don. It is a sea and river port.

The city of Aksay is situated on the high right bank of the Don River, where the Aksay river flows into it (the Don branch), 18 km north-east of Rostov-on-Don. There is a pier on the Don river.

The city of Bataysk – a satellite city to Rostov-on-Don, is situated on the opposite bank of the Don river, 15 km south-east of it. It is a railway and road hub.

The city of Belaya Kalitva is situated at the north-east end of the Donetskiy ridge, on the Severskiy Donets river where the Kalitva river meets it, 168 km north-east of Rostov-on-Don.
The city of Gukovo is situated in the eastern part of the Donetskiy ridge, 115 km north-east of Rostov-on-Don.

The city of Gukovo is situated near the north-eastern outskirts of the Donetskiy ridge, on the Severskiy Donets river (the right tributary of the Don), 8 km from railway station Izvarino, 171 km north-east of Rostov-on-Don.

The city of Zverevo is situated on the eastern part of the Donetskiy ridge, 21 km east of Gukovo, 140 km north-east of Rostov-on-Don.

The city of Gukovo is situated near the north-eastern outskirts of the Donetskiy ridge, on the Severskiy Donets river (the right tributary of the Don), 145 km north-east of Rostov-on-Don. It has the railway station Kamenskaya on Millerovo - Rostov-on-Don the line. It is a roads and highway hub; Moscow - Rostov-on-Don, Volgograd – Kishinev.

The city of Salsk is situated in the north of Ciscaucasia, on the Salsakaya steppe, on the Sredniy Yegorlyk river (the Don basin), 180 km south east of Rostov-on-Don. It is a railway and road hub.
The city of Tsimlyansk is situated on the right bank of the Don river (Tsimlyanskoe reservoir - port), 236 km north-east of Rostov-on-Don.

The city of Millerovo is situated on the Glubokaya river (the Don basin), 218 km north of Rostov-on-Don. It is a large railway and road hub.

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

All the project facilities belong to JSC 'Donenergo' that provide 11 districts of the Rostov region with thermal energy in the amount of 2.67 TJ. The main consumers are residential consumers (78 %), social and cultural facilities (kindergartens, schools, hospitals) (16 %) and others (shops, pharmacies) (6 %).

Supplies of natural gas and coal to the JSC 'Donenergo' boiler-houses are made according to fixed and long-term agreements with Rostovregiongaz (subsidiary affiliate controlled by the JSC Gazprom) and independent coal suppliers. Before starting the Project the maximal coal supply was 374 TJ in 2005, gas supply – 2674 TJ in 2006.

The region has the sources of coal and natural gas deposits. Anthracite of the Eastern Donbass being mined in the region is unique in quality and the best worldwide in respect to calorific value. The explored gas resources are estimated to be 56.2 billion m3.

The utilization of wood as fuel is impossible due to the small area occupied by forests (2.5 % of the whole area), because the forests are intended mostly for water-control functions of the Don river. The total area of the forestry resources of the Rostov Region is 375,100 ha, of which 343 200 is in possession of the forestry management authorities (91.6% of the whole area) including well-known reserves and wildlife areas, carefully protecting the Don nature.

Thermal energy is delivered to consumers at fixed prices (tariffs) regulated by the Regional tariff department. The tariff-setting is politically-driven process and is aimed at keeping heat prices at the lowest limits for residential consumers and social and cultural facilities. This leads to a deficiency in funds for the implementation of investment projects by the JSC 'Donenergo'.

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

As planned, the activities under the Project are implemented from 2005-2010. Description and execution periods of these activities are presented below.

Activity 1. Optimization of the heat supply structure in 2005-2010.

The load shift from less efficient boiler-houses being shut-down to more efficient donor boiler-houses. The efficiency value for the boiler-houses being shut-down is about 75 %. The average efficiency value for the donor boiler-houses is 92% after activity 1. The reduction of fuel consumption from the load shift will be 297 TJ in 2005-2010 and 378 TJ in 2005-2012.

Table A 4.2.1: The shut-down schedule of boiler-houses and their performance prior to the implementation of activity 1

Year	Number of boiler-houses being shut-down	Load, TJ/h	Annual heat generation, TJ	Fuel consumption, TJ/year
2005	20	0,382	827	1068
2006	21	0,293	633	752
2007	6	0,050	103	126
2008	7	0,039	92	152
2009	9	0,037	78	112
2010	10	0,086	191	243
Total	73	0,887	1924	2453

<u>Activity 2.</u> Retrofit of the boiler-houses in 2005-2010.
As a result of this activity, the efficiency of the boiler-houses will be improved to bring about a reduction in the fuel consumption in the amount of 358 TJ in 2005-2010. The total reduction in the fuel consumption will be 385 TJ in 2005-2012.

Additional emission reductions due to reduced electricity consumption by boiler-houses will be also gained under this activity. As the amount of these reductions will be less than 1% of the total volume of reductions, these reductions will not be taken into account from conservative point of view.

Table A 4.2.2: Progress schedule and fuel saving as a result of retrofit of boiler-houses

Year	Fuel consumption in the boiler-houses to be reconstructed, TJ/year		Fuel saving, TJ/year
	Prior to retrofit	After retrofit	
2005	145	142	3
2006	2023	1928	95
2007	373	339	34
2008	588	495	93
2009	777	657	120
2010	649	636	13
Total	4555	4197	358

Activity 3. Reconstruction of heat pipelines in 2005-2010.
Heat losses owing to heat radiation and water losses in heat pipelines will be eliminated through the replacement of existing metal pipes with glass-fiber and metal pre-insulated pipes with foamed polyurethane. The total length of the heat pipelines to be replaced is 72.2 trass km. As a result of the replacement of the heat pipes in 2005-2010, the reduction in fuel consumption will be 750 TJ. The total reduction in 2005-2012 will be 1013 TJ.

Table A 4.2.3: Progress schedule and fuel saving according to activity 3

Year	Fuel consumption, TJ		Fuel saving, TJ
	Prior to reconstruction	After reconstruction	
2005	280	183	97
2006	207	163	44
2007	184	158	26
2008	237	19	218
2009	259	26	233
2010	142	10	132
Total	1309	559	750

More detailed information on the performance of the boiler-houses under Project activities is presented in Annex 4.
The reduction in fuel consumption from all three activities will be 1776 TJ in 2005-2012. The total emission reductions due to Project implementation will be 617,088 tons of CO_2 in 2005-2012 and 518,848 tons of CO_2 in 2008-2012.

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:

In the absence of the proposed Project (the baseline scenario), the practice of operating less efficient boiler-houses with a considerable coal use (44% in the fuel balance of Donenergo) and with higher heat and water losses occurring during delivery to residential consumers would have continued.

The Project activity, i.e. the rehabilitation of the JSC 'Donenergo' heat supply system leads to a reduction of fossil fuel consumption (coal and natural gas) for thermal generation; to a reduction of coal-fired boiler-houses (to 5%) and to reduction of heat losses in heat supply pipelines. All these effects will result in CO_2 emission reductions into the atmosphere versus the baseline scenario. CO_2 emission reductions will occur only in the case of the Project activity, as in the absence of the proposed Project, the situation would have developed according to the baseline scenario. The following arguments point out that the baseline scenario could be possible:

- The deficiency of funds required for the full-scale implementation of similar projects either in the Rostov region or in Russia on the whole leads to the situation in which similar projects are only partially implemented (at a volume in accordance with the budgetary funds provided) or are not implemented at all.

- Owing to the increase in the forecasted domestic prices for natural gas which surpasses the prices for coal in the medium-term, maintaining (and increasing) the percentage of coal-burning boiler-houses in the fuel balance is a more economically feasible choice than converting to natural gas.

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

	Years
Length of crediting period:	2008-2012
Year	Estimate of annual emission reductions in tones of CO_2 equivalent
2008	67 691
2009	102 806
2010	116 117
2011	116 117
2012	116 117
Total estimated emission reductions over the crediting period (tones of CO_2 equivalent)	518 848
Annual average of estimated emission reduction (tones of CO_2 equivalent)	103 770

A.5. Project approval by the Parties involved:

On May 28, 2007, Mr. Fradkov M.E., Chairman of the Government of the Russian Federation, signed Resolution № 332 'On the procedure of approval and control of the progress of the projects to be implemented in accordance with Article 6 of the Kyoto Protocol to the UN Framework Convention on Climate Change'.

In the Russian Federation, the Project will be registered once the final approving determination report is available. Hence, registration of the Project occurs in 2 stages:
- determination of the Project;
- registration of the Project.

The project shall be registered after the determination procedure (independent examination by accredited entity). Based on determination report opinion, after scrutiny by the authorities under the LOA will be issued.

SECTION B. Baseline

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

The latest revised version of approved 'Combined tool to identify the baseline scenario and demonstrate additionality (Version 02/1)' was used for identification the baseline scenario and simultaneous demonstration of additionality.

This tool applies to project activities that make modifications to an existing installations that is operated by project participants such as energy efficiency improvements. In that context the tool can be applicable to the proposed Project activities that is rehabilitation of heat supply system in Rostov region.

The procedure proposed by this tool requires the following four steps:

1. Identification of alternative scenarios.
2. Barrier analysis.
3. Investment analysis (if applicable)
4. Common practice analysis.

Step 1. Identification of alternative scenarios
This step serves to identify all alternative scenarios to the proposed Project activity (s) that can be the baseline scenario through the following sub-steps:

Sub - step 1a. Define alternative scenarios to the proposed project activity
As all alternative scenarios must provide production output with comparable properties, alternative scenarios in this case should be aimed at the performance of one task, which is the provision of residential consumers with thermal energy.
The alternatives scenarios include:

- Alternative scenario №1: shift from fossil fuel (coal and natural gas) to biomass (fuel pellets)

While implementing this alternative, technical re-equipment of existing boiler-houses for utilizing biomass fuel (wood waste, pellet) will be required.

The maximal annual amount of heating energy supplied to a residential consumer must be equal to 2,345[2] TJ (559,611 Gcal), of which 633 TJ is supplied by the boiler-houses involved in activity 1, and 1,712 TJ by the boiler-houses involved in activity 2.

To produce the maximal heat at the 2006 level it is 559,611 Gcal of energy required that 134,550 tons of wooden pellets (112 000 m^3) can generate given the average calorific value of 20 MJ/kg for this type of fuel, the density of pellets of 1,2 t/m^3 and 85% efficiency of the pellet boilers.

The price of a pellet manufacturing plant with an output of 112,000 m^3 a year is about 25 million euro. Additional investments in raw material transportation to the plant will be required as well.

[2] 2,345 TJ corresponds to the maximal amount of heating energy generated by Donenero in 2006.

- Alternative scenario №2: continuation of the practice of annual repair of old boilers and heat pipelines

Such practice is typical for the housing and utilities sector in Russia. Repair of boiler-houses equipment and heat pipelines is carried out in accordance with 'Regulations for maintenance and repair of the equipment, buildings, installations of electric power plant and networks' CO 34.04.181-2003. The scheduled repair of equipment is based on the study and analysis of the operational life for individual parts and units to reveal possible leaks, points with increased heat consumption and the adherence of the networks and equipment to applicable standards. The scheduled preventive maintenance (SPM) is carried out in accordance with the schedule approved by the JSC 'Donenergo' and drawn-up on the basis of fault detection reports for the equipment.

In spite of the situation in the housing and utilities sector in the Russian Federation, the practice of SPM will enable the main task to be carried out (the timely supply of heat to residential consumers at the required amounts) until 2012.

- Alternative scenario №3: the proposed Project activities undertaken without being registered as a JI activity.

As a result of the Project implementation, less efficient boiler-houses will be shut-down with the load shift to more efficient donor boiler-houses. Some boiler-houses will be converted to gas natural gas and reconstructed and the heat pipelines will be replaced with new ones, which will lead to a reduction in heat and water losses. The life-time of the boiler-houses being reconstructed is 20 years, the life-time of the heat pipelines is 25 years. More detailed information on the performance of the boiler-houses at shut-down and load shift, during the process of reconstruction and replacement of heat pipelines is presented in Annex 4.

Sub-step 1b. Consistency with mandatory applicable laws and regulation
In the Russian Federation, there are no regional regulations restricting the utilization of coal, natural gas and biomass fuel as fuel for boiler-houses. Boiler-houses are operated within established maximum permissible emissions (MPE)[3].

Conclusion: None of the alternatives stated above contradicts current legislation, and thus they could be analyzed further.

Step 2. Barrier analysis

This step serves to identify barriers and to assess which alternatives are prevented by these barriers. The following sub-steps apply:

Sub-step 2a. Identify barriers that would prevent the implementation of alternative scenarios.
For the purposes of evaluation, the following barriers are considered:

- *Investment barrier.* The following fact serves as indicator of the presence of this barrier to a definite alternative: no private capital is available from domestic or international capital markets

[3] The the maximal permissible emissions has been set for each boiler-house where norms for emissions of air pollutants (other than CO2) are specified for each source. The permits for pollutant emissions are issued by Rostekhnadzor (a federal supervisory body for technical and industrial safety) in the Rostov region. Compliance to MPE norms is controlled annually by providing scheduled measurements at each boiler-house. Records of emissions measured are available; the specified limits have not been exceeded.

due to real or perceived risks associated with investments in the country where the project activity is to be implemented.

- *Market barrier.* An indicator of the presence of the barrier is the inaccessibility of fuel and influence of the fuel price on the feasibility of the Project.

- *Technological barrier.* Indicators chosen for identification of this barrier are:
  - ✓ Skilled and/or properly trained labor to operate and maintain the technology is not available in the relevant geographical area, which leads to an unacceptably high risk of equipment disrepair, malfunctioning or other underperformance;
  - ✓ Lack of infrastructure for implementation and logistics for maintenance of the technology.

Sub -step 2b. Eliminate alternative scenarios which are prevented by the identified barriers.

Table B 1.1: Barrier analysis

Barrier	Alternative 1	Alternative 2	Alternative 3
Investment barrier	Barrier exists The implementation of this alternative will require about 25 mln euro for primary timber processing, thermal generation, ground-wood pulp refining, not including transportation costs for the raw materials. The cost of wood boilers installation is about 74 mln euro. So, total investment of the implementation of this alternative is about 99 mln euro. As the pricing for heat supply is politically-driven and set by non-market mechanisms (to be fixed by the Regional tariff department), investors could not obtain appropriate profits on capital invested for development of this alternative. Thus, the generation of the same amount (for all scenarios) of thermal energy based on wood pellets technology would have required much more investments and resulted in smaller returns given low tariffs adopted by regional authorities.	Barrier doesn't exist The financing of annual scheduled preventive maintenance (SPM) is made from the funds received as payments for thermal energy supplied. Therefore, this alternative doesn't require the attraction of additional investments. The SPM practice will ensure the fulfillment of the main task, i.e. the timely supply of heat to the residential consumers at the required amounts until 2012. Thus, a source for investments for this alternative is a repair fund of JSC "Donenergo".	Barrier exists Old boiler equipment and pipes are and will be replaced in the course of the Project. The approximate amount of estimated capital investments for the Project implementation is about 50.6 mln. euro. The source of financing of Project costs are cash receipts for heat sold. Due to the unattractiveness of the housing and utilities sector, funds are not sufficient to implement the Project. Implementation of this alternative is also needs considerable investments and brings low incomes in return. This testifies to the presence of a considerable investment barrier.

	Therefore, no private capital is available for this scenario.		
Market barrier	Barrier exists. The Rostov region is mostly steppe zone. Forestry comprises 2.5 %[4] of the region and is intended for water-control function of the Don river. Obviously the resulting wood waste would not be sufficient to meet the demands of boiler-houses if the Project would develop according to this scenario.	Barrier doesn't exist. It is 44% or 69 boiler-houses that use coal under this scenario. In a light of the forecasted increase in price on natural gas and its excess over the price on coal, it is quite feasible to maintain (and, possibly, increase) the number of coal-fired boiler-houses in JSC 'Donenergo'. Therefore, the barrier doesn't exist from this point of view.	Barrier exists. The implementation of this alternative will reduce the number of the coal-fired boiler-houses in JSC 'Donenergo' to 6 (5%). Domestic price on natural gas is expected to be higher than that of coal[5] in 2011. Therefore, the barrier prevents this scenario from being implemented.
Technological barrier	Barrier exists. A shift to wood fuel would require both, technical re-equipment and training of the personnel	Barrier doesn't exist. The boilers are operated by skilled personnel and additional re-training is not required.	Barrier exists. The Projects is aimed at the maximum automation of the boiler-houses, installation of state-of-the-art equipment that, in turn, requires additional re-training of the personnel capable of operating new automated boiler equipment in compliance with safety regulations. Moreover, new barrier will occur when converting boiler-houses from coal to gas: gas pipelines have

4 Ecological atlas of the Rostov region. http://www.ektor.ru/pages/mon1.asp#two

5 According to RAO UES of Russia, the fixed growth rates of gas supplies will be: in 2007 - 15%, in 2008 - 25% , in 2009 and 2010 – 27.7%. Actually, that means that gas prices come gradually into balance with the European market by 2011 excluding all expenditures associated with the delivery of Russian gas there.

The forecast of coal prices throughout the country for 2007-2011 is made with consideration of various price dynamics for export coals (Kuznetsk and Donetsk Basins) and for Kansk-Achinsk coals. In the coming years, domestic prices of Kuznetsk and Donetsk coals (in the Southern Federal District) will be determined by the growth of competition with export supplies. This will lead to an accelerated (versus inflation) growth in the price of coal on the domestic market

Due to the influence of the transportation tariff to be indexed according to inflation, the average annual growth rate of the price of Kuznetsk coal will be 13% in the Western Siberia, and in the European districts – about 10%. Unlike Kuznetsk coals, the supply price for lignites (mostly Kansk-Achinsk ones) at an extremely slow production price growth, will grow in pace with the inflation rate; exceeding it just by basis points.

Quite different price dynamics of growth for gas and coal will lead to a sharp change in price proportions between these two basic types of fuel for the electric-power industry. If the ratio between gas and coal (in current prices) in the Central Federal District is about 1 to 1.2 in 2005, it will change to the contrary in 2011 and will be 1.4 to 1. (The scenario of development for the electric-power industry and Holding Company RAO UES of Russia for 2007-2011, and preliminary long-term forecast of prices up to 2030. The agency for forecasting balances in the electric-power industry. RAO UES of Russia. M., February, 2007).

			been laid out to far from all the boiler-houses. The procedure for getting gas limits and permits for connecting to gas pipelines frequently becomes an insurmountable obstacle even when gas pipelines are directly accessible.

Brief scheme for obtaining permits for connecting to a gas pipeline:
An application in writing to the regional department of the gas service with a request to issue the technical requirements for connecting to the gas-supply. Meanwhile, it is required to present the documents available with any organization: charter, land certificate, documentation for existing facilities, registration card etc.

The presentation of additional information sheets: about gas limits from supply organizations, approval from the regional department of the gas service engaged in gas transportation.

The issue of what particular gas pipeline should be chosen for boiler-houses to be connected to will be decided when negotiating technical requirements. The remoteness of the gas supply and possibility supplying gas to boiler-houses via it are also very important. If the distance to it is too big or its design capacities are exhausted, additional financing will be required for the construction of additional gas pipelines near boiler-houses, and the term for the approval of the technical requirements issuance could be extended for a long time.

Conclusion: The conducted analysis of how the barriers influence the development of the alternative scenarios found that scenarios 1 and № 3 failed to overcome the above-stated barriers and only scenario № 2 (Continuation of the practice of annual repairs of old boilers) has no obstacles for development. Thus, this alternative scenario is the *baseline scenario,* and the amount of greenhouse gas emissions within the framework of this alternative scenario № 2 is *baseline*.

The Implementation of alternative 1 is impossible due to the following reasons: lack of biomass fuel in the Rostov region and, as a consequence, the high supply price for this fuel type to boiler-houses.

In spite of the presence of the barriers stated above, the implementation of alternative 3 (Project) is enabled due to the presence of an additional factor, that is the possibility to use income from the sales of emission reduction units (ERU) in financing the activities of this Project.

In spite of the fact that the first steps towards implementing the activities on the project were made in 2005, the main capital investments are planned to be started in 2008 (the amount of capital investments from 2005 to 2007 was 20 500 000 euro, the amount of capital investments from 2008 to 2010 – 30 100 000 euro). The activities included in the project are being implemented also owing to the possibility of acquisition of income from emission reduction units (ERU) sales. This will help to recoup the retrofitting expenses. Without additional investment, the project implementation could be delayed longer.

Step 3. Investment analysis (not applicable)

Step 4. Common practice analysis

The previous steps shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and geographical area. This test is a **credibility check** to demonstrate additionality which complements the barrier analysis (Step 2).

Insufficiency and delay in the financing of projects in the housing and utilities sector is the main problem in the Russian Federation. In this situation, investors don't invest in the sector due to the vague tariff regulation system, pricing determination and accumulated debt of budgets towards the utility companies.

In the course of preparation of the housing and utilities sector for operation during the heat deficit (autumn-winter) period, scheduled preventive maintenance (SPM) is carried out in the Russian Federation. This regulation is specified in 'Regulations for maintenance and repair of the equipment, buildings, installations of electric power plant and networks' CO 34.04.181-2003. This document offers recommendations. SPM is carried out in accordance with the approved schedule. The expansion of SPM is caused by the fact that funding of this measure covered by cost of heat, therefore, it doesn't need additional investments. That is the most important factor in the housing and utility sector of the Russian Federation, which is experiencing a deficit of capital investments.

Regulations obligating the application of some particular technology for the production of municipal heating power and utilization of the particular fuel type are not available in the Russian Federation.

Heat supply rehabilitation projects have been already started in the Kirov and Leningrad regions (Russia), Chernihiv and Donetsk regions (Ukraine) and all of them are being implemented only within the framework of the Kyoto Protocol JI mechanism. In the absence of that their implementation would have been impossible. The application of the JI mechanism is the only incentive to implement of similar projects.

Conclusion: Based on the available facts, the following is clear:

- Activities similar to this Project are not widespread in the housing and utilities sector of the Russian Federation.
- These activities are not a result of national policy being pursued in respect to promoting the utilization of gas as a fuel in municipal heat supply systems.

Thus, the Project activities do not fall under the category of *common practice.* This testifies to the additionality of the given Project.

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 analysis presented in sub-section **B.1.,** demonstrates clearly that the Project is not the baseline scenario and that the Project activity is additional in respect to the situation that would occur in the implementation of the baseline scenario, i.e. continuation of the annual repairs practice. The barrier analysis presented in sub-section **B.1.,** made it possible to identify **alternative №2** as the baseline scenario – the continuation of the practice of annual repairs for old boilers. Such a practice will allow residential consumers to be provided with thermal energy with minimum costs, timely and at the required amounts.

Alternative №3 is selected as the project scenario, i.e. implementation of the Project without consideration of its registration within the framework of the JI mechanism. The implementation of this alternative will allow the fuel consumption to be reduced in the boiler-houses, eliminate losses in the heat pipelines that in turn leads to the reduction of CO_2 emissions into the air. "A tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf was used for emission estimation in the Baseline and Project scenarios in boiler-houses of the Rostov region.

Table B 2.1: Baseline emissions

Year	Baseline emissions from coal-fired boiler-houses without load shift, tCO2/year	Baseline emissions from boiler-houses without retrofitting, tCO2/year	Baseline emissions from heat pipelines without replacement and treatment of leaks, tCO2/year	Total baseline emissions tCO2/year
Total in 2008-2012	757,582	1,253,023	336,589	2,347,194

While improving the heat supply structure in the Rostov region in 2005-2010, the following activities are to be implemented:

1. optimization of the heat supply structure
2. retrofit of the boiler-houses
3. reconstruction of the heat pipelines

More detailed information on the performance of the boiler-houses under Project activities is presented in Annex 4.

These activities lead to fuel saving since fuel consumption for generation 1 TJ of heating power is to be reduced. CO_2 emissions are to be reduced accordingly. The project emissions from implementation of the above-stated activities are indicated in Table B 2.2.

Table B 2.2: Project emissions from various sources

Year	Projects emissions after load shift (activity 1) , tCO2	Project emissions after retrofit of boiler-houses (activity 2), tCO2	Project emissions after reconstruction of heat pipelines (activity 3), tCO2	Total project emissions, tCO2
Total in 2008-2012	604,937	1,068,976	154,433	1,828,346

The result of the estimation of reductions is presented in Table B 2.3.

Table B 2.3: Estimation results of emission reductions

Year	CO2 emission reductions after activity 1 tCO2	CO2 emission reductions after activity 2 , tCO2	CO2 emission reductions after activity 3, tCO2	Total Project CO2 emission reductions tCO2
Total from 2008-2012	152,645	184,047	182,156	518,848

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

The project boundaries include all the CO_2 emission sources associated with the combustion of fuel in the boiler-houses being reconstructed as well as with leaks in the heat supply networks of the eleven districts of the Rostov region belonging to JSC 'Donenergo'. The inclusion of the emission sources within the Project boundaries depends on factors such as substantiality of these emissions (over 1 % of the volume of reductions[6]) and the capability of JSC 'Donenergo' to control them. CH_4 and N_2O emissions are not substantial in the process of fuel combustion (less than 1% of the volume of reductions), therefore, they are not taken into account. Leaks from residential consumers are not considered as well because the heat consumption and the condition of the heating system will be equal for the baseline and project scenarios. Emissions from the supply of fuel are not considered because natural gas and coal are to be supplied in larger amounts in the Baseline scenario resulting in higher leakages and CO_2 emissions than at the Project activity. This will lead to an increase in the volume of reductions. Therefore, in order to remain conservative, leakages shall be not considered for the given Project. All emission sources for inclusion in the project boundaries are considered below with consideration of the above-stated factors.

Table B 3.1: Emission sources within the framework of the baseline scenario and project activity

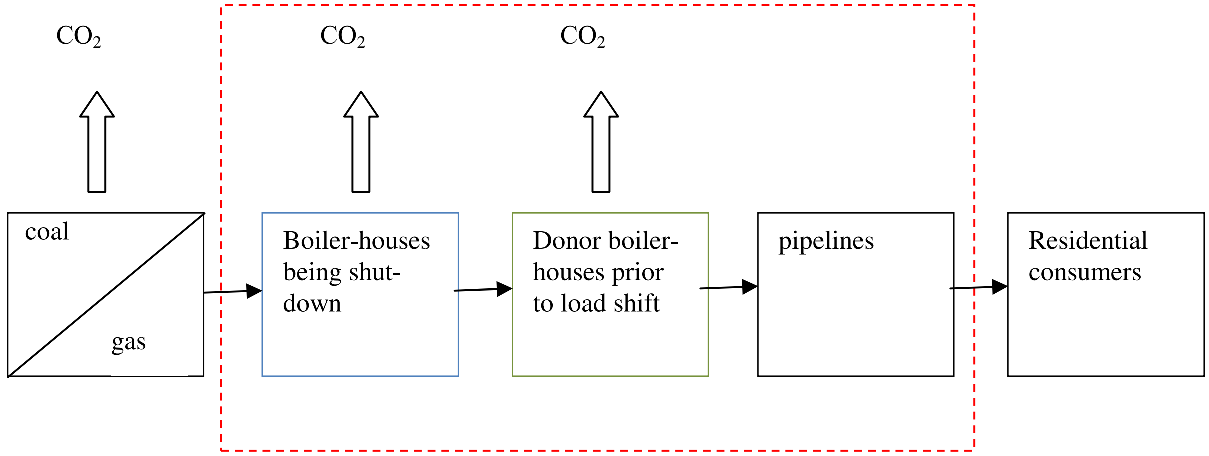
	Source	GHG	Included/ Not included	Grounds/explanation
Baseline	Combustion of fuel in boiler-houses	CO_2	Included	Emissions from the combustion of fossil fuel (coal, natural gas) in boiler-houses. While utilizing existing pipelines without insulation, more fossil fuel is combusted in boiler-houses in order to provide residential consumers with heat.
		CH_4	Not included	Emissions are insignificant
		N_2O	Not included	Emissions are insignificant
	Fuel supplies	CO_2	Not included	Not considered because natural gas and coal are to be supplied in larger amounts in the Baseline scenario resulting in higher leakages and CO_2 emissions than at the Project activity. This will lead to an increase in the volume of reductions. Therefore, in order to remain conservative, leakages shall be not considered for the given Project.

[6] Guidance on the criteria for baseline setting and monitoring. Version 01.

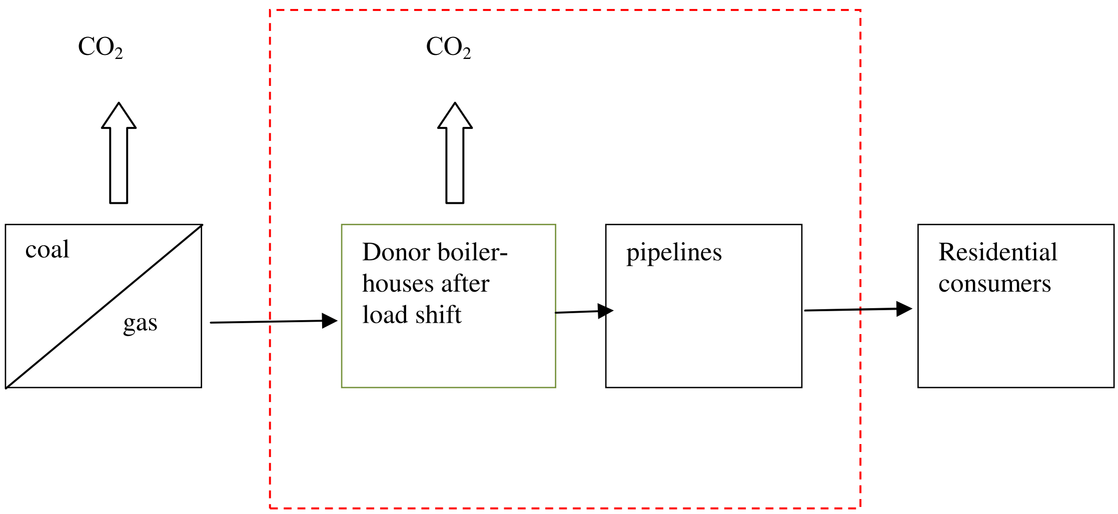
Project	Combustion of fuel in boiler-houses	CO_2	Included	Basic emissions from the source. While implementing the Project activities, the amount of combusted fossil fuel required to provide residential consumers with heat is reduced.
		CH_4	Not included	Emissions are insignificant
		N_2O	Not included	Emissions are insignificant
	Fuel supplies	CO_2	Not included	Not considered because natural gas and coal are to be supplied in larger amounts in the Baseline scenario resulting in higher leakages and CO_2 emissions than at the Project activity. This will lead to an increase in the volume of reductions. Therefore, in order to remain conservative, leakages shall be not considered for the given Project.

Proceeding from the analysis conducted, the Project boundary is presented graphically as follows:

Scheme B 3.1: The Project boundary for the baseline scenario



Scheme B 3.2: The Project boundary for the project scenario



Legend

	Coal/Gas
The Project boundary	Exploitation and transportation of coal and natural gas

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: 21/04/2008.

The baseline was developed by:
- The National Carbon Sequestration Foundation (Moscow);
- Contact person: Mr. Marat Latypov, Head of Project Development Department;
- Tel.: +7 (495) 975 78 35 ext. 103
- Fax: +7 (495) 975 78 35 ext. 107
- e-mail: LatypovMF@ncsf.ru

The National Carbon Sequestration Foundation is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Construction and erection works started in the 1st quarter, 2005

C.2. Expected operational lifetime of the project:

Expected operational lifetime of the Project is 30 years 0 months: 2005 – 2035

C.3. Length of the crediting period:

5 years 0 months: from January 01, 2008 to December 31, 2012

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Monitoring plan for the project 'Rehabilitation of the heat supply system of the JSC "Donenergo" in the Rostov region' was developed in accordance with the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf. The given tool allows the emissions from fossil fuel combustion to be calculated and also provides recommendations for the monitoring performance. According to the tool, the monitoring amounts to the following:

The Project being implemented in the JSC 'Donenergo', comprises the following energy efficiency activities:

Activity 1. Optimization of the heat-supply structure providing the shut-down of low-efficient boiler-houses with the load shift to the boiler-houses with higher efficiency (donor boiler-houses). It will lead to a reduction in fuel consumption with the same heat generation.

Activity 2. Retrofitting of the existing boiler-houses leading to an increase of the fuel utilization efficiency for thermal generation.

Activity 3. Reconstruction of heat pipelines providing the replacement of the existing pipelines which have worn-out insulation with pre-insulated ones. As a result, heat losses due to heat radiation through the pipe surface and due to hot water leaks are reduced. It will lead in turn to the reduction in heat generation in the boiler houses to compensate for the above-stated losses.

As a result of these activities, CO_2 emissions reduction will occur. According to "The tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01), emission calculations at fossil fuel combustion are based on the amount of combusted fuel and the CO_2 emission coefficients. Thus, the monitoring plan for the Project must specify the evaluation of these two values for the basic parameters.

Approaches for the estimation of these values are considered below.

Because CO_2 emission reductions are evaluated as the difference between the emissions level in the absence of the Project (Baseline scenario) and the emissions level in the implementation of the Project, the estimation of emission reductions must be implemented with respect to these two scenarios. Upon that, monitoring of the following parameters must be carried out:

Monitoring of the CO_2 project emissions

1. Amount of fuel combusted in boiler-houses
2. Heating load delivered to residential consumers
3. Specific rates of fuel consumption in boiler-houses
4. Specific rate of heat losses (heat radiation) for pipelines prior to/after insulation replacement (only for activity 3)
5. Extent of pipelines prior to/after insulation replacement (only for activity 3)
6. Losses of heating fluid (hot water) under the Project activity (only for activity 3)
7. The duration of the heating season taking into account heat losses in the networks and the air temperature is to be determined from the reference books.
8. Density of combusted gas
9. Calorific value of the fuel utilized (coal/natural gas)

Monitoring of CO_2 emissions in the baseline scenario

1. Heating load in the absence of the implementation of the activities (equivalent to actual)
2. Losses of heating fluid (hot water) over the period prior to the Project activity.

Since the Project implementation began in 2005, the monitoring of emissions over 2005-2007 was carried out based on the actual values of the indices stated above. This data is stored in the industrial engineering department. From 2008-2012, monitoring of emissions will be based on the estimation of the parameters stated-above using computational and instrument methods.
Using the computational method, the following parameters will be determined:

- heat power generation
- coal consumption (according to the Project)
- coal and natural gas consumption (Baseline scenario)

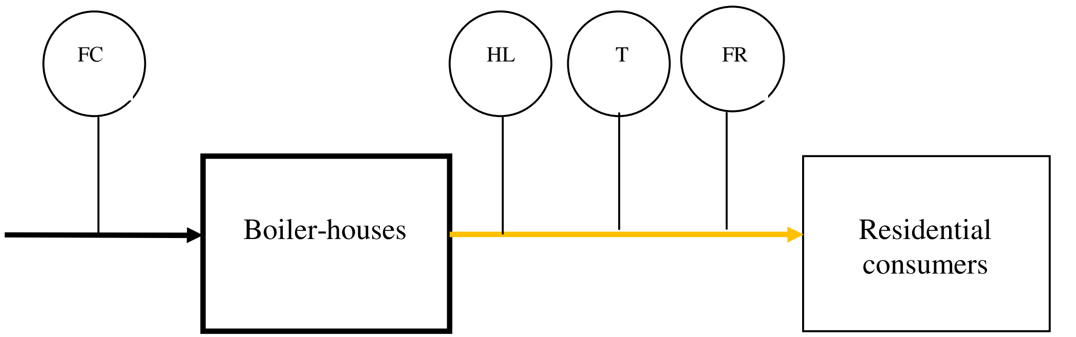
Using the instrument method (instrument readings), the following parameters will be determined:

- natural gas consumption;

- heating loads (in boiler-houses equipped with heat meters[7]);
- water flow

The monitoring schematic for these parameters is presented in the following diagram:

Fig. D.1. Monitoring parameters



Legend

	Fuel supplies to boiler-houses (natural gas, coal)
	Heating power supplies via pipelines
FC	Fuel consumption
HL	Heating load
T	Temperature
FR	Flow rate of heating water

[7] On October 18 2006, the program of equipment installation for metering heating power and heating fluid on heating sources was approved, and has been implemented at the JSC 'Donenergo' since that time.

Specific norms

When estimating the coal consumption for the Project scenario and the coal and natural gas consumption for the Baseline scenario, the coefficients shall be used which express the norms of fuel consumption (kg) per 1 TJ of heating energy. Data values of coefficients are accepted individually for each boiler-house based on the data of the specific fuel consumption over the prior periods. The values of the specific consumption rates for boiler-houses after retrofitting (activity 2) are estimated based on ratings indicated in the passports for new boiler-houses.According to current Russian practice, the values of specific consumption rates are shown in hard coal equivalent per 1 Gcal of generated thermal energy. (kg. s.f.\ Gcal).The conversion of this value into the SI system is performed as follows:

For natural gas:

Norm of fuel consumption	Heat value of standard fuel	Lowest heat value of natural gas	Natural gas density	Conversion factor	Norm of fuel consumption (SI system)
kg.s.f.\Gcal	kg. s.f.\ Gcal	Gcal / m^3	kg/ m^3	TJ / Gcal	Kg / TJ
Data from boiler-houses	7000	From accompanying documents at the fuel supply to boiler-houses	From accompanying documents at the fuel supply to boiler-houses	4186.8	To be calculated
C.1	C.2	C.3	C.4	C.5.	C.6
					$\frac{C1*C.2*C4}{C3*C.5}$

For coal:

Norm of fuel consumption	Heat value of standard fuel	Lowest heat value of coal	Conversion factor	Norm of fuel consumption (SI system)
kg.s.f.\Gcal	Gcal / kg. s.f	Gcal / kg	TJ / Gcal	Kg / TJ
Data from boiler-houses	7000	From accompanying documents at the fuel supply to boiler-houses	4186.8	To be calculated
C.1	C.2	C.3	C.5.	C.6
				$\frac{C1*C.2}{C3*C.5}$

Values of specific heat losses are estimated by reference from the following manuals:

The coefficient of specific heat losses through the pipeline surface (heat radiation) prior to the replacement of the insulation is calculated according to the specialized methodology[8].

The coefficient of specific heat losses through the pipeline surface after the replacement of insulation, according to the methodology described in "Thermal insulation of equipment and heat traces CNaS (Construction norms and specifications) 41-03-2003", the State Committee of the Russian Federation on construction and housing and public utilities (Gosstroy of Russia), 2005.

8 Zhitnyacov S.V. 'Practical calculations of thermal insulation', M.: 'Energia', 1976. This method is used in the JSC 'Donenergo'.

CO2 emission factor

According to the methodological manual "The tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf. The coefficient $\mathbf{COEF_{NG/Coal}}$ is calculated as follows:

$$\mathbf{COEF_{NG/Coal} = NCV * EF_{CO2,\ NG/Coal}} \qquad \mathbf{(D.1\text{-}1)}$$

Where:

$\mathbf{COEF_{NG/Coal}}$ **–** CO2 emission factor for the given fuel type per year, t CO_2/ton;

NCV– net calorific value , TJ /ton;

$\mathbf{EF_{CO2,\ NG/Coal}}$ **–** Coefficient of CO2 emissions from the combustion of fuel (natural gas/coal), t CO_2/ TJ

Table D.1. Data for calculating the CO2 emission factor.

Values	Natural gas	Coal
EF, T CO2/ TJ	56.1[9]	94.6[10]
NCV	From accompanying documents at the fuel supply to boiler-houses	From accompanying documents at the fuel supply to boiler-houses

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

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

[9] 2006 IPCCGuidelines for National Greenhaus Gas Inventories, Volume 2, Energy

[10] 2006 IPCCGuidelines for National Greenhaus Gas Inventories, Volume 2, Energy

ID 1	$LC_{PJ, donor}$ Heat load after implementation of the project activities	Heat evaluator VKT-5, Heat evaluator SPT 961, Heating power supply contracts	TJ /hour	m	Once per hour	100%	electronic	In the absence of meters, the heat generation is estimated according to the actual load, data is taken from heating power supply contracts. The device could be programmed to make readings both in TJ\hour and in Gcal\hour
ID 2	FC_{PJ} Amount of combusted fuel (natural gas)	Readings of the instruments: gas utility meter SG 16, gas consumption corrector SPG 741, gas meter thermo anemometrical PGA 100(300) and gas consumption calculator VRG, and rotary gas meter RG-K-100 Ex and RVG G-160	m^3	m	Once per hour	100%	Paper and electronic	Each boiler-house is equipped with meter(s) to measure the amount of natural gas consumed.
ID 3	SFC_{PJ} Specific norms of fuel consumption in	To be calculated from the values in heating power supply contracts	kg. of natural fuel / TJ	c	Once a year	100%	paper	The specific norms of fuel consumption are defined from

	boiler-houses							data from heating power supply contracts (individual for each boiler-house)
ID 4	$SHL_{PJ,heat}$ Specific norm of heat losses as a result of heat radiation for pipelines prior to the replacement of insulation	To be calculated according to the methodology described in 'Practical calculations of thermal insulation', by Zhitnyacov S.V. M.: 'Energia'76.	TJ /m* hour	c	Once a year	100%	paper	Only for activity 3.
ID 5	$SHL'_{PJ,heat}$ Specific norm of heat losses as a result of heat radiation for pipelines after the replacement of insulation	Calculated according to the methodology described in "Thermal insulation of equipment and pipelines CNaS (Construction norms and specifications) 41-03-2003",	TJ /m* hour	c	Once a year	100%	paper	Only for activity 3.
ID 6	FR_{PJ} Losses of heating water within the framework of the project activity	Readings of the instruments: water flow transducer DRK-3 and flow measuring device of water	m^3/hour	m	Once per hour	100%	electronic	Only for activity 3. Water consumption transducers are located at boiler-houses, which provide heat

		utility meter UFM-001						pipelines with water.
ID 7	L'_{PJ} Length of pipeline with replaced insulation	Work completion certificate according to the annual results	m	c	Once a year	100%	paper	Only for activity 3. The firm contractor gives a report to the accounting department of the JSC "Donenergo"
ID 8	L_{PJ} Length of pipeline without replacement of insulation	Work plan for contracting firms	m	c	Once a year	100%	paper	Only for activity 3. To be made by the department of capital construction of the JSC "Donenergo".
ID 9	K_1 Coefficient, taking in to account heat losses in networks	Calculated according to the methodology described in "Thermal insulation of equipment and pipelines SNiP (Gosstroy of Russia), 2005.	---	c	Once a year	100%	paper	This coefficient is calculated by the research and technical department of the JSC "Donenergo
ID 10	K_2 Conversion factor, which expresses the ratio of the average heat load to the peak	see above	---	c	Once a year	100%	paper	The coefficient is calculated by the research and technical department of the JSC "Donenergo"

	load							
ID 11	d Number of days of heating period	The duty operator of boiler-house monitors	day	m	Annually	100%	paper	This parameter is monitored by the duty operator of boiler-house
ID 12	ρ density of combusted natural gas	Passport for fuel	ton/m^3	m	Annually	100%	paper	This parameter is provided with a passport for purchased fuel. It is calculated by an independent certified laboratory
ID 13	NCV_{NG}/NCV_{coal} Calorific Net value of fuel(heat value)	Passport for fuel	TJ / ton	m	Annually	100%	paper	This parameter is provided with a passport for purchased fuel It is calculated by an independent certified laboratory

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

$$\sum PE_y = \sum PE_{CO2,\ load\ shift} + \sum PE_{CO2,boilers\ retrofit} + \sum PE_{CO2,pipe\ retrofit} \qquad \textbf{(D.1-2)}$$

Where:

$\sum PE_y$ –project emissions per year;

$\sum PE_{CO2,\ load\ shift}$ – GHG emissions from donor boiler-houses after load shift , tons of CO_2.

$\sum PE_{CO2,\ boilers\ retrofit}$ – GHG emissions from boiler-houses after carrying out retrofitting, tons of CO_2.

$\sum PE_{CO2,\ pipe\ retrofit}$ – GHG emissions from boiler-houses after reconstruction of heat pipelines, tons of CO_2.

Activity 1. Monitoring of Project emissions in the optimization of the heat supply structure (load shift of shut-down low-efficient boiler-houses)**.**

The implementation of the Project leads to the shut-down of 35 low-efficient boiler-houses, the emissions of which will be equal to zero in this case. At the same time, the generation of heating energy will be shifted to so-called donor boiler-houses which will increase the load to compensate for the shut-down of low-efficient boiler-houses.

Therefore, emissions at donor boiler-houses $PE_{CO2,\ donor}$ will be calculated as follows:

$$PE_{CO2,\ donor} = \sum FC_{PJ,\ donor} * COEF_{NG/Coal} \qquad \textbf{(D.1-3)}$$

Where:
$FC_{PJ,\ donor}$ – amount of combusted fuel at donor boiler-house, tons/year;
$COEF_{NG/Coal}$ – coefficient of CO2 emissions for corresponding fuel type (natural gas, coal), tons of CO2/ton of fuel
Variable $FC_{PJ\ donor}$ - amount of combusted fuel (natural gas) is calculated according to the gas meter readings:

$$FC_{PJ} = \sum FC_{NG} * \rho_{NG} \qquad \textbf{(7.5)}$$

FC_{NG} – amount of combusted natural gas, m^3;
ρ_{NG} – density of combusted natural gas, tons/m^3;

Variable $FC_{PJ\ donor}$ – the amount of combusted fuel (coal) is calculated according to the following formula:

$$FC_{PJ\ donor} = HG_{PJ,\ donor} * SFC_{PJ}/1000 \qquad \textbf{(D.1-4)}$$

Where:
$HG_{PJ, donor}$[11] – heat generation by the donor boiler-house, TJ;
SFC_{PJ} – specific norm of fuel consumption at a donor boiler-house after load shift (to be specific for each boiler-house[12]), kg of natural fuel/ TJ[13];

The value of the heating energy supply after load shift **$HG_{PJ, donor}$** is calculated as follows:

$$HG_{PJ, donor} = LC_{PJ, donor} * K_1 * K_2 * T_{PJ} \qquad \textbf{(D.1-5)}$$

Where:
$LC_{PJ, donor}$ – connected heat load at a donor boiler-house (individual for each boiler-house), TJ /hour;
K_1 – coefficient, taking into account heat losses in networks (taken value is 1.10-1.12[14]);
K_2 – conversion coefficient (to be taken separately for each region depending on the temperature difference in each of them[15]);
T_{PJ} – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

The conversion coefficient **K_2** is defined for each district of the region by the following formula:

$$K_2 = (t_{set} - t_{average})/(t_{set} - t_{max}) \qquad \textbf{(D.1-6)}$$

Where:

t_{set} – specified indoor temperature (according to sanitary regulations **$t_{set} = 18^0C$**);
$t_{average}$ – outdoor average temperature over a heating season (defined by "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and housing and utilities (the Gosstroy of Russia, 2005)
t_{max} – outdoor minimum temperature (also defined by the data of the SNiP (construction norms and regulations 41-03-2003).

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11 To be calculated according to the data of the industrial engineering department of the JSC 'Donenergo'.It is included in "The technical and economic index of the operation of boiler-houses for one year ".

12 They are shown in Excel computation tables (Computation 1, Computation 2, Computation 3).

13 The conversion formula from kg.s.f./Gcak to kg. of natural fuel/TJ is shown in the preamble of section D.

14 The methodology "Thermal insulation of equipment and pipelines SNiP (Construction norms and regulations) 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

15 The methodology " Thermal insulation of equipment and pipelines SNiP (Construction norms and regulations) 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

Activity 2. Monitoring of Project emissions from boiler-houses after carrying out retrofitting.

$$PE_{CO2,\ boilers\ retrofit} = \sum FC_{PJ,boiler\ retrofit,} * COEF_{NG/Coal} \qquad \textbf{(D.1-7)}$$

Where:

$PE_{CO2,\ boilers\ retrofit}$ - GHG emissions after retrofit of boiler-houses, tons of CO2/year;
$FC_{PJ,boiler\ retrofit}$ – amount of combusted fuel at boiler-houses a year after retrofit, tons/year
$COEF_{NG/Coal}$ – coefficient of CO2 emissions for the given fuel type a year, tons of CO2/fuel ton

Variable $FC_{boiler\ retrofit}$ – the amount of combusted fuel (natural gas) is calculated according to the gas meters readings:

$$FC_{PJ} = \sum FC_{NG} * \rho_{NG} \qquad \textbf{(D.1-8)}$$

FC_{NG} – amount of combusted natural gas, m^3/hour;
ρ_{NG} – density of combusted natural gas, tons/m^3;

Variable $FC_{boiler\ retrofit}$ – the amount of combusted fuel (coal) is calculated as following:

$$FC_{boiler\ retrofit} = HG_{PJ,\ boiler\ retrofit} * SFC_{heat}/1000 \qquad \textbf{(D.1-9)}$$

Where:

$HG_{PJ,\ boiler\ retrofit}$ – heat generation after retrofitting, TJ;

SFC_{heat} – specific norm for fuel consumption after carrying out retrofitting (to be specific for each boiler-house[16]), kg of natural fuel/TJ;

The value of the heat supply after retrofitting $HG_{PJ,\ boiler\ retrofit}$ is calculated as follows:

$$HG_{PJ,\ boiler\ retrofit} = LC_{PJ,\ donor} * K_1 * K_2 * T_{PJ} \qquad \textbf{(D.1-10)}$$

Where:

$LC_{PJ,\ donor}$ – connected load at boiler-house after retrofit (for every boiler-house), TJ/hour;

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[16] They are shown in Excel computation tables (Computation 1, Computation 2, Computation 3).

K_1 **–** coefficient, taking into account heating losses in networks (the value taken is 1.10-1.12[17]);
K_2 **–** conversion factor (it is taken separately for each region depending on the temperature difference in each of them[18]);
T_{PJ} **–** number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

Activity 3. Monitoring of Project emissions after insulation replacement and treatment of pipe leaks in the heat pipelines.

Within the framework of the project, reconstruction of the heat pipelines of JSC "Donenergo" is being carried out. This activity includes the replacement of pipes without insulation with pre-insulation pipes. This leads to a reduction in heat losses (owing to heat radiation) and hot water leaks. It will result in the saving of fuel which is necessary for heat generation in order to compensate for the indicated losses.

The calculation of GHG emissions after the implementation of this activity consists of emissions estimation at the boiler-house during the combustion of fuel for heat generation to compensate for heat losses associated with emission through the surface of the insulated pipe and hot-water leaks after reconstruction of heat pipelines, i.e:

$$PE_{CO2,pipes\ retrofit} = PE_{CO2,heat\ loss} + PE_{CO2,water\ leaks} \qquad (D.1\text{-}11)$$

Where:

$PE_{CO2,\ pipes\ retrofit}$ **–** emissions from the combustion of fuel for heat generation to compensate for heatr losses after the reconstruction of heat pipelines, tons of CO_2/year;

$PE_{CO2,heat\ loss}$ **–** emissions from the combustion of fuel for heat generation to compensate for heat losses due to heat radiation after the reconstruction of heat pipelines, tons of CO_2/year;
$PE_{CO2,\ water\ leaks}$ **–** emissions from the combustion of fuel for heating power generation to compensate for heat losses due to water leaks after the reconstruction of heat pipelines, tons of CO_2/year.

Calculation of emissions from the combustion of fuel for thermal generation in connection with heat radiation

$$PE_{CO2,\ heat\ loss} = \sum FC_{PJ,heat\ loss} * COEF_{NG/Coal} \qquad (D.1\text{-}12)$$

Where:

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[17] Methodology "Thermal insulation of equipment and pipelines SNiP 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

[18] The methodology " Thermal insulation of equipment and pipelines SNiP 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

$FC_{PJ,heat\ loss}$ – amount of combusted fuel owing to the compensation of annual heat losses, tons/year;
$COEF_{NG/Coal}$ – coefficient of CO2 emissions for the given fuel type a year, t CO2/fuel ton;

Variable **$FC_{PJ\ heat\ loss}$** – the amount of combusted fuel (coal or natural gas) is calculated according to the formula:

$$FC_{PJ,heat\ loss} = SFC_{heat} * HL_{PJ}/1000 \qquad (D.1\text{-}13)$$

Where:
SFC_{heat} – specific fuel consumption (individual for each boiler-house), kg of natural fuel/TJ;
HL_{PJ} – annual heat losses through heat networks, TJ;

$$HL_{PJ} = (SHL_{PJ,\ heat} * L_{PJ} + SHL'_{PJ,\ heat} * L'_{PJ}) * T_{PJ} \qquad (D.1\text{-}14)$$

Where:
HL_{PJ} – annual heat losses after the insulation of pipes, TJ;
$SHL_{PJ,\ heat}$[19] – specific heat losses by the pipeline prior to insulation replacement (individual for every region of heat networks), TJ/m*h;
L_{PJ} – length of pipeline without replaced insulation, m
$SHL'_{PJ,\ heat}$[20] – specific heat losses by pipeline after insulation replacement, TJ/m*h;
L'_{PJ} – length of pipeline with replaced insulation, m
T_{PJ} – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

Calculation of emissions from the combustion of fuel to compensate the heat losses owing to water leaks after the reconstruction of heat networks

$$PE_{CO2,\ water\ leaks} = \sum FC_{PJ,\ water\ leaks} * COEF_{NG/Coal} \qquad (D.1\text{-}15)$$

Where:
$PE_{CO2,\ water\ leaks}$ - GHG emissions from the combustion of fuel for thermal generation for the compensation of heat losses associated with water leaks after the reconstruction of heat networks, tons of CO2/year;

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[19] The calculation of this index is carried out according to the methodology described in ‘Practical calculations of thermal insulation’ by Zhitnyacov S.V., M.: ‘Energia’, 1976.

[20] The calculation of this value is to be made according to the methodology described in “Thermal insulation of equipment and pipelines SNiP 41-03-2003”, the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005

$FC_{PJ,\ water\ leaks}$ – amount of combusted fuel for heating generation for the compensation of heat losses associated with water leaks after the reconstruction of heat networks, tons/year;
$COEF_{NG/Coal}$ – coefficient of CO2 emissions for the given fuel type per year, t CO2/ton of fuel;

Variable **$FC_{PJ,water\ leaks}$** is calculated as follows:

$$FC_{PJ,water\ leaks} = SFC_{,heat} * WL_{PJ}/1000 \qquad (D.1\text{-}16)$$

Where:
$FC_{PJ,water\ leaks}$ – amount of combusted fuel for heat generation for the compensation of heat losses associated with water leaks after the reconstruction of heat networks, tons/year;
$SFC_{PJ,heat}$ [21]– specific fuel consumption [22], kg of natural fuel/TJ;
WL_{PJ} –annual heat losses due to water leakage, TJ;

Annual heat losses with leakage are calculated as follows[23]:

$$WL_{PJ} = FR_{PJ,water} * h_{water} * \rho_{water} * T_{PJ} \qquad (D.1\text{-}17)$$

Where:
WL_{PJ} – annual heat losses with leaks, TJ;
$FR_{PJ,water}$ – consumption of heat water in pipes, m^3/h;
h_{water} – water enthalpy, TJ/kg;
ρ_{water} – water density, kg/m^3 (1000 kg/m^3);
d – number of days of heating period;
T_{PJ} – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

[21] To be calculated according to the methodology presented in "Thermal insulation of equipment and pipelines SNiP 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005

[22] They are shown in Excel calculation tables (Calculation 1, Calculation 2, Calculation 3).

[23] To be estimated according to documentary data based on water leakage values according to the data from water meters and the methodology described in "Thermal insulation of equipment and pipelines SNiP 41-03-2003", the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005

The consumption value of heating water **FR** $_{PJ,water}$ is calculated with the help of the correlative water consumption sensor DRK-3 and the water flow-meter UFM-001.

The water enthalpy is calculated as follows:

$$\mathbf{h_{water} = shc_{water} * \Delta t} \qquad \textbf{(D.1-18)}$$

Where:
$\mathbf{h_{water}}$ **-** water enthalpy, TJ/kg;
$\mathbf{shc_{water}}$ **–**specific heat capacity, TJ/kg*deg (4,19*10 $^{-6}$ TJ/kg*deg);
Δt – temperature difference of influent water and return water at average outdoor temperatures (to be individual for different settlements).

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
ID 14	$LC_{PJ,\ donor}$ Heat load after implementation of the project activities	Heat evaluator VKT-5, Heat evaluator SPT 961, Heating power supply contracts	TJ /hour	m	Once per hour	100%	electronic	In the absence of meters, the heat generation is estimated according to the actual load, data is taken from heating power supply contracts. The device could be programmed to make readings both in TJ\hour and in Gcal\hour

ID 15	SFC_{heat} Specific norms of fuel consumption in boiler-houses	To be calculated from the values in heating power supply contracts	kg. of natural fuel / TJ	c	Once a year	100%	paper	The specific norms of fuel consumption are defined from data from heating power supply contracts (individual for each boiler-house)
ID 16	$SHL_{,heat}$ Specific norm of heat losses as a result of heat radiation for pipelines prior to the replacement of insulation	To be calculated according to the methodology described in 'Practical calculations of thermal insulation', by Zhitnyacov S.V. M.: 'Energia'76.	TJ /m* hour	c	Once a year	100%	paper	Only for activity 3.
ID 17	FR_{BL} Losses of heating water within the framework of the project activity	Readings of the instruments: water flow transducer DRK-3 and flow measuring device of water utility meter UFM-001	m^3/hour	m	Once per hour	100%	electronic	Only for activity 3. Water consumption transducers are located at boiler-houses, which provide heat pipelines with water.

ID 18	L_{BL} Length of pipeline without replacement of insulation	Work plan for contracting firms	m	c	Once a year	100%	paper	Only for activity 3. To be made by the department of capital construction of the JSC “Donenergo”.
ID 19	K_1 Coefficient, taking in to account heat losses in networks	Calculated according to the methodology described in “Thermal insulation of equipment and pipelines SNiP (Gosstroy of Russia), 2005.	---	c	Once a year	100%	paper	This coefficient is calculated by the research and technical department of the JSC “Donenergo
ID 20	K_2 Conversion factor, which expresses the ratio of the average heat load to the peak load	see above	---	c	Once a year	100%	paper	The coefficient is calculated by the research and technical department of the JSC “Donenergo”
ID 21	d Number of days of heating period	The duty operator of boiler-house monitors	day	m	Annually	100%	paper	This parameter is monitored by the duty operator of boiler-house

ID 22	NCV_{NG}/NCV_{coal} Calorific Net value of fuel(heat value)	Passport for fuel	TJ / ton	m	Annually	100%	paper	This parameter is provided with a passport for purchased fuel It is calculated by an independent certified laboratory
ID 23	$LC_{BL,\ boiler\ no\ retrofit}$ connected load at boiler-house without carrying out retrofitting	To be calculated from the values in fuel supply contracts	TJ/hour	e	Once a month	100%	paper/ electronic	The specific norms of fuel consumption are defined from data from fuel supply contracts

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

The baseline scenario reflects the hypothetical situation in the absence of the Project Activity in which the boiler-houses and heat pipelines of JSC "Donenergo" would be operated in the former way, i.e. without the shut-down of low-efficient boiler-houses and load shift and without the reconstruction of the boiler-houses and heat pipilines.

$$\sum BE_y = \sum BE_{CO2,\ no\ load\ shift} + \sum BE_{CO2,\ boiler\ no\ retrofit} + \sum BE_{CO2,\ pipe\ no\ retrofit} \qquad (D.1\text{-}19)$$

Where:

$\sum BE_y$ – annual emissions at the baseline, tons of CO2/year;

$\sum BE_{CO2,no\ load\ shift}$ – GHG emissions from low-efficient boiler-houses and from donor boiler-houses, tons of CO2/year;

$\sum BE_{CO2,\ boiler\ no\ retrofit}$ – GHG emissions from boiler-houses without retrofitting being carried out, tons of CO2/year;

$\sum BE_{CO2,\ pipe\ no\ reconstruction}$ – GHG emissions from boiler-houses without heat traces being reconstructed, tons of CO2/year;

Activity 1.Baseline emissions monitoring from low-efficient boiler-houses and donor boiler-houses .

To estimate the emissions from the combustion of fossil fuel at the boiler-houses of the Rostov region, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC was used http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

According to the baseline scenario, low-efficient boiler-houses will not be shut-down, and accordingly, their load will not be shifted to other boiler-houses (donor- boiler-houses). Therefore, $\mathbf{BE_{CO2,\ load\ shift}}$ will be calculated as follows:

$$\sum BE_{CO2,\ no\ load\ shift} = \sum BE_{CO2,coal/NG} + \sum BE_{CO2,donor} \qquad \text{(D.1-20)}$$

Where:

$\sum \mathbf{BE_{CO2,coal/NG}}$ – GHG emissions from low-efficient boiler-houses, tons of CO2/year;

$\sum \mathbf{BE_{CO2,donor}}$ – GHG emissions from donor boiler-houses, tons of CO2/year;

The emissions from shut-down boiler-houses will be calculated according to the following formula[24]:

$$BE_{CO2,\ coal/NG} = \sum FC_{coal/NG} * COEF_{NG/Coal} \qquad \text{(D.1-21)}$$

Where:

$\mathbf{BE_{CO2,coal/NG}}$ – GHG emissions from low-efficient boiler-houses, tons of CO2/year;
$\mathbf{FC_{coal/NG}}$ – amount of fuel combusted per year, tons/year;
$\mathbf{COEF_{NG/coal}}$ – coefficient of CO2 emissions for the given fuel type per year, tons of CO2/ton of fuel;

Variable $\mathbf{FC_{coal/NG}}$ – amount of fuel combusted per year at low-efficient boiler-houses:

$$FC_{coal/NG} = HG_{BL,\ coal/NG} * SFC_{heat}/1000 \qquad \text{(D.1-22)}$$

Where:
$\mathbf{HG_{BL,\ coal/NG}}$[25] – heating power generation at boiler-houses being shut-down, TJ;

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[24] To estimate emissions from fossil fuel combustion at the boiler-houses of the Rostov Region, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" was used (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

[25] To be calculated according to the data of the JSC 'Donenergo' sales department and included in the 'technical-and-economic index of the operation of the boiler-houses for a year.

$\mathbf{SFC_{heat}}$ – specific norm of fuel consumption at low-efficient boiler-houses being shut-down (individual for each boiler-house[26]), kg of natural fuel /TJ[27];

The value of heating power generation after load shift $\mathbf{HG_{BL,\ coal/NG}}$ is calculated according to the following formula:

$$\mathbf{HG_{BL,\ coal/NG} = \alpha * LC_{PJ,\ donor} * K_1 * K_2 * T_{PJ}} \qquad \textbf{(D.1-23)}$$

Where:
$\mathbf{LC_{PJ,\ donor}}$ **–** connected load after residential consumers are switched over to donor boiler-houses (individual for each boiler-house), TJ/hour;
$\boldsymbol{\alpha}$ **–** amount of heat load provided by low-efficient boiler-houses [28];
$\mathbf{K_1}$ **–** ratio taking into account heat losses in networks (taken value - 1,12[29]);
$\mathbf{K_2}$ **–** conversion factor (to be separate for districts depending on the temperatures difference in each of them[30]);
$\mathbf{T_{PJ}}$ **–** number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

For calculation, reference data was used (provided by the JSC ‘Donenergo’) which is shown in Table 1, Annex 2.

Emissions from donor boiler-houses which take the load from low-efficient boiler-houses being shut-down within the framework of the Baseline are calculated according to the following formula[31]:

$$\mathbf{\sum BE_{CO2,\ donor} = \sum FC_{donor} * COEF_{NG/Coal}} \qquad \textbf{(D.1-24)}$$

Where:
$\mathbf{FC_{donor}}$ **–** amount of fuel combusted at a donor boiler-house per year, tons/year;

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26 Given in Excel computation tables (Computation 1, Computation 2, Computation 3).

27 The conversion formula from kg cf/ Gcal into kg n. fuel /TJ is given in the preamble of section D.

28 The specification procedure of the given index is shown in Annex 3.

29 The methodology ‘thermal insulation of the equipment and pipelines SNiP 41-03-2003’, the State committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

30 The methodology ‘Thermal insulation of the equipment and pipelines SNiP 41-03-2003’, the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

31 To estimate emissions from the combustion of fossil fuel at the boiler-houses of the Rostov region, the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 01) UN FCCC was used http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

$\mathbf{COEF_{NG/Coal}}$ – Coefficient of CO2 emissions for the given fuel type per year, tons of CO2/ton of fuel

Variable $\mathbf{FC_{donor}}$ – amount of fuel combusted per year at a donor boiler-house, tons/year

$$\mathbf{FC_{donor} = HG_{BL,\ donor} * SFC_{heat} / 1000} \qquad \textbf{(D.1-25)}$$

Where:
$\mathbf{HG_{BL,\ donor}}$[32] – heating power generation at a donor- boiler-house, TJ;
$\mathbf{SFC_{heat}}$ – specific fuel consumption rate at a donor boiler-house (individual for each boiler-house[33]), kg of natural fuel /TJ;

The value of the heating power generation after load shift $\mathbf{HG_{BL,\ donor}}$ is calculated according to the following formula:

$$\mathbf{HG_{BL,\ donor} = \beta * LC_{PJ,\ donor} * K_1 * K_2 * T_{PJ}} \qquad \textbf{(D.1-26)}$$

Where:
$\mathbf{LC_{PJ,\ donor}}$ – connected load after residential consumers are switched over to donor boiler-houses (individual for each boiler-house), TJ/hour;
β – amount of heat load provided by donor boiler-houses[34];
$\mathbf{K_1}$ – ratio taking into account heat losses in networks (taken value - 1,12[35]);
$\mathbf{K_2}$ – conversion factor (to be separate for districts depending on the temperatures difference in each of them);
$\mathbf{T_{PJ}}$ – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

For calculation, reference data was used (provided by the JSC 'Donenergo'), which is shown in Table 1, Annex 2.

Activity 2.Baseline emissions monitoring at boiler-houses without carrying out retrofitting.
According to the baseline scenario, there will be no retrofitting of the JSC 'Donenergo' boiler-houses, and also there will be no conversion of boiler-houses from coal to natural gas. The estimation of GHG emissions from the operation of the boiler-houses is carried out according to the Methodology provided in the

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32 To be calculated according to the data from the JSC 'Donenergo' sales department and to be included in the 'technical-and-economic index of the operation of the boiler-houses for a year'.

33 Given in Excel computation tables (Computation 1, Computation 2, Computation 3).

34 The specification procedure of the given index is shown in Annex 3.

35 The methodology 'Thermal insulation of the equipment and pipelines SNiP 41-03-2003, the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC
http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf
Consequently:

$$BE_{CO2,\ boiler\ no\ retrofit} = \sum FC_{boiler\ no\ retrofit} * COEF_{NG/Coal} \qquad (D.1\text{-}27)$$

Where:

$BE_{CO2,\ boiler\ no\ retrofit}$ - GHG emissions from boiler-houses without carrying out retrofitting within the framework of the baseline, tons of CO2/year;
$FC_{boiler\ no\ retrofit}$ – amount of fuel combusted at a boiler-house per year without carrying out retrofitting within the baseline, tons/year;
$COEF_{NG/Coal}$ – Coefficient of CO2 emissions for the given fuel type per year, tons of CO2/ton of fuel;

Variable **$FC_{boiler\ no\ retrofit}$** – amount of fuel combusted per year is calculated according to the following formula:

$$FC_{boiler\ no\ retrofit} = HG_{BL,\ boiler\ no\ retrofit} * SFC_{BL,\ heat} / 1000 \qquad (D.1\text{-}28)$$

Where:
$HG_{BL,\ boiler\ no\ retrofit}$ [36] – heating power supply to boiler-house without carrying out retrofitting, TJ;
$SFC_{BL,\ heat}$ – specific norm of fuel consumption at a boiler-house without carrying out retrofitting (individual for each boiler-house[37]), kg of natural fuel /TJ;

The value of heating power supply after carrying out retrofitting **$HG_{BL,\ boiler\ no\ retrofit}$** is calculated according to the following formula:

$$HG_{BL,\ boiler\ no\ retrofit} = LC_{BL,\ boiler\ no\ retrofit} * K_1 * K_2 * T_{PJ} \qquad (D.1\text{-}29)$$

Where:
$LC_{BL,\ boiler\ no\ retrofit}$ – connected load at boiler-house without carrying out retrofitting (individual for each boiler-house and equal to the actual load as a result of implementation of the given activities), TJ /hour;
K_1 – ratio taking into account heat losses in networks (taken value - 1,12[38]);
K_2 – conversion factor (to be separate for districts depending on the temperatures difference in each of them[39]);

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[36] Calculated according to the data of the OJSC 'Donenergo' sales department and to be included in the 'technical-and-economic index of the operation of the boiler-houses for a year'.

[37] Given in Exell computation tables (Computation 1, Computation 2, Computation 3).

[38] The methodology 'thermal insulation of the equipment and pipelines SNiP 41-03-2003', the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

T_{PJ} **–** number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season;

Activity 3. Baseline emissions monitoring without retrofitting the heat pipelines

According to the baseline scenario, no retrofitting of the JSC 'Donenergo' heat pipelines is planned. Accordingly, no measures for the replacement of pipe insulation and elimination of heat and water leakages will be carried out. This will require the generation of additional heat as compensation. The estimation of GHG emissions from heat traces without replacing the insulation of pipes and eliminating leakages consists of two parts: emissions from heat pipelines without replacing the insulation of pipes $BE_{CO2,\ no\ insulation}$ and emissions without eliminating leaks $BE_{CO2,\ water\ leaks}$, i.e.:

$$BE_{CO2,\ pipes\ no\ retrofit} = BE_{CO2,\ heat\ loss} + BE_{CO2,\ water\ leaks} \quad \textbf{(D.1-30)}$$

Where:

$BE_{CO2,\ pipes\ no\ retrofit}$ **–** emissions from the combustion of fuel for heating power generation to compensate for heat losses without the reconstruction of heat pipeliness, tons of CO2/year;
$BE_{CO2,\ heat\ loss}$ **–** emissions from the combustion of fuel for heating power generation to compensate for heat losses due to radiation , tons of CO2/year;
$BE_{CO2,\ water\ leaks}$ **–** emissions from the combustion of fuel for heating power generation to compensate for heat losses that are associated with water leaks without heat pipelines reconstruction, tons of CO2/year;

Estimation of emissions from the combustion of fuel for heating power generation to compensate for heat losses in heat pipelines.

$$BE_{CO2,\ heat\ loss} = \sum FC_{BL,heat\ loss} * COEF_{NG/Coal} \quad \textbf{(D.1-31)}$$

Where:

$FC_{BL,heat\ loss}$ **–** amount of fuel combusted per year associated with heat loss compensation, tons/year;
$COEF_{NG/Coal}$ **–** Coefficient of CO2 emissions for the given fuel type per year, tons of CO2/ton of fuel;
Index value $FC_{heat\ loss}$ **–** the amount of fuel combusted (natural gas or coal) at boiler-houses providing heat pipelines with hot water for heating is calculated according to the following formula:

[39] The methodology 'thermal insulation of the equipment and pipelines SNiP 41-03-2003', the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

$$FC_{BL,heat\ loss} = SFC_{heat} * HL_{BL} / 1000 \qquad (D.1\text{-}32)$$

Where:

SFC_{heat} – specific norm of fuel consumption (individual for each boiler-house [40]), kg of natural fuel /TJ;
HL_{BL} – annual heat losses from un-insulated pipes, TJ;

The annual heat losses in heat networks per year **HL_{BL}** is calculated according to the following formula[41]:

$$HL_{BL} = SHL_{heat} * L_{BL} * T_{PJ} \qquad (D.1\text{-}33)$$

Where:

SHL_{heat} – specific heat losses by heat pipeline (individual for each district of heat networks), TJ /m*h;
L_{BL} – length of heat pipeline with insulation that has not been replaced, m
T_{PJ} – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

Estimation of emissions from the combustion of fuel for heating power generation to compensate for water losses due to water leaks after the reconstruction of heat traces.

$$BE_{CO2,\ water\ leaks} = \sum FC_{BL,water\ leaks} * COEF_{NG/Coal} \qquad (D.1\text{-}34)$$

Where:
$BE_{CO2,\ water\ leaks}$ – GHG emissions from the combustion of fuel for heating power generation to compensate for heat losses due to water leaks without the reconstruction of heat pipelines, tons of CO2/year;
$FC_{BL,water\ leaks}$ – amount of fuel combusted for heating power generation to compensate for heat losses due to water leaks without the reconstruction of heat pipelines, tons/year;
$COEF_{NG/Coal}$ – Coefficient of CO2emissions for the given fuel type per year, tons of CO2/ton of fuel;

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40 Given in Excel computation tables (Computation 1, Computation 2, Computation 3).

41 According to the Methodology for un-insulated pipes described in 'Practical computation for thermal insulation' by Zhitnyakov S.V., M.: 'Energiya', 1976.

Variable $\mathbf{FC}_{BL,water\ leaks}$ is calculated according to the following formula:

$$\mathbf{FC}_{BL,water\ leaks} = \mathbf{SFC}_{heat} * \mathbf{WL}_{BL,water\ leaks}/1000 \qquad \textbf{(D.1-35)}$$

Where:
$\mathbf{SFC}_{heat}$[42] – specific norm of fuel consumption[43], kg of natural fuel /TJ;
$\mathbf{WL}_{BL,\ water\ leaks}$[44] – annual heat losses without the elimination of leaks, TJ;

The annual heat losses along with leaks are calculated according to the following formula[45]:

$$\mathbf{WL}_{BL} = \mathbf{FR}_{BL,} * \mathbf{h}_{water} * \rho_{water} * \mathbf{T}_{PJ} \qquad \textbf{(D.1-36)}$$

Where:

$\mathbf{WL}_{BL}$ – annual water losses along with leaks, TJ;
$\mathbf{FR}_{BL}$ – heating water consumption in pipes, m^3/h;
$\mathbf{h}_{water}$ – water enthalpy, TJ/ kg;
ρ_{water} – water-mass density, kg/m^3 (1000 kg $/m^3$);
d – number of days of the heating season;
$\mathbf{T}_{PJ}$ – number of working hours of boiler-house during heating season (calculated through monitored parameter **d** – the number of days of heating season);

Values of water consumption $\mathbf{FR}_{BL}$ are measured using the correlation detector of water consumption DRK-3 and the flow-rate indicator – water meter UFM-001. It is assumed that it equals to the water loss.

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[42] Calculated according to the Methodology given in 'Thermal insulation of the equipment and pipelines SNiP 41-03-2003', the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

[43] Given in Exell computation tables (Computation 1, Computation 2, and Computation 3).

[44] To be computed according to the documentary data based on water leakage values for the preceding period and to the Methodology given in 'Thermal insulation of the equipment and pipelines SNiP 41-03-2003', the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

[45] Determined according to documentary data based on water leakage values according to the water meters readings and to the Methodology given in 'Thermal insulation of the equipment and pipelines SNiP 41-03-2003', the State Committee of the Russian Federation for construction and housing and public utilities (The Gosstroy of Russia), 2005.

The water enthalpy is calculated according to the following formula:

$$\mathbf{h_{water} = shc_{water} * \Delta t} \qquad \textbf{(D.1-37)}$$

Where:

$\mathbf{h_{water}}$ **-** water enthalpy, TJ/ kg;
$\mathbf{shc_{water}}$ **–** water specific-heat capacity, TJ/ kg *C^0 (4,19*10 $^{-6}$ TJ/ kg * C^0);
$\mathbf{\Delta t}$ **–** temperature difference of primary and return water at average outside temperatures, C^0 (individual for each inhabited locality);

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

This option is not used

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

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

This option is not used

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

Within the framework of the given Project, leakages occur when natural gas and coal are delivered to the JSC 'Donenergo' boiler-houses. Their causes are:

- Physical losses when natural gas is delivered via the OAO 'GAZPROM' gas transmission system. Old boiler and pumping equipment will be replaced and automatic control equipment will be installed in the course of the reconstruction;
- CO_2 emissions that occur as a result of the consumption of fuel when coal is delivered by motor-vehicle or by railway.

In Baseline scenario, natural gas and coal are delivered in larger volumes versus the project scenario, therefore, there are more leakages versus the Project activity. This leads to an increase in the number of reductions. Accordingly, from the viewpoint of a conservative estimate, leaks data is ignored.

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

This option is not used

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

This option is not used

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):

The project reductions are calculated according to the following formula:

$$ER_y = BE_y - PE_y \qquad \text{(D.1-38)}$$

Where:

ER_y – the reduction in the project emissions per year, tons of CO2/year;
BE_y – the baseline scenario emissions per year, tons of CO2/year;
PE_y – the project scenario emissions per year, tons of CO2/year;

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:

Due to the fact that there is no environmental service at the JSC 'Donenergo', the main specialist from the production and technical department deals with ecological issues. He ensures that ecological production monitoring is functioning in the company and renders methodical assistance in environmental protection to the heat pipeline district personal. In heat pipeline districts, ecological production monitoring duties are entrusted to specialists from various departments and services – the work safety department, the production and technical group, the chemical service, the production and technical department.

A planning schedule of environment protective measures for a year is available at each boiler-house. Every year, third-party specialized expert organizations (accredited laboratories) estimate the maximum permissible emissions (MPE) for pollutants of basic types (nitrogen oxides, sulfur dioxide, carbon monoxide, soot) at the facilities of the JSC 'Donenergo'. All results are given to the project-technical department (PTD) and a technical report is made based on them. This report goes to the Rostov division of 'Rostekhnadzor' for approval.

At the moment, the maximum permissible emissions do not exceed the enforceable standards.

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.
Table D.1.1.1 ID 1, Table D.1.1.3 ID 14, ID 23	Low[46]	Instruments: heat evaluator VKT-5, heat evaluator SPT 961 will be monitored once a year. The calibration of instruments will be done by the Federal Statutory Board Rostov Center of Standardization and Metrology (FSB Rostov CSM).
Table D.1.1.1 ID 2	Low[47]	Instruments: gas meter SG 16, gas consumption corrector SPG 741, thermoanemometric gas consumption meter RGA 100(300) and gas consumption measurer VRG and rotary gas meter RG-K-100 Ex and RVG G-160 will be monitored once a year. The calibration of instruments will be done by the Federal Statutory Board Rostov Center of Standardization and Metrology (FSB Rostov CSM).

[46] Considering that the degree of data uncertainty is considered to be the instrumental error multiplied by 2, we can draw the conclusion, that the degree of uncertainty is 4%, as the margin of error for the measurement unit of heating power supply is 2%. Hence we can the draw conclusion that the degree of data uncertainty for heat meters is low.

[47] Considering that the degree of data uncertainty is considered to be the instrumental error multiplied by 2, we can draw the conclusion, that the degree of uncertainty is 2-3%, depending on the type of instrument. Hence we can draw the conclusion that the degree of uncertainty for gas meters is low.

Table D.1.1.1, D. 1.1.3. ID 6, ID 17	low[48]	Instruments: water flow transducer DRK-3 and water consumption measurer UFM-001 will be monitored once a year. The calibration of instruments will be done by the Federal Statutory Board Rostov Center of Standardization and Metrology (FSB Rostov CSM).
Table D.1.1.1 ID 12, ID 13, Table D.1.1.3 ID 22	Low	When purchasing coal fuel, samples of it will be sent to the accredited regional lab centre of the JSC 'Yuzhgeologiya', where they will undergo tests and their calorific net-value will be determined; the density of natural gas being combusted is determined by the supplier of the given fuel type.
Table D.1.1.1 ID 7, ID 8, Table D.1.1.3 ID 18	Low	The data of measurement length for insulated and un-insulated pipes is given by the works and building department and a contracting firm. Data precision is checked by accounting reports of the JSC 'Donenergo'.
Table D.1.1.1, D. 1.1.3 ID 3, ID 15	low	The specific standard of fuel consumption at boiler-houses is estimated using data from heating power supply contracts (individual for each boiler-house). Data precision is checked by accounting reports of the JSC 'Donenergo'.
Table D.1.1.1 ID 4, ID 5, ID 9, ID 10, ID 11, Table D.1.1.3 ID 16, ID 19, ID 20, ID 21	low	Value computation and thus data quality control is carried out annually by the project and technical department of the JSC 'Donenergo'.

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

At every district boiler-house the duty operator monitors the hourly heat sensor readings (heat evaluator VKT-5, heat sensor SPT 961), the gas meters (gas meter SG 16, gas consumption corrector SPG 741, thermo anemometric gas consumption meter RGA 100(300) and gas consumption measurer VRG, and rotary gas meter RG-К-100 Ex and RVG G-160 gas meters), and also the water flow transducer DRK-3 and water consumption measurer UFM-001.

Duty operators submit all information to the chief engineer of the production and technical group (PTG) of the corresponding district of heating systems. Information will be processed and systematized and then submitted to the production and technical department (PTD) which is located in Rostov-on-Don, where it will be processed and submitted to the head of the production and technical department.

On the basis of the data received, the production and technical department prepares monthly and yearly technical reports for all the district boiler-houses of the JSC 'Donenergo'. Factors such as heating power generation, gas and water consumption, specific fuel consumption and others shall be included in this report.

[48] Considering that the degree of data uncertainty is considered to be the instrumental error multiplied by 2, we can draw the conclusion that degree of uncertainty is 4%, as the margin of error for the measurement unit of water consumption is 2%. Hence we can draw the conclusion, that the degree of uncertainty for water meters is low.

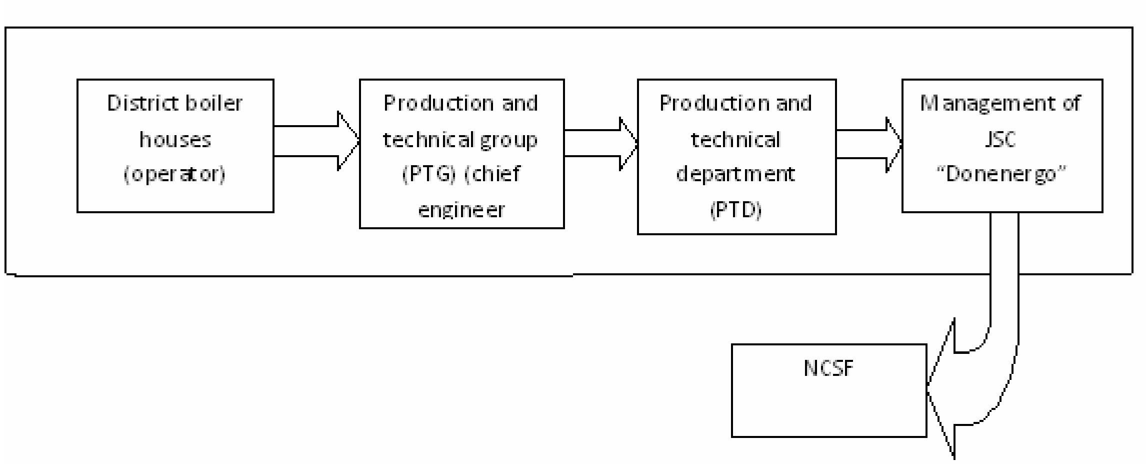
This department also makes calculations of solid fuel (coal) consumption, according to the information obtained from coal purchase and heat supply contracts for residential consumers[49].

Information about the length of un-insulated heat traces and heat traces with replaced insulation comes from work completion certificates based on the results of a year to be given by the works and building department of the firm contracted to do this work.

The net heating value of the fuel being used is controlled by the accredited agency, the District Lab Centre of the JSC 'Yuzhgeologiya'. Laboratory test data goes to the production and technical department.

Then information goes to the management of the JSC 'Donenergo' and then to NCSF, where corresponding calculations of the obtained data are made together with specialists from the production and technical department, which submits reports about reductions to an independent entity for verification and to the Buyer of the Emission Reduction Units.

Schematically, this can be presented as follows:



[49] Information from contracts for coal purchase is generalized in electronic format for every district of heating networks and is called the 'Technical-and-economic work indexes of boiler-houses'.

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

Monitoring plan developer:

National carbon sequestration foundation;
Contact person: Marat Latypov, head of the project development department;
Tel. 8 495 975 78 35 ext. 103
Fax 8 495 975 78 35 ext. 107
e-mail: latypovmf@ncsf.ru

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

To evaluate the emissions from the combustion of fossil fuels at the boiler-houses in the Rostov Region, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC was used. http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

According to the project, the following activities are planned and are being implemented within the framework of the rehabilitation of the heat supply system of JSC "Donenergo" in Rostov region:

1. Activity 1. Optimization of the heat supply structure.
2. Activity 2. Boiler-houses retrofitting.
3. Activity 3. Heat pipelines retrofitting with old pipes replacement.

These activities lead to reductions in fossil fuels in the boiler-houses of the JSC "Donenergo". Consequently, due to the Project activity CO2 emissions into the air are decreased.

Therefore, the Project emissions are defined by the following formula:

$$\sum PE_y = \sum PE_{CO2,\,donor} + \sum PE_{CO2,\,boilers\ retrofit} + \sum PE_{CO2,\,pipe\ retrofit} \qquad \textbf{(E.1-1)}$$

Where:

$\sum PE_y$ – annual project emissions;
$\sum PE_{CO2,\,donor}$ – GHG emissions from the donor boiler-houses after load shift of the shut-down low-efficient boiler-houses, tons of CO_2;
$\sum PE_{CO2,\,boilers\ retrofit}$ – GHG emissions from the boiler-houses after retrofitting;
$\sum PE_{CO2,\,pipe\ retrofit}$ – GHG emissions from the boiler-houses after retrofitting of heating traces , tons of CO_2;

Activity 1. GHG emissions computation at the donor boiler-houses (after load shift of the shut-down low-efficient boiler-houses).

The Project implementation leads to the shut-down of the 35 low-efficient boiler-houses; in this case their emissions will be equal to zero. Furthermore, the heat generation will be shifted to the so-called donor boiler-houses which increase the load to compensate for the shut-down of the coal boiler-houses. Accordingly, these donor boiler-houses will increase their fuel consumption, which will lead to an increase in CO_2 emissions. Therefore $PE_{CO2,\,donor}$ will be defined as follows:

$$PE_{CO2,\,donor} = \sum FC_{PJ\ donor} * COEF_{NG/Coal} \qquad \textbf{(E.1-2)}$$

Where:

$FC_{PJ\ donor}$– – the amount of combusted fuel in a donor boiler-house, ton/year;
$COEF_{CO2,NG/coal}$[50]– annual coefficient of CO_2 emissions for a certain fuel type (natural gas, coal), CO_2 ton/ton of fuel;
$FC_{PJ\ donor}$– amount of combusted fuel (natural gas or coal) in a donor boiler-house, ton/year:

$$FC_{PJ\ donor} = HG_{PJ\ ,donor} * SFC_{PJ}/1000 \qquad \textbf{(E.1-3)}$$

[50] The coefficient computation is described in Annex 2.

Where:

$HG_{PJ,donor}$ – heating power supply by a donor boiler-house, TJ;
SFC_{PJ} – specific fuel consumption rate in the donor boiler-houses after the load shift[51] (individual for each boiler-house) kg of natural fuel/TJ;
Heating power supply value after the load shift to a donor boiler-house **$HG_{PJ,donors}$** is defined as follows:

$$HG_{PJ,donors} = LC_{PJ,donors} * K_1 * K_2 * T \quad \textbf{(E.1-4)}$$

Where:

$LC_{PJ,donors}$ – connected load after the switching over the residential consumers (individual for each boiler-house), TJ/ hour;
K_1 – heat line loss coefficient (the value of 1.12 is accepted)[52] ;
K_2 – reduction coefficient expresses the ratio of the average heat load to the peak load (to be taken separately for each district)[53];
T – heating season duration (to be taken separately in districts according to the "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and housing and utilities (the Gosstroy of Russia, 2005), hours;

The reference data listed in Table 1 of Annex 2. (provided by the JSC "Donenergo") has been used for the computation.
The conversion coefficient **K_2** is defined for each district of the region by the following formula:

$$K_2 = (t_{set} - t_{average})/(t_{set} - t_{max}) \quad \textbf{(E.1-5)}$$

Where:

t_{set} – specified indoor temperature (according to sanitary regulations **$t_{set} = 18^0C$**);
$t_{average}$ – outdoor average temperature over a heating season (defined by "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and housing and utilities (the Gosstroy of Russia, 2005)
t_{max} – outdoor minimum temperature (also defined by the data of the SNiP (construction norms and regulations 41-03-2003).

Activity 2. GHG emissions computation from the reconstructed boiler-houses after retrofitting.

After retrofitting the facilities of the JSC "Donenergo", the operating efficiency of the boiler-houses will increase, and due to the conversion of some boiler-houses from coil to natural gas, CO2 emissions into the air will be reduced. GHG emissions from the working boiler-houses after retrofitting are computed according to the suggested procedure, the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

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51 Defined by the actual data which is included in the electronic document "Technical-and-economic indexes of the boiler-houses working" for a certain period (month, year) for the heat network area.
52 According to the method given in "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and Housing and Utilities (the Russian Gosstroy) 2005.
53 Define for each heat networking area in accordance with the method "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and Housing and Utilities (the Russian Gosstroy) 2005.

Hence:

$$\mathbf{PE_{CO2,\ boilers\ retrofit} = \sum FC_{boilers\ retrofit} * COEF_{NG/Coal}} \qquad \textbf{(E.1-6)}$$

Where:

$\mathbf{PE_{CO2,\ boilers\ retrofit}}$ - GHG emissions after retrofitting of boiler-houses, tons of CO_2/year;
$\mathbf{FC_{boilers\ retrofit}}$ – amount of combusted fuel in the reconstructed boiler-houses, ton/year;

$\mathbf{COEF_{NG/Coal}}$[54] – annual coefficient of CO_2 emissions for a certain fuel type, tons of CO_2/ton of fuel;

$$\mathbf{FC_{,\ boilers\ retrofit} = HG_{PJ,boilers\ retrofit} * SFC_{heat}/1000} \qquad \textbf{(E.1-7)}$$

Where:

$\mathbf{HG_{PJ,\ boilers\ retrofit}}$ – heat power generation after retrofitting, TJ;
$\mathbf{SFC_{heat}}$ – – specific fuel consumption rate after retrofitting (individual for each boiler-house)[55], kg of natural fuel/TJ;

$$\mathbf{HG_{PJ,\ boilers\ retrofit} = LF_{PJ} * K_1 * K_2 * T} \qquad \textbf{(E.1-8)}$$

Where:

$\mathbf{LF_{PJ}}$ – connected load after retrofitting (individual for each boiler-house), TJ/ hour;
$\mathbf{K_1}$ – coefficient taking into account heat losses in the networks;
$\mathbf{K_2}$ – conversion coefficient expresses the ratio of the average heat load to the peak load (to be taken separately for each district);
T – heating season duration (to be taken separately in districts), hours;

The reference data listed in Table 1 of Annex 2 (provided by the JSC "Donenergo") has been used for the computation.

The conversion coefficient $\mathbf{K_2}$ is defined for each district by the following formula:

$$\mathbf{K_2 = (t_{set} - t_{average})/(t_{set} - t_{max})} \qquad \textbf{(E.1-9)}$$

Where:

$\mathbf{t_{set}}$ – specified indoor temperature (according to sanitary regulations $\mathbf{t_{set} = 18^0C}$);
$\mathbf{t_{average}}$ – average outdoor temperature over a heating season (defined by "Heat insulation of the facilities and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of the Russian Federation for construction and housing and utilities (the Gosstroy of Russia, 2005);
$\mathbf{t_{max}}$ – outdoor minimum temperature (also defined by the data of the construction norms and regulations 41-03-2003)

Activity 3. GHG emissions computation after retrofitting of heating pipelines .
Within the framework of the project, the retrofitting of the heating traces of the JSC "Donenergo" is being carried out. This activity means the replacement of pipe insulation leading to the reductions of heating power losses and heating fluid leakages (hot water).

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54 The coefficient computation is described in Annex 2.
55 Defined by the document "Technical-and-economic indexes of the boiler-houses working" for a certain period (month, year) for the heat network area.

The computation of GHG emissions after the implementation of this activity consists of the measurement of boiler-house emissions from the combustion of fuel for heating power generation to compensate for the heat loss associated with water leakages after the retrofitting of heat traces, i.e.:

$$PE_{CO2,pipes\ retrofit} = PE_{CO2,heat\ loss} + PE_{CO2,water\ leaks} \quad \textbf{(E.1-10)}$$

Where:

$PE_{CO2,pipes\ retrofit}$ – emissions from the combustion of fuel for heating power generation to compensate for heat and water losses after the retrofitting of heating traces, tons of CO_2/year;
$PE_{CO2,heat\ loss}$ – emissions from the combustion of fuel for heating power generation to compensate for heat losses due to emissions after retrofitting of heating traces , tons of CO_2/year;
$PE_{CO2,water\ leaks}$ – emissions from the combustion of fuel for heating power generation to compensate for heat losses due to water leakages after retrofitting of heating traces , tons of CO_2/year;

Emissions from the combustion of fuel for heating power generation to compensate for heat losses due to heat emission

$$PE_{CO2,\ heat\ loss} = \sum FC_{PJ,heat\ loss} * COEF_{NG/Coal} \quad \textbf{(E.1-11)}$$

Where:

$FC_{PJ,\ heat\ loss}$ – amount of combusted fuel due to annual heat loss compensation, ton/year;
$COEF_{NG/Coal}$[56] – annual coefficient of CO_2 emissions for a certain fuel type, tons of CO_2/ton of fuel;

$$FC_{PJ,\ heat\ loss} = SFC_{heat} * HL_{PJ}/1000 \quad \textbf{(E.1-12)}$$

Where:

SFC_{heat} – specific fuel consumption (individual for each boiler-house), kg of natural fuel/TJ;
HL_{PJ} – annual heat losses through heating networks, TJ;

$$HL_{PJ} = SHL_{PJ,heat} * L_{PJ} * T \quad \textbf{(E.1-13)}$$

Where:

$SHL_{PJ,heat}$ – specific heat losses of pipelines (individual for each heating network district[57]), TJ/m*h;
L_{PJ} – length of pipeline with replaced insulation, m
T – the number of working hours in the heating season (the average is taken for the Rostov region, 4104 h.);

Fuel consumption emissions computation for heating power generation to compensate for heat losses associated with water leakages after the retrofitting of heat traces.

$$PE_{CO2,\ water\ leaks} = \sum FC_{PJ,\ water\ leaks} * COEF_{NG/Coal} \quad \textbf{(E.1-14)}$$

Where:

$PE_{CO2,\ water\ leaks}$ - GHG emissions from the combustion of fuel for heating power generation to compensate for heat losses associated with water leakages after the retrofitting of heat traces, tons of CO_2/year;

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56 The coefficient computation is described in Annex 2.
57 Defined by the document "Technical-and-economic indexes of the boiler-houses working" for a certain period (month, year) for the heat network area.

$FC_{PJ,\ water\ leaks}$ – amount of combusted fuel for heating power generation to compensate for heat losses associated with water leakages after the retrofitting of heat traces, tons/year;
$COEF_{NG/Coal}$[58] – coefficient of annual CO_2 emissions for a certain fuel type, tons of CO_2/ton of fuel;

$$FC_{PJ,\ water\ leaks} = SFC_{PJ,heat} * WL_{PJ}/1000 \qquad (E.1\text{-}15)$$

Where:

$SFC_{PJ,heat}$ – specific fuel consumption, kg of natural fuel/TJ;
WL_{PJ} – annual heat losses associated with water leakages, TJ;

Annual heat losses with leakages are defined as follows[59]:

$$WL_{PJ} = FR_{water,} * h_{water} * \rho_{water} * T \qquad (E.1\text{-}16)$$

Where:

WL_{PJ} – annual heat losses with leakages, TJ;
$FR_{water,}$ – water consumption in pipes,m^3/h;
h_{water} – water enthalpy, TJ/kg;
ρ_{water} – water density, kg/m^3 (1000 kg/m^3);
T – number of hours in the days of the heating season;
The water consumption values **FR_{water}** are measured by correlation a water consumption transducer CCT-3 and flow-meter UFM-001.

The water enthalpy is defined as follows:

$$h_{water} = shc_{water} * \Delta t \qquad (E.1\text{-}17)$$

Where:

h_{water} - water enthalpy, TJ/kg;
shc_{water} – specific water heating capacity, TJ/kg*deg ($4,19*10^{-6}$ TJ/kg*deg);
Δt – temperatures differences of primary water and return water at average outdoor temperatures, degrees (individual for each locality);

Therefore, the project emissions will comprise:

[58] The coefficient computation is described in Annex 2.
[59] Defined according to documentary evidence based on water leakage amounts by water counters and the method given in "Heat insulation of the equipment and pipelines SNiP (construction norms and regulations) 41-03-2003", the State Committee of Russian Federation for construction and Housing and Utilities (the Russian Gosstroy) 2005.

Table E1. Project emissions from different sources

Year	Expected GHG emissions after implementation of activity 1, t CO_2 equivalent.	Expected GHG emissions after implementation of activity 2 , t CO_2 equivalent.	Expected GHG emissions after implementation of activity 3, t CO_2 equivalent.	**Expected GHG emissions in the project, t. CO_2 equivalent.**
2008	109 854	162 857	29 380	302 091
2009	114 743	199 703	30 847	345 293
2010	126 780	235 472	31 402	393 654
2011	126 780	235 472	31 402	393 654
2012	126 780	235 472	31 402	393 654
Total from 2008-2012.	604 937	1 068 976	154 433	**1 828 346**

E.2. Estimated leakage:

Within the framework of the project, leakages occur upon the delivery of natural gas and coal to the boiler-houses of the JSC "Donenergo"; these are:

- physical leakages upon delivery of natural gas via the gas transmission system of the OAO 'GAZPROM'. Old boiler and pumping equipment will be replaced and automatic control equipment will be installed in the course of the reconstruction;

- CO2 emissions resulting from the consumption of fuel during coal transportation by motor-vehicles and railway.

Since natural gas and coal are delivered in higher volumes at the baseline, consequently there are more leakages than in the Project. This leads to an according increase in reductions. Therefore from the viewpoint of a conservative estimate, the current leakages are ignored.

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

Table E2. Total emissions from leakages and different sources according to the project

Year	Expected GHG emissions after the implementation of activity 1, t CO_2 equivalent.	Expected GHG emissions after the implementation of activity 2, t CO_2 equivalent.	Expected GHG emissions after the implementation of activity 3, t CO_2 equivalent.	Expected leakage effect, t CO_2 equivalent.	**Expected GHG emissions according to the project, t CO_2 equivalent**
2008	109 854	162 857	29 380	0	302 091
2009	114 743	199 703	30 847	0	345 293
2010	126 780	235 472	31 402	0	393 654
2011	126 780	235 472	31 402	0	393 654

2012	126 780	235 472	31 402	0	393 654
Total from 2008-2012.	**604 937**	**1 068 976**	**154 433**	**0**	**1 828 346**

E.4. Estimated baseline emissions:

The baseline scenario reflects the hypothetical situation in the absence of the Project activity, according to which the boiler-houses and heating networks of the JSC "Donenergo" would operate in the previous conditions, i.e. without the shut-down of low-efficient boiler-houses and the shift of loads, without the retrofitting of boiler-houses and heat traces.

Therefore, the baseline scenario emissions:

$$\sum BE_y = \sum BE_{CO2,\ no\ load\ shift} + \sum BE_{CO2,\ boiler\ no\ retrofit} + \sum BE_{CO2,\ pipe\ no\ retrofit} \quad (E.4\text{-}1)$$

Where:

$BE_{CO2,\ no\ load\ shift}$ – GHG emissions from low-efficient boiler-houses and donor boiler-houses, tons of CO_2/year;

$BE_{CO2,\ boiler\ no\ retrofit}$ – GHG emissions from boiler-houses without retrofitting, tons of CO_2/year;

$BE_{CO2,\ pipe\ no\ retrofit}$ – GHG emissions from boiler-houses without the reconstruction of heating networks, tons of CO_2/year.

For the computation of emissions from the combustion of fossil fuel in the boiler-houses of the Rostov region, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC was used.
http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

Activity 1. Estimation of GHG emissions at low-efficient boiler-houses and donor boiler-houses.
According to the baseline scenario, low-efficient boiler-houses will not be shut-down, and, therefore, their load will not be shifted to donor boiler-houses. Consequently, **the emissions in the absence of this activity** will be calculated as follows:

$$\Sigma BE_{CO2,\ no\ load\ shift} = \Sigma BE_{CO2,coal/NG} + \Sigma BE_{CO2,donor} \quad (E.4\text{-}2)$$

Where:

$\Sigma BE_{CO2,coal/NG}$ – GHG emissions from low-efficient boiler-houses, tons of CO_2/year
$\Sigma BE_{CO2,donor}$ – GHG emissions from donor boiler-houses, tons of CO_2/year.

$$\Sigma BE_{CO2,\ coal/NG} = \sum FC_{coal/NG} * COEF_{Coal/NG} \quad (E.4\text{-}3)$$

Where:

$BE_{CO2,coal/NG}$ – GHG emissions from low-efficient boiler-houses, tons of CO_2/year;
$FC_{coal/NG}$ – annual amount of combusted fuel, tons/year;

$COEF_{Coal/NG}$[60] **–** coefficient of CO2 emissions for the given type of fuel, tons of CO2/ton of fuel;

Variable **$FC_{coal/NG}$ –** annual amount of combusted fuel at low-efficient boiler-houses:

$$FC_{coal/NG} = HG_{BL,\ coal/NG} * SFC_{heat}/1000 \qquad \text{(E.4-4)}$$

Where:

$HG_{BL,coal/NG}$ – heating power generation at low-efficient boiler-houses being shut-down, TJ;
SFC_{heat} – specific rate of fuel consumption at low-efficient boiler-houses being shut-down (individual for each boiler-house[61]), kg of natural fuel/TJ;
The value of heating power generation after load shift **$HG_{BL,\ coal/NG}$** is calculated as follows:

$$HG_{BL,\ coal/NG} = LC_{BL,\ coal/NG} * K_1 * K_2 * T \qquad \text{(E.4-5)}$$

Where:

$LC_{BL,\ coal/NG}$ – connected load at low-efficient boiler-houses being shut-down (individual for each boiler-house), TJ/hour;
K_1– network heat loss factor (accepted as 1.12 according to SNiP 41-03-2003) ;
K_2 – conversion factor, expresses the ratio of average heat load to peak load (to be taken separately for each district. Calculated on the basis of SNiP 41-03-2003);
T – duration of heating season (to be taken separately for each district, according to the methodology 'Heat insulation of equipment and pipelines SNiP (construction norms and regulations 41-03-2003' , the State Committee of the Russian Federation for construction and housing and public utilities (the Gosstroy of Russia), 2005, hours;
Reference data was used for the calculation (provided by the JSC 'Donenergo'), which is listed in Table 1 of Annex 2.
The conversion factor K_2 is calculated for each district of the region by the following formula:

$$K_2 = (t_{set} - t_{average})/(t_{set} - t_{max}) \qquad \text{(E.4-6)}$$

Where:

t_{set} – the specified indoor temperature (according to sanitary standards $t_{set} = 18^0C$);
$t_{average}$ – average outdoor temperature during the heating season (accepted according to the data from SNiP 41-03-2003)
t_{max} – minimum outdoor temperature (also accepted according to the data from SNiP 41-03-2003);

Emissions from boiler-donors (boilers, which take the load from low-efficient boiler-houses in the Project activity) are calculated by the following formula[62]:

$$\Sigma BE_{CO2,\ donor} = \sum FC_{donor} * COEF_{NG/Coal} \qquad \text{(E.4-7)}$$

Where:

FC_{donor} – amount of combusted fuel at a donor boiler-house, tons/year;

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60 The calculation of this coefficient is shown in the annex 2

61 Is defined according to the actual data, which is included in the electronic document 'technical-and-economic indexes of the operation of the boiler-houses' for a certain period (month, year) for the heating system district.

62 For emission estimation during the burning of fossil fuels in the Rostov region, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC was used http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf

$\mathbf{COEF_{NG/Coal}}$[63] **–** coefficient of CO2 emissions for the given of fuel type per year, t CO2/ton;

Variable $\mathbf{FC_{donor}}$ **–** amount of combusted fuel at a donor boiler-house, tons per year:

$$FC_{donors} = HG_{BL,\ donor} * SFC_{heat} / 1000 \qquad (E.4\text{-}8)$$

Where:

$\mathbf{HG_{BL,\ donor}}$ **–** heating power generation at a donor boiler-house, TJ;
$\mathbf{SFC_{heat}}$ – specific rate of heating power consumption at a donor boiler-house (individual for each boiler-house[64]), kg of natural fuel/TJ;
The value of the heating power generation prior to load shift $\mathbf{HG_{BL,\ donor}}$ is calculated as follows:

$$HG_{BL,\ donor} = LC_{BL,\ donor} * K_1 * K_2 * T \qquad (E.4\text{-}9)$$

Where:

$\mathbf{LC_{BL,\ donor}}$**–** connected load at a donor boiler-house (individual for each boiler-house before switching over residential consumers (individual for each boiler-house), TJ/hour;
$\mathbf{K_1}$**–** network heat losses factor (is accepted as 1.12 according to SNiP 41-03-2003);
$\mathbf{K_2}$**–** conversion factor (to be taken separately for each region depending on the temperature difference in each of them, is calculated on the basis of SNiP 41-03-2003);
T – duration of heating season (to be taken separately for each region according to the methodology 'Thermal insulation of equipment and pipelines SNiP (construction norms and regulations) 41-03-2003' the State Committee of the Russian Federation for construction and housing and public utilities (the Gosstroy of Russia), 2005, hours;
The conversion factor K_2 is calculated for each district of the region by the following formula:

$$K_2 = (t_{set} - t_{average})/(t_{set} - t_{max}) \qquad (E.4\text{-}10)$$

Where:

t_{set} – the specified indoor temperature (according to sanitary standards $t_{set} = 18^0C$);
$t_{average}$ – average outdoor temperature during the heating season (accepted according to the data from SNiP 41-03-2003)
t_{max} – minimum outdoor temperature (also accepted according to the data from SNiP 41-03-2003);
Reference data was used for the calculation (provided by GUP'Donenergo'), which is listed in Table 1 of Annex 2.

Activity 2. Calculation of GHG emissions from boiler-houses without carrying out retrofitting.
According to the baseline scenario, retrofitting of boiler-houses of JSC 'Donenergo' will not be carried out, there also will be no conversion of boilers from coil to natural gas. GHG emissions from boiler-houses are calculated according to the proposed methodology, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf
Therefore:

$$BE_{CO2,\ boiler\ no\ retrofit} = \sum FC_{boiler\ \ no\ retrofit} * COEF_{NG/Coal} \qquad (E.4\text{-}11)$$

Where:

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63 The calculation of this coefficient is shown in the annex 2

64 Is defined according to the actual data, which is included in the electronic document 'technical-and-economic indexes of the operation of the boiler-houses' for a certain period (month, year) for the heating system district.

$BE_{CO2, boiler\ no\ retrofit}$ – GHG emissions from boiler-houses without carrying out retrofitting, tons of CO2/year;
$FC_{boiler\ no\ retrofit}$ – amount of combusted fuel at a boiler-house without carrying out retrofitting, tons/year;
$COEF_{NG/Coal}$[65] **–** coefficient of CO2 emissions for the given fuel type per year, tons of CO2/ton of fuel;
The variable **$FC_{boiler\ no\ retrofit}$** – the amount of combusted fuel per year is calculated as:

$$FC_{boiler\ no\ retrofit} = HG_{BL,\ boiler\ no\ retrofit} * SFC_{BLheat} / 1000 \qquad (E.4\text{-}12)$$

Where:

$HG_{BL,\ boiler\ no\ retrofit}$ – heating power generation at a boiler-house with no upgrading carried out, TJ;
$SFC_{BL,heat}$ – specific rate of fuel at a boiler-house without carrying out retrofitting (individual for each boiler-house[66]), kg of natural fuel/TJ;

$$HG_{BL,\ boiler\ no\ retrofit} = LC_{BL,\ boiler\ no\ retrofit} * K_1 * K_2 * T \qquad (E.4\text{-}13)$$

Where:

$LF_{BL,\ boiler\ no\ retrofit}$ – connected load without carrying out retrofitting (individually for each fuel), TJ/hour;
K_1– network heat losses factor (accepted as 1.12 according to SNiP 41-03-2003);
K_2– conversion factor (accepted separately for each region depending on the temperature difference in each of them. Calculated on the basis of SNiP 41-03-2003);
T – duration of heating season (accepted separately for each region according to the methodology ‘Thermal isolation of equipment and ducts SNiP (construction rules and regulations) 41-03-2003’, the State Committee of the Russian Federation for construction and housing and utilities (the Gosstroy of Russia), 2005.), hours;
The conversion factor K_2 is calculated for each district of the region by the following formula:

$$K_2 = (t_{set} - t_{average})/(t_{set} - t_{max}) \qquad (E.4\text{-}14)$$

Where:

t_{set} – specified indoor temperature (according to sanitary standards $t_{set} = 18^0C$);
$t_{average}$ – average outdoor temperature during the heating season (according to the data from SNiP 41-03-2003)
t_{max} – minimum outdoor temperature (also accepted according to the data from SNiP 41-03-2003);

Reference data was used for the calculation (provided by the JSC ‘Donenergo’), which is listed in Table 1 of Annex 2.

Activity 3. Calculation of GHG emissions from boiler-houses without carrying out reconstruction of heat traces.
The calculation of GHG emissions from boiler-houses without carrying out the reconstruction of heat traces includes the emissions from the combustion of fuel at a boiler-house for heating power generation to compensate for heat losses due to water leakage, i.e.:

$$BE_{CO2,pipes\ no\ retrofit} = BE_{CO2\ heat\ loss} + BE_{CO2,water\ leaks} \qquad (E.4\text{-}15)$$

Where:

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[65] The calculation of this coefficient is shown in the annex 2

[66] Is defined according to the actual data, which is included in the electronic document ‘technical-and-economic indexes of the operation of the boiler-houses’ for a certain period (month, year) for the heating system district

$BE_{CO2,pipes}$ – emissions from the combustion of fuel for heating power generation to compensate for heat losses without carrying out reconstruction of heat traces, tons of CO_2/year;
$BE_{CO2,\ heat\ loss}$– emissions from the combustion of fuel for heating power generation to compensate for heat losses without reconstruction, tons of CO_2/year;
$BE_{CO2,water\ leaks}$ – emissions from the combustion of fuel for heating power generation to compensate for heat losses associated with water leakages without carrying out the reconstruction of heat traces, tons CO_2/year.

Calculation of fuel combustion emissions for heating power generation to compensate for heat losses

$$BE_{CO2,\ heat\ loss} = \sum FC_{BL,\ heat\ loss} * COEF_{NG/Coal} \qquad (E.4\text{-}16)$$

Where:

$FC_{BL,\ heat\ loss}$ – amount of combusted fuel due to heat loss compensation per year, tons/year;
$COEF_{NG/Coal}$ [67]– coefficient of CO2 emissions for the given of fuel type per year, tons of CO2/ton of fuel;
The coefficient of CO2 emissions for fuel is calculated in the same way as in Activity 1.

$$FC_{BL,\ heat\ loss} = SFC_{heat} * HL_{BL} / 1000 \qquad (E.4\text{-}17)$$

Where:

SFC_{heat} – specific fuel consumption (individual for each boiler-house[68]), kg of natural fuel/TJ;
$HL_{BL,}$ – annual heat losses from un-insulated pipes, TJ;
The annual losses in heat supply networks **$HL_{BL,}$** are calculated as follows:

$$HL_{BL} = SHL_{heat} * L_{BL} * T \qquad (E.4\text{-}18)$$

Where:

$SHL_{BL,heat}$ – specific heat losses by a pipeline (individual for each heat supply networks district, calculated by ‘Operational method of thermal isolation’, by Zhitnyakov S.V., M.: ‘Energia’, 1976.), TJ/m*h;
L_{BL} – length of pipeline with insulation that has not been replaced, m
T – number of working hours during the heating season (the average value of 4104 hours in the Rostov Region is accepted).

Calculation of emissions from the combustion of fuel for heating power generation to compensate for heat losses due to water leaks after the reconstruction of heat pipelines.

$$BE_{CO2,\ water\ leaks} = \sum FC_{BL,water\ leaks} * COEF_{NG/Coal} \qquad (E.4\text{-}19)$$

Where:

$BE_{CO2,\ water\ leaks}$ – GHG emissions from the combustion of fuel for heating power generation to compensate for heat losses due to water leakage without carrying out the reconstruction of heat traces, tons of CO_2/year;

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[67] The calculation of this coefficient is shown in the annex 2

[68] Is defined according to the actual data, which are included in the electronic document ‘technical-and-economic indexes of the operation of the boiler-houses for a certain period (month, year) for the heating system district

$FC_{BL,water\ leaks}$ – amount of combusted fuel for heating power generation to compensate for heat losses due to water leakage without carrying out the reconstruction of heat traces, tons /year;
$COEF_{NG/Coal}$[69] **–** coefficient of CO2 emissions for the given fuel type per year, tCO2/t;

The variable **$FC_{BL,water\ leaks}$** is calculated as follows:

$$FC_{BL,water\ leaks} = SFC_{heat}*WL_{BL,\ water\ leaks}/1000 \qquad (E.4\text{-}20)$$

Where:
SFC_{heat} – specific fuel consumption, kg of natural fuel/TJ;
$WL_{BL,water\ leaks}$ – annual heat losses without leakages reduction, TJ;
Data for annual heat losses without leakage reduction is provided by the JSC 'Donenergo', calculated by the methodology 'Thermal insulation of equipment and pipelines SNiP (constructional rules and regulations) 41-03-2003', the State Committee of the Russian Federation for construction and housing and utilities (the Gosstroy of Russia), 2005.

Annual heat losses with leakages are calculated in the following way[70]:

$$WL_{BL} = FR_{water,} * h_{water} *\rho_{water}* T \qquad (E.4\text{-}21)$$

Where:

WL_{BL} – annual heat losses with leakages, TJ;
$FR_{water,}$ – water flow in pipes, m^3/h;
h_{water} – enthalpy of water, TJ/kg;
ρ_{water} – water-mass density, kg/m^3 (1000 kg/m^3);
T– number of hours in the days of the heating season;
The values of water flow **FR_{water}** are measured with the help of the correlated water flow-rate transducer DRK-3 and utility meter UFM-001.

The enthalpy of water is calculated as follows:

$$h_{water} = shc_{water}*\Delta t \qquad (E.4\text{-}22)$$

Where:

h_{water} – enthalpy of water, TJ/kg;
shc_{water} – specific heating capacity of water, TJ/kg*degr ($4{,}19*10^{-6}$ TJ/kg*grad);
Δt – temperature difference of influent and return water at the average outdoor temperature, degrees (individual for different communities);

The baseline emissions are listed in Table E3.

[69] The calculation of this coefficient is shown in the annex 2

[70] Is defined according to the documentary evidence on the basis of the water loss value according to the utility meters and the methodology, described in 'the thermal insulation of the facility and pipelines SNiP 41-03-2003' the State Department of the Russian Federation for construction and housing and public utilities (the Gosstroy of Russia), 2005

Table E3. Baseline emissions

Year	Expected GHG emissions without the implementation of activity 1, tons of CO2 equivalent.	Expected GHG emissions without the implementation of activity 2, tons of CO2 equivalent.	Expected GHG emissions without the implementation of activity 3, tons of CO2 equivalent.	**Expected GHG emissions in the baseline scenario, tons of CO2 equivalent.**
2008	136 213	182 653	50 916	369 782
2009	143 955	238 704	65 440	448 099
2010	159 138	277 222	73 411	509 771
2011	159 138	277 222	73 411	509 771
2012	159 138	277 222	73 411	509 771
Total from 2008-2012	**757 582**	**1 253 023**	**336 589**	**2 347 194**

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

The Project reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad \textbf{(E.5-1)}$$

Where:

ER_y – The reduction in the project emissions per year, tons of CO2/year;
BE_y – the baseline scenario emissions per year, tons of CO2/year;
PE_y – the project scenario emissions per year, tons of CO2/year;

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

The result of the reductions calculation is listed in table E4.

Table E4. Result of the emissions reductions of project activity

Year	Expected GHG emissions according to the project scenario, (tons of CO2 equivalent)	Expected 'leakage' effect, (tons of CO2 equivalent)	Expected GHG emissions according to the baseline scenario, (tons of CO2 equivalent)	Expected reduction in GHG emission volumes, (tons of CO2 equivalent)
2008	302 091	0	369 782	67 691
2009	345 293	0	448 099	102 806
2010	393 654	0	509 771	116 117
2011	393 654	0	509 771	116 117
2012	393 654	0	509 771	116 117
Total from 2008-2012	**1 828 346**	**0**	**2 347 194**	**518 848**

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:

The Draft for the maximum permissible emissions has been worked out for each boiler-house, in which the emissions standards are specified for each source. The permit for pollutant emissions is to be issued by Rostekhnadzor in the Rostov region. Compliance of the MPE is performed by taking measurements in each boiler-house in accordance with the plan-schedule as approved in part of the MPE volume – once a year. Records of measurements of emissions taken are available. The specified standards were shown to have been exceeded.
According to the Town Planning Code of the Russian Federation №190-F3 paragraph 49 point 1, 4, 5:

'The project documentation of the construction of buildings and facilities are subject to a state review. The state review of the project documentation is made by the federal executive body which is authorized to make the state review, or by the jurisdictional official institution. The subject of the state review of the project documentation is the assessment of the conformity of the project documentation to the requirements of the technical regulations, including sanitation-and-epidemiological, ecological requirements, state protection requirements of the facilities of cultural heritage, fire, industry, nuclear, radiological and other safety requirements, and also the result of the engineering investigations'.

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:

According to the federal law about the Protection of Environment №7- Federal law paragraph 32:

'The assessment of the environmental impact is made according to planning, economic or other activities which can have a direct or indirect effect on the environment apart from the legal entity's incorporation of the business or other activities'.
For each boiler-house being retrofitted, project documentation is developed, i.e., the Working draft "the modernization of boiler-house #15 with the conversion to gas fuel in Gukovo, situated at 9B Krasnodonetskii Lane" which also includes an environmental impact assessment of the project under development. This project documentation is approved in the State review of the draft document land use planning and project documentation in the Rostov region and also the review of industrial safety. The result of these reviews is the positive conclusion regarding the compliance of the project documentation with the existing requirements of the regulatory documents.

SECTION G. Stakeholders' comments

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

Federal Law 'About Protection of the Environment' №7- F3, paragraph 20 determines the participation of citizens and social organizations in the performing of the public ecological review.

Public consultations are made on each Working draft. The main point of them is to inform the citizens about the scheduled activities. The result of the public consultations is a record which is attached to the project documentation for consideration in the state review.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

According to the Methodological guidance, the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" (Version 01) UN FCCC http://cdm.unfccc.int/Reference/Guidclarif/EB32_repan09_Tool_proj_emiss.pdf for estimating GHG emissions, it is required to calculate the coefficient **$COEF_{NG/Coal}$**, which may be found according to variant A with the application of the carbonic content data in each type of utilized fuel and also the data about the fuel density for each boiler-house, or according to variant B with the application of data on fuel NCV and the coefficient of CO2 emissions. Owing to the absence of calculation data on variant A, we will use variant B.

Therefore, **$COEF_{NG/Coal}$** is CALCULATED:

$$COEF_{NG/Coal} = NCV * EF_{CO2, NG/Coal} \qquad (A2\text{-}1)$$

Where:
$COEF_{NG/Coal}$ – for the given type of fuel per year, tons of CO2/ton of fuel;
NCV– average calorific net- value for 1 ton of fuel, TJ;
$EF_{CO2, NG/Coal}$ – averaged coefficient of CO2 emissions from the combustion of fuel (natural gas/coal), tons of CO2/TJ

The tabular data taken from the guidelines IPCCC 2006 which are shown in table (1) were used for the calculation.

Table 1. Data for calculation of the coefficient of CO2 emissions.

The value according to data from IPCCC 2006	Natural gas	Coal
EF, t CO2/TJ	56,1	94,6
NCV, TJ/tones	From the accompanying documents when delivering fuel to the boiler-houses	From the accompanying documents when delivering fuel to the boiler-houses

Table 2. Data for the calculation of the volume of combusted fuel.

Parameter name	**K1** – The coefficient taking into account heat losses in the networks. hl,coef	**K2** – Reduction coefficient (to be taken individually in each district depending on the temperature difference in each of them), t,coef		Duration of the heating season, h (hours)
Value	1.10-1.12	City of Gukovo	0.465	4272

Parameter name	**K1** – The coefficient taking into account heat losses in the networks. hl,coef	**K2** – Reduction coefficient (to be taken individually in each district depending on the temperature difference in each of them), t,coef		Duration of the heating season, h (hours)
		City of Donetsk	0.463	4152
		City of Zverevo	0.459	4224
		City of Salsk	0.422	4080
		City of Belaya Kalitva	0.465	4272
		City of Tsimlyansk	0.465	4272
		City of Millerovo	0.491	4416
		City of Aksay	0.458	4104
		City of Bataysk	0.458	4104
		City of Kamensk	0.55	4416
		City of Azov	0.458	4104
		Azov district	0.465	4104
		Aksay district	0.465	4104
		Bataysk district	0.465	4104
		Belaya Kalitva district	0.488	4272
		Zverevo district	0.459	4224
		Donetsk district	0.463	4152
		Gukovo district	0.488	4272
		Kamensk district	0.463	4416
		Salsk district	0.422	4080
		Tsimlyansk district	0.465	4272

Annex 3

MONITORING PLAN

For estimation of change of load in the baseline scenario use coefficients α, β.
α – amount of heat load provided by low-efficient boiler-houses. It shows the share of additional load which reallocated on the boiler-houses (donors) from shut down boiler-houses. It is calculated for each boiler-houses according to the following formula:

$$\alpha = (LC_{closure,i}/(LC_{donor\ boiler,i} + LC_{closure,i}))*100\% \qquad \textbf{(A3-1)}$$

Where:
α – amount of heat load provided by low-efficient boiler-houses;
$LC_{closure,i}$ – connected load at low-efficient boiler-houses being shut-down (individual for each boiler-houss), TJ/hour;
$LC_{PJ,\ donor}$ **–** connected load after residential consumers are switched over to donor boiler-houses (individual for each boiler-house), TJ/hour;
β – amount of heat load provided by donor boiler-houses. It shows the share of load itself by donor boiler-houses . It is calculated for each boiler-houses according to the following formula:

$$\beta = 100 - \alpha \qquad \textbf{(A3-2)}$$

Connected load at low-efficient boiler-houses being shut-down in the baseline scenario calculated according to the following formula:

$$LC_{BL\_closure} = LC_{PJ\_donor} * \alpha \qquad \textbf{(A3-3)}$$

Where:
$LC_{BL\_closure}$ - connected load at low-efficient boiler-houses being shut-down in the baseline scenario;
LC_{PJ_donor} - connected load after residential consumers are switched over to donor boiler-houses in the project;
α – amount of heat load provided by low-efficient boiler-houses.

Connected load at donor boiler-houses in the baseline scenario calculated according to the following formula:

$$LC_{BL\_donor} = LC_{PJ\_donor} * \beta \qquad \textbf{(A3-4)}$$

Where:
LC_{BL_donor} - connected load at donor boiler-houses in the baseline scenario;
LC_{PJ_donor} - connected load after residential consumers are switched over to donor boiler-houses in the project;
β – amount of heat load provided by donor boiler-houses.

Table 1. Value of the load shift coefficient for shut-down and donor boiler-houses in activity 1

	Load shift coefficient for boiler-houses being shut-down (α), %	**Load shift coefficient for donor boiler-houses (β), %**
2005		
City of Gukovo		

	Load shift coefficient for boiler-houses being shut-down (α), %	**Load shift coefficient for donor boiler-houses (β), %**
№19, p. sh. Gukovskaya, Mir street, 27 to boiler-house №21, Promploschadka (coal - gas)	1.07	98.93
№2, p. sh. Rostovskaya, Zheleznodorozhnaya street, to boiler-house №6 situated on Kolodeznaya street (coal - coal)	9.39	90.61
№7, p. sh. Rostovskaya, Leningradskaya street to boiler-house №9 (sector. №3) (coal - coal)	34.81	65.19
№2, p. Uglerodskiy, Shahterskaya street to boiler-house №1, situated on p. Uglerod (coal - coal)	57.33	42.67
City of Donetsk		
№4, p. Zapadniy, Ulyanova street to boiler-house №13 situated on Stanislavaskiy street (coal - gas)	17.36	82.64
№13,p. Zapadniy, Stanislavskiy street to boiler-house №13 situated on Stanislavaskiy street (coal - gas)	100.00	0.00
City of Zverevo		
№3, CGB (ЦГБ) to boiler-house №8 situated on Obukhov street (coal - gas)	0.12	99.88
№7, Obuhova street to boiler-house №8 situated on Obukhov street (coal - gas)	38.13	61.87
City of Salsk		
7 per. Sportivniy to the boiler-house situated at Moskovskaya street, 14 (coal - gas)	2.97	97.03
6 per. Klubniy to the boiler-house situated at 31 Uchebnaya street, (coal - gas)	69.38	30.62
31 Uchebnaya street to the boiler-house situated at 31 Uchebnaya street, (shk. №76) (coal - gas)	50.00	50.00
Uchebnaya street (d. sad) to the boiler-house situated at 31 Uchebnaya street (coal - gas)	38.83	61.17
1 Kutuzov street to the new boiler-house (coal - gas)	100.00	0.00
178 Verkhniaya street to the new boiler-house (coal - gas)	100.00	0.00
2006		
City of Gukovo		
№20, p. Oktyabrskiy, Volodarskiy street to boiler-house №20 situated on Volodarskogo street (coal - gas)	100.00	0.00
City of Donetsk		
№44 to the boiler- house “Promuzla”(coal - gas)	2.43	97.57
The boiler- house “Slujby zakazchira” to the boiler- house "Promuzla" (coal - gas)	0.99	99.01
City of Salsk		
12 Traktovaya street to the boiler-house situated at 4 Rodnikovaya (coal - gas)	12.60	87.40
214a Odesskaya street to the boiler-house situated at 4 Rodnikovaya (coal - gas)	5.74	94.26
26 Kovpak street to the boiler-house situated at 4 Rodnikovaya (coal - gas)	8.87	91.13

	Load shift coefficient for boiler-houses being shut-down (α), %	**Load shift coefficient for donor boiler-houses (β), %**
2 Privokzalnaya street to the boiler-house situated at 14 Moskovskaya, (coal - gas)	1.64	98.36
Per. 74 Zapadnii to the boiler-house situated at 14 Moskovskaya (coal - gas)	1.85	98.15
City of Cimlyansk		
h. Antonova, 17a Centralnaya street to the new boiler-house (coal - gas)	100.00	0.00
st. Kalininskaya, 14a per. Krutoy to the new boiler- house (coal - gas)	100.00	0.00
City of Millerovo		
№ 11 situated at 23 Gorkiy street to boiler-house №11(coal - gas)	100.00	0.00
№ 24 situated at 70 III – International street to boiler-house №24(coal - gas)	100.00	0.00
№ 25 situated at 22 L.Matros street to boiler-house №25 (coal - gas)	100.00	0.00
№10 situated at 6 Tchkalov street to boiler-house №9 at 3 Tchkalov street (coal - gas)	50.00	50.00
№16 DCHT to the new boiler-house (coal - gas)	100.00	0.00
№12 12a Kirov street to boiler-house №3 situated at 8 Plekhanov street,(coal - gas)	2.70	97.30
2007		
City of Bataysk		
The boiler- house, situated on Vilyams street, 2б to the boiler-house situated on Industrialnaya street, 7a (gas - gas)	28.49	71.51
The boiler- house situated at 114a Rabochaya stree to the boiler-house situated at 2b Lenin street (gas - gas)	7.85	92.15
City of Zverevo	14.39	100.00
№24 65a Gorkiy street to the new boiler-house (coal - gas)	100.00	0.00
№22 154 Krupskaya street to the new boiler-house (coal - gas)	100.00	0.00
2008		
City of Gukovo		
№5 p. sh.Antracit,116 Tchekhov street to the new boiler-house №75 (coal - gas)	1.02	98.98
City of Donetsk		
The Boiler-house GNI (ГНИ) at 9a per.Gagarina to the boiler-house Boguraevskaya, situated at 79 Gorkiy street (coal - gas)	100.00	0.00
City of Zverevo		
№12, Sovetskaya street, 1 to the boiler-house №13 situated on Tchkalov street, 55 (coal - gas)	57.69	42.31
№13 55 Chkalova street to boiler-house №13 situated on 55 Tchkalov street (coal - gas)	67.57	32.43
City of Salsk		

	Load shift coefficient for boiler-houses being shut-down (α), %	**Load shift coefficient for donor boiler-houses (β), %**
The boiler-house situated at 28 Kuibyshev street to the new boiler-house (coal - gas)	99.87	0.13
City of Azov		
№21 20 Petrovskiy b. to the new boiler-house at 61 per.Sotcialistitcheskiy	18.46	81.54
№3Gorbol'nitsa, 58 Izmailiova street to the boiler-house situated on 71 Izmailov street	41.86	58.14
№10, 20 Kondaurov to the boiler-house situated on 71 Izmailov street	20.93	79.07
2009		
City of Azov		
№4 4 Bezimyannaya street to boiler-house №34 v, 83 (gas - gas)	75.50	24.50
City of Gukovo		
№14 p. sh.Antracit, 1в Militseiskaya street to boiler-house №9 в p. sh. Antrracit (coal - gas)	2.81	97.19
№15 p. sh. Antracit, 2a Kooperativnaya street to boiler-house №9 в p. sh. Antracit (coal - gas)	75.97	24.03
№20 p. sh. Antracit, 85a Komcomolskaya st to boiler-house №9 в p. sh. Antracit (coal - gas)	38.43	61.57
№31 p. sh. Antracit, 1a Budennyi street to boiler-house №9 в p. sh. Antracit (coal - gas)	66.01	33.99
City of Tcimlyansk		
№13, st. Krasnoyarskaya, 130 Pobeda street to boiler-house №12 situated on 2a Gagarina street (coal - gas)	100.00	0.00
2010		
City of Azov		
№18 60 Moskovskaya street to boiler-house №30 situated on Sotsialistitcheskaya street (gas - gas)	10.00	90.00
№12 30 Makarovskiy street to boiler-house №9 on 71 Izmailov street (gas - gas)	96.00	4.00
№27 266 Lenin street to boiler-house №9 on 71 Izmailov street (gas - gas)	64.88	35.12
City of Millerovo		
№26 s. Voloshino, Lenin street to the new boiler-house in s. Voloshino (coal - coal)	100.00	0.00
№27 s. Voloshino, Sovetskaya street to the new boiler-house in s. Voloshino (coal - coal)	100.00	0.00
City of Salsk		
k/z Budennyi, 3 Lenin street to the new boiler-house (coal - gas)	100.00	0.00
k/z Budennyi, 6 Samokhvalov street to the new boiler-house (coal - gas)	100.00	0.00

Annex 4

INFORMATION ON PERFORMANCE OF BOILER-HOUSES

Activity 1. Optimization of the heat supply structure in 2005-2010.

While implementing activity 1, some boiler-houses will be shut-down with the load shifted to the donor boilers-houses.

Before activity 1, the fuel consumption is 2,943 TJ

The total fuel consumption after activity 1 is 2,565 TJ.

The performance of the boiler-houses which will be shut-down as a result of the implementation of activity 1, is presented in the Table 4.1.

Table A4.1: The performance of the boiler-houses in the districts of the Rostov region during shut-down of the boiler- houses and shift of the load.

District	Number of boiler-houses before the activity, pc	Connected load before the activity, TJ/h	Number of boiler-houses after the activity, pc	Connected load after the activity, TJ/h
2005				
City of Gukovo	8 (7 coal, 1 gas)	0.125	4 (3 coal, 1 gas)	0.125
City of Donetsk	3 (2 coal, 1 gas)	0.010	1 (1 gas)	0.010
City of Zverevo	3 (2 coal, 1 gas)	0.215	1 (1 gas)	0.215
City of Salsk	6 (4 coal, 2 gas)	0.032	4 (4 gas)	0.032
Total in 2005	***20 (15 coal, 5 gas)***	**0.382**	***10 (3 coal, 7 gas)***	**0.382**
2006				
City of Gukovo	1 (1 coal)	0.009	1 (1 gas)	0.009
City of Donetsk	3 (2 coal, 1 gas)	0.171	1 (1 gas)	0.171
City of Salsk	7 (5 coal, 2 gas)	0.099	2 (2 gas)	0.099
City of Tsimlyansk	2 (2 coal)	0.002	2 (2 gas)	0.002
City of Millerovo	8 (6 coal, 2 gas)	0.012	6 (6 gas)	0.012
Total in 2006	***21 (16 coal, 5 gas)***	**0.293**	***12 (12 gas)***	**0.293**
2007				
City of Bataysk	4 (4 gas)	0.049	2 (2 gas)	0.049
City of Zverevo	2 (2 coal)	0.001	2 (2 gas)	0.001
Total in 2007	***6 (2 coal, 4 gas)***	**0.050**	***4 (4 gas)***	**0.050**
2008				
City of Gukovo	2 (1 coal, 1 gas)	0.033	1 (1 gas)	0.033
City of Donetsk	2 (1 coal, 1 gas)	0.001	1 (1 gas)	0.001
City of Zverevo	2 (1 coal, 1 gas)	0.001	1 (1 gas)	0.001
City of Salsk	1 (1 coal)	0.004	1 (1 gas)	0.004
Total in2008	***7 (4 coal, 3 gas)***	**0.039**	***4 (4 gas)***	**0.039**
2009				
City of Azov	2 (2 gas)	0.019	1 (1 gas)	0.019
City of Gukovo	5 (4 coal, 1 gas)	0.017	1 (1 gas)	0.017
City of Tsimlyansk	2 (1 coal, 1 gas)	0.001	1 (1 gas)	0.001

District	Number of boiler-houses before the activity, pc	Connected load before the activity, TJ/h	Number of boiler-houses after the activity, pc	Connected load after the activity, TJ/h
Total in 2009.	***9 (5 coal, 4 gas)***	**0.037**	***3 (3 gas)***	**0.037**
2010				
City of Azov	6 (6 gas)	0.079	2 (2 gas)	0.079
City of Millerovo	2 (2 coal)	0.005	2 (2 coal)	0.005
City of Salsk	2 (2 coal)	0.002	2 (2 gas)	0.002
Total in 2010	***10 (4 coal, 6 gas)***	**0.086**	***6 (2 coal, 4 gas)***	**0.086**
TOTAL for 2005-2010	**73 (46 coal, 27 gas)**	**0.887**	**39 (5 coal, 34 gas)**	**0.887**

<u>Activity 2.</u> **Reconstruction of the boiler – houses in 2005-2010.**

During the reconstruction, boiler and pumping equipment will be replaced; automatic control equipment will be installed. Upon completion of the reconstruction, almost all of the boiler- houses will be gas-fired.

Fuel consumption for the boiler-houses being gasified – 5,853 TJ.

Fuel consumption after implementation of the activity 2 – 5,468 TJ.

The performance of the boiler-houses are presented in the Table 4.2,

Table A4.2: The performance of the boiler-houses in the districts of the Rostov region during the reconstruction.

District	Number of boiler-houses before the activity, pc	Connected load before the activity, TJ/h	Number of boiler-houses after the activity, pc	Connected load after the activity, TJ/h
2005				
Gasifying of the boiler-houses				
City of Belaya Kalitva	2 (2 gas)	0.058	2 (2 gas)	0.058
Total number of gasified boiler - houses in 2005	***2 (2 gas)***	**0.058**	***2 (2 gas)***	**0.058**
2006				
Gasifying of the boiler-houses				
City of Aksay	2 (2 gas)	0.011	2 (2 gas)	0.011
City of Bataysk	3 (3 gas)	0.085	3 (3 gas)	0.085
City of Belaya Kalitva	4 (1 coal, 3 gas)	0,185	4 (4 gas)	0.185
City of Gukovo	2 (2 gas)	0.170	2 (2 gas)	0.170
City of Donetsk	1 (1 gas)	0.091	1 (1 gas)	0.091
City of Zverevo	1 (1 gas)	0.133	1 (1 gas)	0.133
City of Kamensk	2 (2 gas)	0.021	2 (2 gas)	0.021
City of Millerovo	5 (5 gas)	0.020	5 (5 gas)	0.020
City of Salsk	3 (3 gas)	0.084	3 (gas)	0.084
City of Tsimlyansk	1 (1 gas)	0.001	1 (1 gas)	0.001

District	Number of boiler-houses before the activity, pc	Connected load before the activity, TJ/h	Number of boiler-houses after the activity, pc	Connected load after the activity, TJ/h
Total number of gasified boiler - houses in 2006	***24 (1 coal, 23 gas)***	**0.800**	***24 (24 gas)***	**0.800**
2007				
Gasifying of the boiler-houses				
City of Aksay	3 (3 gas)	0.037	3 (3 gas)	0.037
City of Bataysk	3 (3 gas)	0.020	3 (3 gas)	0.020
City of Belaya Kalitva	2 (2 gas)	0.053	2 (2 gas)	0.053
City of Millerovo	1 (1 gas)	0.014	1 (1 gas)	0.014
City of Salsk	3 (2 coal, 1 gas)	0.016	3 (3 gas)	0.016
City of Tsimlyansk	1 (1 gas)	0.002	1 (1 gas)	0.002
Total number of gasified boiler - houses in 2007 .	***13 (2 coal, 11 gas)***	**0.141**	***13 (13 gas)***	**0.141**
2008				
Gasifying of the boiler-houses				
City of Azov	1 (1 gas)	0.013	1 (1 gas)	0.013
City of Gukovo	3 (3 coal)	0.031	3 (3 gas)	0.031
City of Donetsk	2 (2 coal)	0.005	2 (2 gas)	0.005
Kamensk	1 (1 coal)	0.002	1 (1 gas)	0.002
Millerovo	1 (1 coal)	0.002	1 (1 gas)	0.002
Sal’sk	2 (1 coal, 1 gas)	0.054	2 (2 gas)	0.054
Tsimlyansk	1 (1 coal)	0.003	1 (1 gas)	0.003
Reconstruction				
Aksay district heat networks	5 (5 gas)	0.099	5 (5 gas)	0.099
Tsimlyansk district heat networks	1 (1 gas)	0.068	1 (1 gas)	0.068
Total number of gasified boiler - houses in 2008	***17 (9 coal, 8 gas)***	**0.277**	***17 (17 gas)***	**0.277**
2009				
Gasifying of the boiler-houses				
City of Azov	1 (1 gas)	0.022	1 (1 gas)	0.022
City of Aksay	1 (1 gas)	0.029	1 (1 gas)	0.029
City of Belaya Kalitva	1 (1 coal)	0.001	1 (1 gas)	0.001
City of Gukovo	2 (2 coal)	0.015	2 (2 gas)	0.015
City of Millerovo	1 (1 coal)	0.0004	1 (1 gas)	0.0004
City of Tsimlyansk	1 (1 coal)	0.001	1 (1 gas)	0.001
Reconstruction				
Bataysk district heat networks	2 (2 gas)	0.038	2 (2 gas)	0.038

District	Number of boiler-houses before the activity, pc	Connected load before the activity, TJ/h	Number of boiler-houses after the activity, pc	Connected load after the activity, TJ/h
Belokalitvinskii district heat networks	1 (1 gas)	0.004	1 (1 gas)	0.004
Zverevo district heat networks	1 (1 coal)	0.063	1 (1 gas)	0.063
Donetsk district heat networks	1 (1 gas)	0.084	1 (1 gas)	0.084
Total number of gasified boiler - houses in 2009 .	***12 (6 coal, 6 gas)***	**0.258**	***12 (12 gas)***	**0.258**
2010				
Gasifying of the boiler-houses				
City of Azov	2 (2 gas)	0.023	2 (2 gas)	0.023
City of Aksay	2 (2 gas)	0.061	2 (2 gas)	0.061
City of Belaya Kalitva	1 (1 coal)	0.004	1 (1 gas)	0.004
City of Zverevo	1 (1 coal)	0.003	1 (1 gas)	0.003
City of Kamensk	1 (1 coal)	0.001	1 (1 gas)	0.001
City of Salsk	2 (2 coal)	0.006	2 (2 gas)	0.006
Reconstruction				
Gukovo district heat networks	3 (3 gas)	0.072	3 (3 gas)	0.072
Kamensk district heat networks	2 (1 coal, 1 gas)	0.006	2 (2 gas)	0.006
Salsk district heat networks	1 (1 coal)	0.001	1 (1 coal)	0.001
Tsimlyansk district heat networks	1 (1 gas)	0.068	1 (1 gas)	0.068
Total number of gasified boiler - houses in 2010 .	***16 (5 coal, 11 gas)***	**0.245**	***16 (15 gas, 1 coal)***	**0.245**
Total number in 2008-2010.	**84 (23 coal, 61 gas)**	**1.779**	**84 (83 gas, 1 coal)**	**1.779**

The total number of the boiler-houses is 157 (the boiler-houses considered in activity 1, are not considered in activity 2). Retrofitting of the boiler- houses will lead to an improvement in the performance coefficient of the boiler – house by 20% versus (performance factor) before modernization.

Activity 3. The replacement of the heat traces in 2005-2010.

Implementation of this activity will make it possible to eliminate heat losses through insulation and water leakages.

Thermal insulating materials being utilized have high thermal insulating properties (the coefficient of thermal expansion doesn't exceed 0.06 W/(m•0C)), endurance (durability to the effects of water, chemical and biological attacks), resistance to cold and mechanical resistance, fire safety and environmental safety, i. e. they do not pose a danger to the environment or the health and safety of people. Isocyanate foam fully meets these requirements.

As usual, urethane foam insulation is utilized in pipes in factory conditions and joints are insulated at the construction site after the pipeline has been welded and tested.

The urethane foam insulation provides the following advantages versus existing designs:
- increased lifetime (resource of a pipeline) by 2-3 times;
- reduction in heat losses by 2-3 times;
- reduction in maintenance costs by 2 times (specific damaging decreases by 10 times);
- reduction in installation costs in construction by 2-3 times;
- availability of remote inspection system for dampening heat-insulation.

Pipes are made of various materials depending on the operating conditions. At the present time, steel pipes for the construction of heat traces are the most common, the physicochemical parameters of which are shown in Table 4.3.

Table A4.3: Main thermal properties of the steel pipes

Thermal properties		
Linear thermal expansion coefficient	$1/^0C$	1.2•10
Specific heat capacity	$KJ/(kg•^0C)$	0.48
Heat conductivity coefficient	$W/(m•^0C)$	76

The main reason for the wide utilization of steel piping is its low cost, ease of treatment coupled with high strength and also the ability to use standard welding to join the pipes.

The fuel consumption before and after the activities to replace insulating material and treat the leakages are shown in Table 4.4.

Table A4.4: Fuel consumption after and before reduction of losses due to heat radiation and elimination of water losses

		The reduction of heat losses through insulation		Elimination of water losses	
Location of heat networks	Length, trace meters	Fuel consumption, TJ		Fuel consumption, TJ	
		before the activity	after the activity	before the activity	after the activity
2005-2007					
City of Aksay	1369.0	6.3	1.4	1.1	0.7
City of Bataysk	1560.0	12.5	1.7	0	0
City of Belaya Kalitva	6918.0	33.0	8.9	131.7	126.5
City ofGukovo	8510.0	34.3	8.1	131.0	105.8
City of Donetsk	4511.0	19.5	5.4	142.8	136.4
City of Zverevo	3432.0	15.9	3.6	95.7	90.5

Kamensk district	1098.0	3.4	1.1	0	0
City of Millerovo	282.0	0.8	0.3	0	0
City of Salsk	8721.0	25.8	8.3	0	0
City of Tsimlyansk	5493.0	17.2	5.6	0	0
TOTAL from 2005-2007	41894.0	168.7	44.4	502.3	459.9
2008-2010					
City of Azov	6592.0	97.8	6.9	1.0	0.7
City of Aksay	7983.5	128.5	11.2	0	0
City of Bataysk	400.0	1.9	0.6	3.8	0.9
City of Belaya Kalitva	10581.0	174.4	12.1	11.1	1.8
City of Gukovo	2560.0	142.5	9.0	0	0
City of Donetsk	1220.0	44.1	2.9	22.7	7.4
City of Salsk	1000.0	8.0	0.5	1.5	1.5
TOTAL from 2008-2010	30336.5	597.2	43.2	40.1	12.3

The total length of heat networks being replaced is 72 trace km.
As a result of the implementation of the three activities, the reduction in fuel consumption will be 1,776 TJ.

Annex 5

INFORMATION ON EMISSIONS FROM 2005-2007.

As rehabilitation of the heat supply structure started in 2005, the amount of emission reductions from 2005-2007 will be 102 242 tons of CO2.

2005-2007	
Year	Estimation of annual emission reduction, (t CO_2 equivalent)
2005	21 241
2006	36 539
2007	40 460
Total emission reductions over the whole crediting period (tons of CO_2 equivalent)	98 240
Mid-annual emission reductions (tons of CO_2 equivalent)	32 747

Table A5.1: Baseline emissions

Year	Emissions from the coal boiler- houses and from the boiler – houses without load shift (tCO2/year)	Emissions from the boiler- houses without carrying-out of retrofitting (t CO2/year)	Emissions from the heat pipeline without replacement of insulation and treatment of leakages (t. CO2/year)	Baseline scenario emissions (t. CO2/year)
Total from 2005-2007	321 196	274 213	80 703	676 112

Table A5.2: Project emissions from various sources

Year	Emissions from the load shift as a result of shut-down of the coal boiler-houses, (tCO2/year)	Emissions from the retrofitted boiler - houses, (tCO2/year)	Emissions from retrofitting of the heat traces, (tCO2/year)	Project emissions (t CO2/year)
Total from 2005-2007	260 737	259 148	57 986	577 871

Table A5.3: Results of emission reductions calculation

Year	Emission reductions from the load shift as a result of the shut-down of the coal boiler-houses, (tCO_2/year)	Emission reductions emission due to reconstruction of the boiler- houses (t CO_2/year)	Emission reductions from reconstruction of the heat traces, (tCO_2/year)	Emission reductions on the Project (tCO_2/year)
Total from 2005-2007	60 458	15 065	22 717	98 240

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