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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Energy switch to renewables in Novoshakhtinsk, Rostov region, Russia

Report version number: 1.0

Date: 30 June 2007

A.2. Description of the project:

The purpose of the project is utilizing local renewable energy sources (RES) instead of fossil fuel for heat supply of social objects in town of Novoshakhtinsk, Rostov region.

The project is based on using of heat pumps with utilization of low-potential heat of abandoned coal mines waters (temperature 12÷13 °C) for heating needs of Novoshakhtinsk. Besides electricity necessary for the work of heat pumps will be mainly generated in gas-engine CHP units due to natural gas combustion and at small hydroelectric plant (SHEP).

Several dozens of boiler houses mostly coal ones work in Novoshakhtinsk at present. Boiler houses have great wear and extremely low efficiency. The town meets with heat deficit of about 230 thousand GJ per year. Many coal boiler houses are located inside the buildings and are not equipped with efficient combustion products purification systems thus polluting heated buildings and contiguous territories with harmful and dangerous substances.

Using of heat pumps results in substantial decrease of fossil fuel consumption, reduction of harmful emissions into the atmosphere and increase of heat supply systems efficiency correspondingly. Using of gas-engine CHP units and SHEP together with heat pumps will reduce electricity cost compared with electricity from grid. The opportunity of additional utilization of heat output from the cooling systems of CHP units allows further increase of heat generation efficiency.

The project stipulates for reconstruction of heat supply system of three districts of Novoshakhtinsk owing to implementation of the following steps:

- construction of three heat pump stations (HPS) with total installed capacity of 40 MW;
- construction of SHEP with total installed capacity of 1.3 MW on the basis of the existing dam;
- reconstruction of a part of heat networks.

As a result of the project:

- fourteen inefficient and ecologically dirty coal boiler houses will be put out of operation;
- anthracite consumption will be cut by 6.3 thousand tons per year;
- natural gas consumption will be cut by 0.91 million m^3 per year;
- electricity consumption from grid will be decreased by 1.07 thousand MWh per year;
- CO_2 emissions from fossil fuel combustion will be reduced by 16.7 thousand tons per year;
- harmful environmental impact will be decreased.

The construction of HPS-1 started in July 2006 and is planned to be completed by the third quarter of 2007. After the completion of construction and putting the station into operation analysis of performance data will be executed and changes will probably be made in working drafts on HPS-2 and HPS-3. It is caused by almost complete absence of experience of heat pumps using for heat supply needs in Russia.

It is planned to complete construction of HPS-2 and HPS-3 in the third quarter of 2008 and the third quarter of 2009 correspondingly. SHEP construction is planned to start simultaneously with HPS-2 construction. All building and assembly works are planned to be completed not later than by the third quarter of 2009.

The amount of necessary capital investments into the project is about €11 million.

The project is supported by the Administration of the Rostov region and by authorities of Novoshakhtinsk.

Project implementation will allow getting unique experience in Russia for further practicing in other mining towns.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A: Russian Federation (host Party)	Legal entity A1: Limited Company Teplonasosnye sistemy	No
Party B: EU countries	Legal entity B1: Private company CI Camco (Cyprus) Limited	No

Limited Company Teplonasosnye sistemy (TNS Ltd.) is a private innovation research-and-production company specially established for implementation of projects on construction and maintenance of heat supply systems using low-potential heat of mine waters and other renewables in the end of 2004 under the patronage of Association of Mining Towns of Russia (which unites 93 mining towns in 24 regions of Russia).

CI Camco (Cyprus) Limited is a subsidiary of Camco International Ltd., a Jersey based public company listed at AIM in London. Camco International is the world leading carbon asset developer and projects promoter under both joint implementation and clean development mechanism of the Kyoto Protocol. Camco's project portfolio consists of more than 70 projects, generating altogether over 118 Mt CO_2e of GHG reductions all over the world. Camco operates in Eastern Europe, Africa, China, and Southeast Asia. The company has been actively operating in Russia since 2005.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project activity is located in town of Novoshakhtinsk, Rostov region, Russia.

A.4.1.1. Host Party(ies):

Russian Federation

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

Rostov region

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

Town of Novoshakhtinsk

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

Novoshakhtinsk is a town of regional subordination in Rostov region (Fig. A.4-1) situated 105 km long from Rostov near the border with Ukraine (Fig. A.4-2). The town population was 117.8 thousand people in 2006. This region is a large anthracite mining center.

Geographic latitude: 47°46'. Geographic longitude: 39°55'. Time zone: GMT +3:00.

Fig. A.4-1. European part of the Russian Federation

Fig. A.4-2. Location of Novoshakhtinsk in the Rostov region

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

Description of applied technologies

Main technical decisions used for all the three heat pump stations are analogous. The principle scheme of HPS is showed in Fig. A.4-3.

Big amount of water in hydraulically connected watersealed mines of Novoshakhtinsk which is heated by earth heat at great depths has large heat energy resources. Vertical circulation caused by gravity brings heated water out closer to mine surface where it can be accessed through short boreholes (50÷150 meters) thus providing reliable and inexpensive source of primary energy for heat pumps. Water from the group of mines with the temperature 12÷13 °C is brought from pressure wells to primary circuit of heat pump unit (HPU) using drowned pumps and returns to mines through drawdown well located on other level of excavations after heat energy extraction being cooled to 5÷7 °C. This results in keeping mine water-bearing integrity and derived water temperature practically unchanged. Environmental consequences of using such energy source are minimal.

Main elements of compression vapor-liquid heat pump are evaporator, electric motor driven compressor, condenser and throttle (expansion valve). Depending on pressure heat pump is divided into two parts: low pressure part and high pressure part. Working substance loaded into heat pump boils in the evaporator at low pressure taking heat for evaporation from low-potential source of heat energy. Compressor draws vapor of the working substance from the evaporator sustaining low pressure in the evaporator and simultaneously creating high pressure in the condenser where vapor of the working substance condenses and gives stored heat back. This heat is transmitted to network water flowing through the condenser. The throttle provides division of high pressure and low pressure parts and is a thermodynamic element as important as other elements of the heat pump.

One of the most important characteristics of heat pump is its transformation factor calculated as ratio of useful heat energy taken from the condenser to the electrical energy consumed by the compressor electric drive. Value of this factor depends on the conditions of heat pump usage and especially on the temperature of low-potential source. In the case under consideration transformation factor equals approximately 3.5. Not less than a half of annual heat supply will be provided owing to HPU.

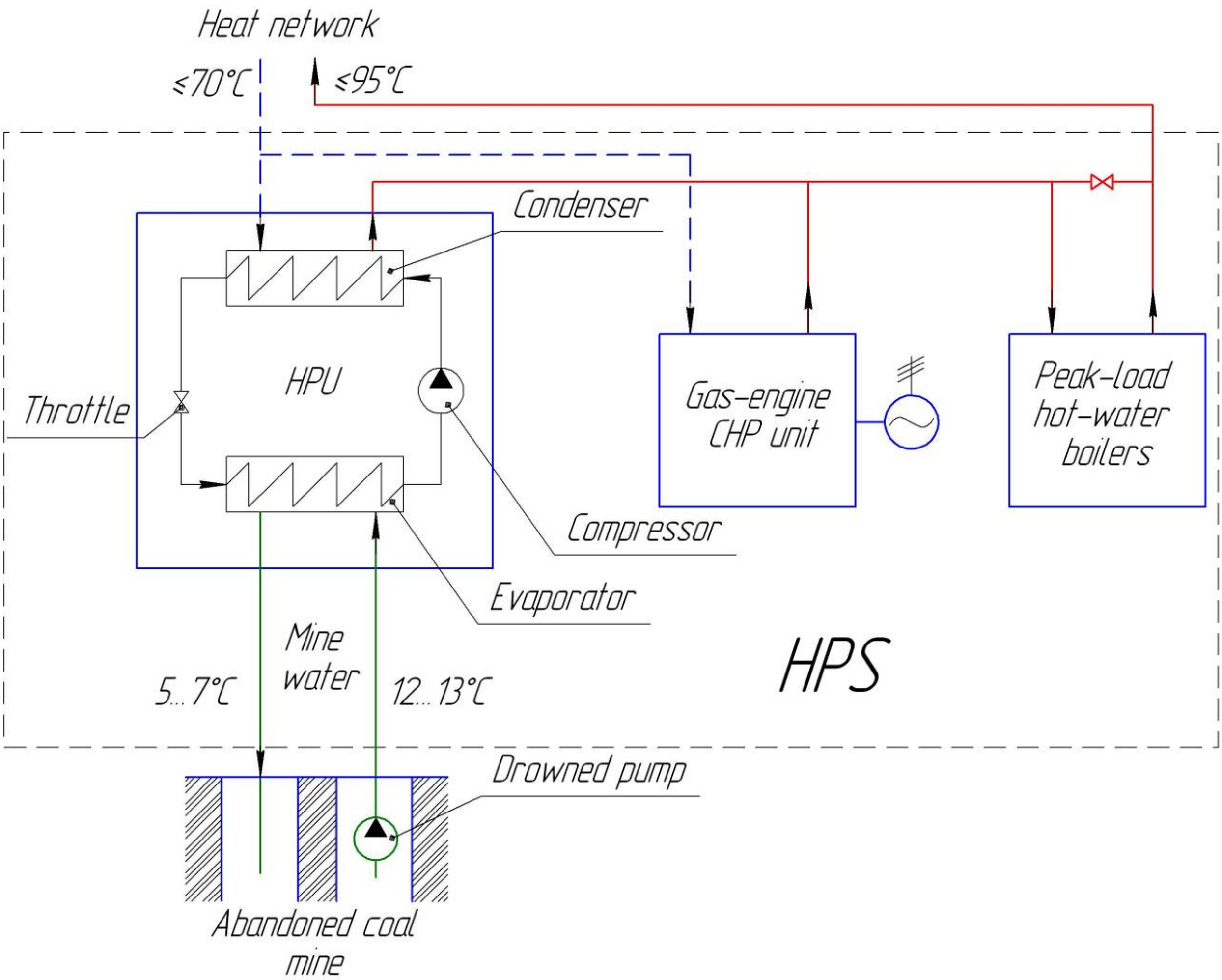

Fig. A.4-3. Principal scheme of heat pump station

It is planned to use its own CHP unit working on natural gas and located in the building of the station for power supply of the equipment. CHP unit is a set of cogeneration gas reciprocating engines which provide combined generating of electric and heat energy with high efficiency factor (35% - electric and 45% - heat). Heat energy taken from the cooling systems of CHP unit is transferred to network water fed to the parallel with heat pumps.

The town grid is used as backup electricity source. Small amount (10÷15%) of electricity from the town grid will be used mainly for feed of auxiliary equipment and electric lighting and besides as a reserve power supply source when performing preventive maintenance of CHP unit or in emergency cases.

Additional heating of network water is organized using peak-load hot-water boilers (PHWB) working on natural gas located in the building of the heat pump station in the periods of the year with low negative temperatures of outside air. The same boilers function as standby source of heat energy which can be necessary in the periods of scheduled and unscheduled repairs of heat pump equipment of the station.

The project also envisages construction of SHEP (Fig. A.4-4). Water derived from the storage reservoir (position 1) through the water intake (position 2) is fed to water turbine (position 3) giving part of its potential energy and rotates turbine shaft and generator rotor connected with it (position 5). Used water is taken away through outlet manifold (position 4).

Construction of SHEP will be performed close to one of the town transformer substations that will reduce costs for cabling. Energy will further be transfer to the town grid. Town grid company will take energy generated at SHEP into account when calculating consumption of grid electricity at HPSs.

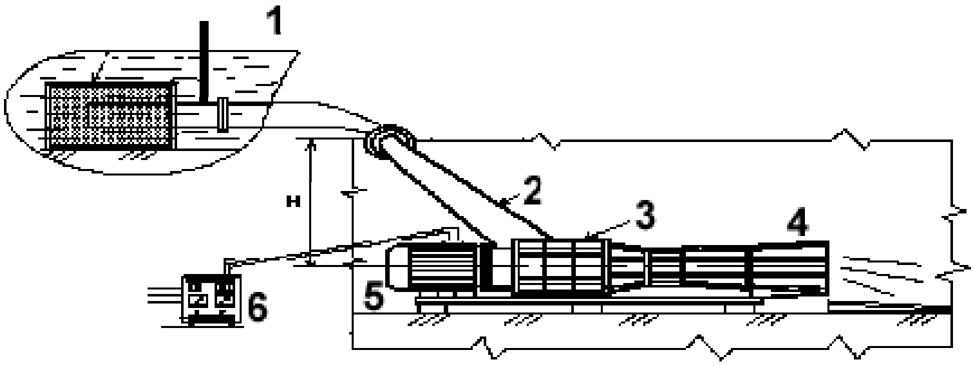

Fig. A.4-4. Scheme of small hydroelectric plant

Described technologies can be applied in many mining towns of Russia.

<u>Description of main project construction objects</u>

Heat pump station #1 (HPS-1)

Construction of heat pump station #1 allows providing centralized heat supply for hospital complex buildings and buildings of school, vocational school, kindergarten and several administrative and budget establishments and industrial enterprises of the town contiguous to the hospital territory together with stop of operation of nine old coal hot-water boiler houses including:

- boiler house of the surgery department of the hospital;
- boiler house of the children's town hospital;
- boiler house of the children's infectious diseases hospital;
- boiler house of school #27;
- boiler house of vocational school #58;
- boiler house of kindergarten #34 "Mishutka";
- boiler house of militarized mining rifle unit (MMRU);
- boiler house of geological survey;
- boiler house of Vodokanal.

Main predicted performance values of HPS #1 are as follows:

- annual calculated heat supply	60.3 thousand GJ
- installed capacity of HPU	1.7 MW
- installed capacity of gas-engine CHP unit:	
electricity	0.45 MW
heat	0.58 MW

- installed capacity of peak-load hot-water boilers 6 MW

HPS #1 is located in the center of heat loads (Fig. A.4-5) – on the territory of the enterprise “Monatef-Plus”, one of heat energy consumers. Pressure and drawdown wells as well as heat energy consumers are located within the radius of 500 meters from HPS #1. General view of HPS #1 is presented at Fig. A.4-6 and A.4-7; general view of the installed hot-water boilers – at Fig. A.4-8.

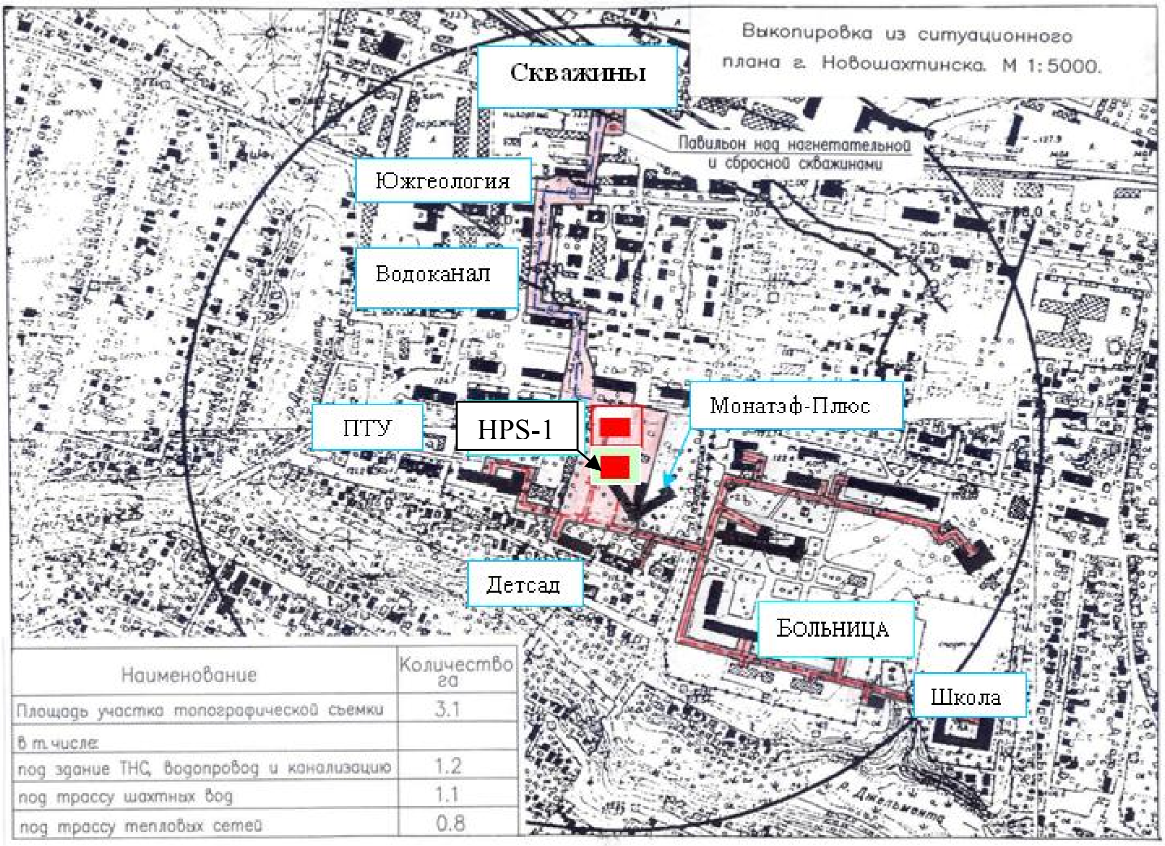

Fig. A.4-5. General location plan of HPS-1

Fig. A. 4-6. General view of HPS -1 (computer image)

Fig. A.4-7. General view of HPS -1 (construction site)

Fig. A.4-8. Assembling of three ZIOSAB-2000 peak-load hot-water boilers at HPS-1

Heat pump station #2 (HPS-2)

Construction of heat pump station #2 allows closing five old coal hot-water boiler houses including:

- boiler house of the House of Culture of the Mine named after Lenin;
- boiler house #1 of mining energy college;
- boiler house #2 of mining energy college;
- boiler house of kindergarten #28 “Chaika”;
- boiler house of school #1.

HPS-2 differs from HPS-1 by the opportunity to construct pressure and drawdown wells close to the main building of the station – in the mine tunnels of old mines which worked in 1934÷1945. In this situation it is not necessary to build long mine water conduit.

At present equipment capacities are specified. Main predicted performance values of HPS-2 according to preliminary evaluation are as follows:

- annual calculated heat supply	44.4 thousand GJ
- installed capacity of HPU	1.7 MW
- installed capacity of gas-engine CHP unit:	
electricity	0.45 MW
heat	0.58 MW
- installed capacity of peak-load hot-water boilers	4 MW

Construction of HPS-2 is planned in the central part of Novoshakhtinsk – in the area of the House of Culture of the Mine named after Lenin (Fig. A.4-9).

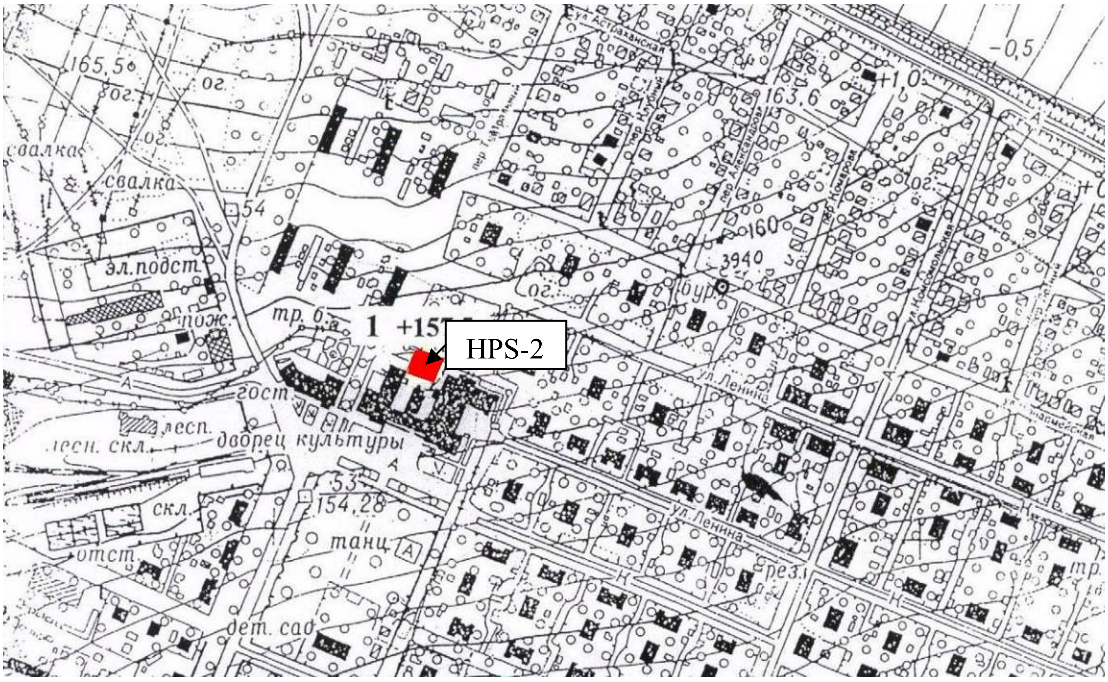

Fig. A.4-9. General location plan of HPS -2

Heat pump station #3 (HPS-3)

Construction of HPS-3 is planned close to the existing large gas boiler house which presently supplies heating for twenty three apartment houses with several thousand people living there in Radio district of Novoshakhtinsk (Fig. A.4-10). Although the equipment of the gas boiler house is relatively new its capacity is not enough to cover necessary heat load of the consumers.

HPS-3 differs by the opportunity to use the existing KVG-2.5-95 gas boilers as peak-load and reserve heat energy sources with possible increase of the number of boilers.

Boring of three wells two of them being pressure ones is planned for HPS-3.

At present equipment capacities are specified. Main predicted performance values of HPS-3 according to preliminary evaluation are as follows:

- annual calculated heat supply	263.8 thousand GJ
- installed capacity of HPU	7.5 MW
- installed capacity of gas-engine CHP unit:	
electricity	2 MW
heat	2.6 MW
- installed capacity of peak-load hot-water boilers	15 MW

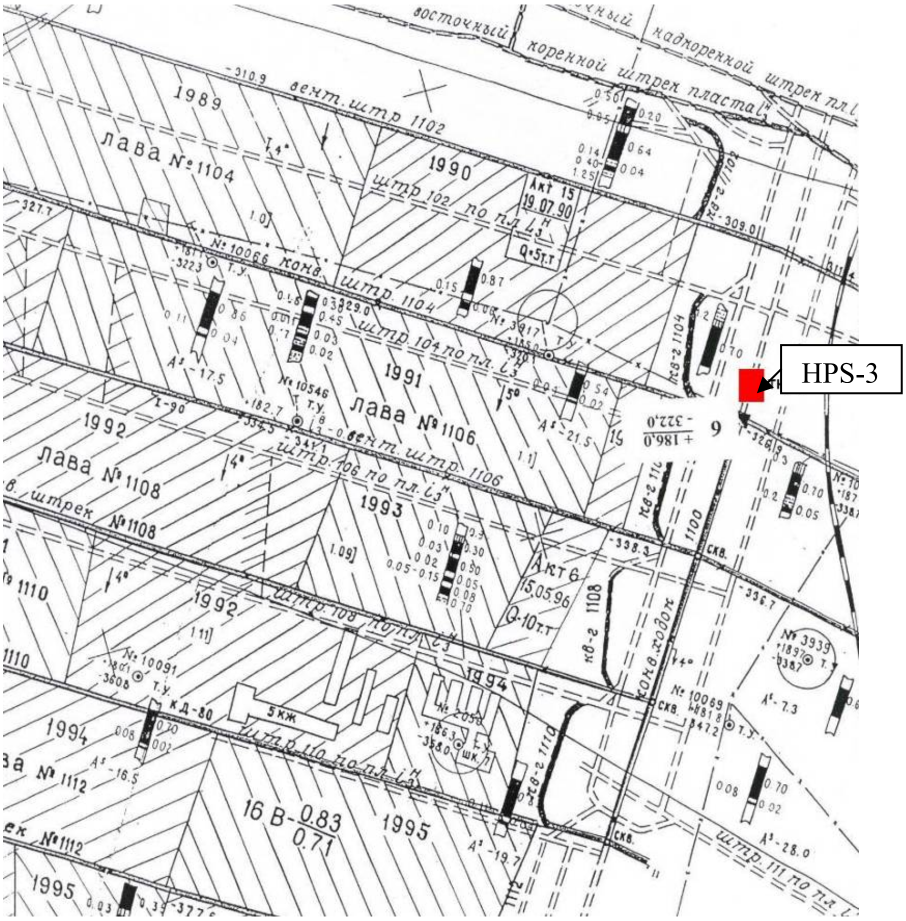

Fig. A.4-10. General location plan of HPS -3

Small hydroelectric plant

SHEP construction is planned near the existing dam of Sokolovskoe storage reservoir on the Kundryuchya River (Fig.A.4-11). Escapage from this storage reservoir reaches 12 m^3/second that allows generating maximum electric power of about 1.3 MW. SHEP average power will vary from 100 to 500 kW during the year. Figures A.4-12 and A.4-13 show the dam of Sokolovskoe storage reservoir and the planned place of SHEP construction.

Electrical energy generated by SHEP will allow partial covering of electricity demand of heat pump stations and thus increasing efficiency of the whole energy complex utilizing RES in Novoshakhtinsk.

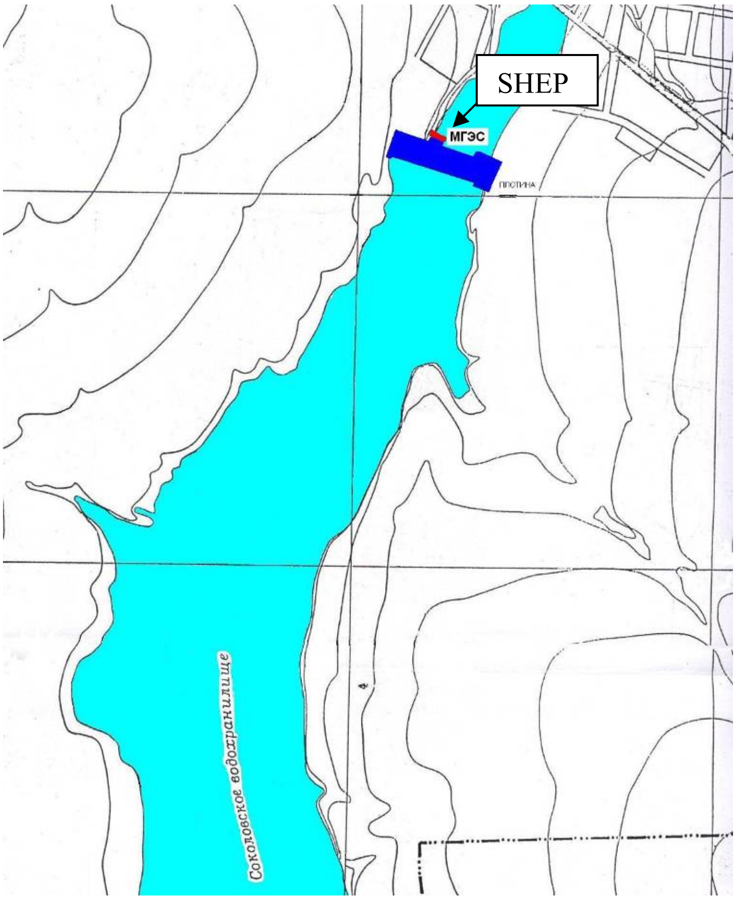

Fig. A.4-11. General location plan of SHEP

Fig. A.4-12. Dam of Sokolovskoe storage reservoir

Fig. A.4-13. The place of SHEP construction

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

The project implementation will result in reduction of GHG emissions from fossil fuel combustion with CO_2 being the main greenhouse gas. N_2O and CH_4 emissions from fossil fuel combustion are negligibly small compared with CO_2 emissions and were not taken into account when developing this project.

As a result of the project implementation CO_2 emission reduction will take place owing to:

1) reduction of anthracite and natural gas consumption at the municipal boiler houses;

2) lower natural gas consumption for a unit of heat generated at HPS compared with ordinary boiler houses;

3) reduction of the amount of fossil fuel combustion at grid power producers.

The first reason is caused by closing old municipal boiler houses due to HPSs construction.

The second reason is explained by the fact that substantially smaller volume of natural gas will be combusted in HPSs (namely in gas-engine CHP units) compared with ordinary gas boiler house for supplying equivalent amount of heat energy. Mine water low-potential heat will be converted to high-potential heat energy using heat pump. Electric energy consumption by heat pump will be three or four times smaller than heat energy supplied by it. Additional increment of HPS heat efficiency will be caused by the presence of cogeneration as well.

The third reason is caused by (a) electric energy generating at gas-engine CHP units which are known to be usually more efficient than most of grid electric power stations taking into account energy losses at electricity transmission and also by (b) generating electric energy at SHEP located within the precincts of the town.

GHG emission reductions would not be achieved without joint implementation project. The fact is that most coal boiler houses of the town are in a sad state, their equipment is old and it exhausted its resource long ago. Sometimes efficiency factor of heat supply from these coal boiler houses does not exceed 60%. Administration of Novoshakhtinsk would most probably take the following measures to cover heat energy deficit and improve heat supply quality (without JI mechanism):

- construction of new coal boiler houses and/or modernization of the old ones;
- additional equipment of the gas boiler house of Radio district with new gas boilers.

Coal boiler houses are unlikely to be completely replaced by gas ones due to strict limits for natural gas set by its suppliers. Besides the price for natural gas in Russia will probably grow and will exceed the price for coal soon (converted to equivalent fuel).

In any case the variant based on the development of boiler houses will result in increase of GHG emissions due to increase of fossil fuel consumption. However construction of heat pump stations is unlikely to take place without JI mechanism as:

- total cost of measures within the variant of the development of boiler houses will be much lower than the implementation cost of the project based on heat pump stations;
- the nature conservation legislation of Russia is unlikely to be changed in a way, which would force the town's administration to abandon using coal and gas boiler houses for heat supply of the town;
- no restrictions on GHG emissions for municipal boiler houses are and expected to be in force in Russia up to 2012;
- construction of heat pump stations is not common practice in Russia and is connected with a number of barriers.

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

Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	7 875
2009	13 558
2010	16 701
2011	16 692
2012	16 684
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**71 509**
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	14 302

A.5. Project approval by the Parties involved:

The Parties' Approval Letters will be received later.

SECTION B. Baseline

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

The baseline scenario was chosen based on the analysis of several alternatives of heat supply (see Section B.2).

The baseline scenario envisages providing necessary heat supply owing to reconstruction of the existing and/or construction of new coal boiler houses as well as to installation of additional gas boilers at the boiler house of Radio district. Boiler houses will be supplied with electricity from the town grid.

The baseline scenario is business-as-usual under the existing standards and rules, which do not limit use of fossil fuel in the existing and new boilers of town boiler houses. This scenario is justified to be conservative and it is much less costly compared to project activities. It should be also noted that there are no restrictions on GHG emissions for Russian enterprises and according to prognoses they are not expected to be introduced before 2012.

There are no methodologies connected with use of heat pump units among approved CDM methodologies.

While working out the baseline the developer suggests his own approach based on methodological developments of IPCC [R1] and other documents, common sense and his competence. Everything concerning assessment of emissions is sufficiently described and justified according to requirements of *Decision 9/CMP.1*, *Annex B* [R2].

Key factors determining GHG emissions both in the baseline and project scenarios have been singled out. These factors are the following:

- annual heat supply;
- fossil fuel combustion;
- electricity consumption and generation.

Let's view each factor in detail.

Annual heat supply

The purpose of municipal boiler houses is regular heat supply of consumers to meet their heating and hot water needs. During the heating season heating load changes depending on the outside temperature while average daily hot water supply load remains practically constant value. In summer period when the outside temperature is over +8 °C heating load equals zero and average hot water supply load is fixed at a lower level than that during the heating season.

There is heat deficit about 230 thousand GJ per year in the town. During the project implementation annual heat supply will increase up to 368 thousand GJ by 2010 as heat pump stations are put into operation (Table B.1-2). According to the project implementation schedule HPS-1, HPS-2 and HPS-3 are planned to be put into operation at the beginning of heating seasons in 2007, 2008 and 2009 correspondingly. Before each HPS is put into operation heat supply will be provided by the replaced old boiler houses in the amount not exceeding the one before the project (average annual actual heat supply for the period of 2004-2006). After each HPS is put into operation the replaced boiler houses will be closed.

Let's view the work of HPS at its planned load over a year. In summer period when there is only hot water supply load heat will be generated by HPU (about 70%) and gas-engine CHP unit (about 30%), the last working in a way to generate electricity enough to cover all needs of the HPS. When the heating season begins HPS starts working in transient mode. Heat energy is still generated owing to the work of HPU and CHP unit in about the same ratio. This period is peculiar for the fact that CHP unit provides maximum possible heat supply (that is caused by the necessity to generate maximum possible amount of electricity) from the beginning of this period while at the same time heat supply delivered by HPU starts growing as the outside temperature decreases. The length of this period is different for all three heat pump stations and depends directly on consumer loads as well as on the ratio of HPU and CHP unit installed capacities. When the outside temperature decreases down to a certain level HPU capacity appears to be not enough to provide necessary heat supply; at that time peak hot-water boilers start working and the third main winter period of HPS work begins when CHP unit and HPU are loaded to the maximum and lacking heat is generated by PHWB. During the year full stop of each HPS is planned for maintenance and repair for 14 days in summer period.

Special calculations allowed dividing heat supply over the groups of equipment for all three HPSs at their planned load during the year (Table B.1-1).

Table B.1-1. Annual heat supply from the groups of HPSs equipment

Name	Unit	Values in the corresponding periods			Total
		main winter	transient	summer	
HPU					
HPS-1	GJ	24 518	585	8 422	33 525
HPS-2	GJ	13 455	9 415	6 199	29 070
HPS-3	GJ	106 766	3 928	36 798	147 493
CHP unit					
HPS-1	GJ	8 344	204	3 708	12 256
HPS-2	GJ	4 579	3 969	2 730	11 278
HPS-3	GJ	36 606	1 386	16 271	54 263
PHWB					
HPS-1	GJ	14 511	0	0	14 511
HPS-2	GJ	4 034	0	0	4 034
HPS-3	GJ	62 026	0	0	62 026
Total					
HPS-1	GJ	47 374	789	12 130	60 293
HPS-2	GJ	22 069	13 384	8 929	44 382
HPS-3	GJ	205 398	5 314	53 069	263 781
Total annual heat supply	**GJ**	**274 840**	**19 487**	**74 129**	**368 456**

Annual heat supply from old boiler houses will remain unchanged under the baseline scenario. Heat deficit will be covered owing to putting new coal boiler houses into operation as well as owing to installation of new gas boilers at the boiler house of Radio district. The dynamics of heat supply growth under the baseline scenario is expected to be similar to the dynamics of heat supply growth under the project scenario (Table B.1-3).

Table B.1-2. Annual heat supply under the project scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
HPS-1 and the replaced coal boiler houses									
Existing coal boiler houses	GJ	50 453	30 072	0	0	0	0	0	0
HPS-1	GJ	0	24 355	60 293	60 293	60 293	60 293	60 293	301 464
Total	GJ	50 453	54 428	60 293	60 293	60 293	60 293	60 293	301 464
HPS-2 and the replaced coal boiler houses									
Existing coal boiler houses	GJ	18 779	18 779	11 193	0	0	0	0	11 193
HPS-2	GJ	0	0	17 928	44 382	44 382	44 382	44 382	195 457
Total	GJ	18 779	18 779	29 121	44 382	44 382	44 382	44 382	206 650
HPS-3 and the replaced gas boiler house									
Existing gas boiler house	GJ	69 241	69 241	69 241	41 271	0	0	0	110 513
HPS-3	GJ	0	0	0	106 555	263 781	263 781	263 781	897 898
Total	GJ	69 241	69 241	69 241	147 826	263 781	263 781	263 781	1 008 411
Total annual heat supply	**GJ**	**138 473**	**142 448**	**158 655**	**252 501**	**368 456**	**368 456**	**368 456**	**1 516 525**

Table B.1-3. Annual heat supply under the baseline scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
Coal boiler houses replaced by HPS-1									
Existing coal boiler houses	GJ	50 453	50 453	50 453	50 453	50 453	50 453	50 453	252 264
New coal boiler house	GJ	0	3 975	9 840	9 840	9 840	9 840	9 840	49 200
Total	GJ	50 453	54 428	60 293	60 293	60 293	60 293	60 293	301 464
Coal boiler houses replaced by HPS-2									
Existing coal boiler houses	GJ	18 779	18 779	18 779	18 779	18 779	18 779	18 779	93 893
New coal boiler house	GJ	0	0	10 343	25 604	25 604	25 604	25 604	112 757
Total	GJ	18 779	18 779	29 121	44 382	44 382	44 382	44 382	206 650
Gas boiler house replaced by HPS-3									
Existing gas boiler house	GJ	69 241	69 241	69 241	69 241	69 241	69 241	69 241	346 207
New gas boilers	GJ	0	0	0	78 585	194 540	194 540	194 540	662 203
Total	GJ	69 241	69 241	69 241	147 826	263 781	263 781	263 781	1 008 411
Total annual heat supply	**GJ**	**138 473**	**142 448**	**158 655**	**252 501**	**368 456**	**368 456**	**368 456**	**1 516 525**

Fossil fuel combustion

Two types of fuel - anthracite and natural gas - are combusted at the boiler houses of Novoshakhtinsk. Only natural gas will be combusted in HPSs.

Under the baseline scenario the amount of fossil fuel combusted in the old boiler houses was assumed to be the same as in 2006. Heat deficit will be covered owing to anthracite combustion in new coal boiler houses and natural gas combustion in the new boilers of the boiler house of Radio district.

Under the project scenario old boiler houses exploitation is planned till the replacing heat pump stations are put into operation. Heat will be supplied owing to anthracite combustion at the boiler houses replaced by HPS-1 and HPS-2 and natural gas combustion at the boiler house of Radio district replaced by HPS-3.

Annual amount of fossil fuel combusted at the boiler houses was determined as ratio of annual heat supply and net efficiency factor. For the calculation of both the baseline and project scenarios net efficiency factor for coal boiler houses (new and old) was assumed equal to 0.7; for gas boiler house – 0.9. These values of net efficiency factor are typical for energy sources of this type and meet the conservative requirement.

After heat pump stations are put into operation the old boiler houses and anthracite combustion will be stopped. Heat will be supplied owing to heat pump stations only. Natural gas is combusted in gas-engine CHP unit and PHWB in each HPS. CHP unit will operate during the whole period of HPS work (excluding obligatory stops connected to various examinations and repairs). Natural gas will be combusted in PHWB in the periods of low outside temperatures when total heat capacity of HPU and CHP unit are not enough to provide necessary heat supply. Annual amount of natural gas combusted by HPS equipment was determined as ratio of annual heat supply from this unit and its net efficiency factor. This value was assumed equal to 0.9 for PHWB and 0.45 for CHP unit.

The results of calculations of annual fuel consumption under the project and baseline scenarios are shown in Tables B.1-4 and B.1-5.

Table B.1-4. Annual fuel consumption under the project scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
HPS-1 and the replaced coal boiler houses									
Anthracite combustion in the existing coal boiler houses	ton	3 036	1 810	0	0	0	0	0	0
	GJ	72 076	42 960	0	0	0	0	0	0
Natural gas combustion in HPS-1	thousand m^3	0	518	1 283	1 283	1 283	1 283	1 283	6 415
	GJ	0	17 515	43 360	43 360	43 360	43 360	43 360	216 799
HPS-2 and the replaced coal boiler houses									
Anthracite combustion in the existing coal boiler houses	ton	1 130	1 130	674	0	0	0	0	674
	GJ	26 827	26 827	15 990	0	0	0	0	15 990
Natural gas combustion in HPS-2	thousand m^3	0	0	353	874	874	874	874	3 850
	GJ	0	0	11 935	29 544	29 544	29 544	29 544	130 112
HPS-3 and the replaced gas boiler house									
Natural gas combustion in the existing gas boiler house	thousand m^3	2 276	2 276	2 276	1 357	0	0	0	3 633
	GJ	76 935	76 935	76 935	45 857	0	0	0	122 792
Natural gas combustion in HPS-3	thousand m^3	0	0	0	2 265	5 607	5 607	5 607	19 086
	GJ	0	0	0	76 549	189 501	189 501	189 501	645 052
Fuel combustion, total									
Anthracite	ton	4 166	2 940	674	0	0	0	0	674
	GJ	98 902	69 787	15 990	0	0	0	0	15 990
Natural gas	thousand m^3	2 276	2 795	3 912	5 779	7 764	7 764	7 764	32 984
	GJ	76 935	94 450	132 229	195 311	262 405	262 405	262 405	1 114 755
Total fuel combustion	**GJ**	**175 837**	**164 237**	**148 219**	**195 311**	**262 405**	**262 405**	**262 405**	**1 130 745**

Table B.1-5. Annual fuel consumption under the baseline scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
Coal boiler houses replaced by HPS-1									
Anthracite combustion in the existing coal boiler houses	ton	3 036	3 036	3 036	3 036	3 036	3 036	3 036	15 180
	GJ	72 076	72 076	72 076	72 076	72 076	72 076	72 076	360 378
Anthracite combustion in the new coal boiler house	thousand m^3	0	239	592	592	592	592	592	2 961
	GJ	0	5 678	14 057	14 057	14 057	14 057	14 057	70 285
Coal boiler houses replaced by HPS-2									
Anthracite combustion in the existing coal boiler houses	ton	1 130	1 130	1 130	1 130	1 130	1 130	1 130	5 650
	GJ	26 827	26 827	26 827	26 827	26 827	26 827	26 827	134 133
Anthracite combustion in the new coal boiler house	thousand m^3	0	0	622	1 248	1 541	1 541	1 541	6 492
	GJ	0	0	14 775	36 577	36 577	36 577	36 577	161 082
Gas boiler house replaced by HPS-3									
Natural gas combustion in the existing gas boiler house	thousand m^3	2 276	2 276	2 276	2 276	2 276	2 276	2 276	11 382
	GJ	76 935	76 935	76 935	76 935	76 935	76 935	76 935	384 675
Natural gas combustion in the new gas boilers	thousand m^3	0	0	0	2 584	6 396	6 396	6 396	21 771
	GJ	0	0	0	87 316	216 155	216 155	216 155	735 781
Fuel combustion, total									
Anthracite	ton	4 166	4 405	5 380	6 006	6 299	6 299	6 299	30 283
	GJ	98 902	104 580	127 734	149 536	149 536	149 536	149 536	725 877
Natural gas	thousand m^3	2 276	2 276	2 276	4 860	8 672	8 672	8 672	33 153
	GJ	76 935	76 935	76 935	164 251	293 090	293 090	293 090	1 120 456
Total fuel consumption	**GJ**	**175 837**	**181 515**	**204 669**	**313 787**	**442 626**	**442 626**	**442 626**	**1 846 333**

Electricity consumption and generation

At present electricity is supplied from the town grid connected with outside power plants.

Electricity consumption to cover the following needs of the HPSs - HPU compressor drive and drowned pumps drive as well as other auxiliary needs (as in an ordinary boiler house) - was taken into account at the development of the project scenario. HPU compressor drive is the main electricity consumer. Gas-engine CHP units will generate most of necessary electricity.

The amount of electricity consumption of HPU compressor was determined as ratio of the amount of heat supplied by HPU during this period of the year and average transformation factor of heat pump that was assumed equal to 3.5 based on special analysis. The value of this factor can be considered conservative.

The amount of electricity consumption of drowned pumps was determined taking the following data and assumptions into account. The installed power of drowned pumps will be 52 kW for HPS-1, 52 kW for HPS-2 and 250 kW for HPS-3. With the rated load of HPU the power input of drowned pumps was assumed equal half of their installed power. The power input of drowned pumps decreases proportionally to the decrease of HPU load.

The amount of electricity consumption for other auxiliary needs of HPSs and for own needs of boiler houses was determined as product of the amount of heat supply and specific electricity consumption factor. This value was conservatively assumed equal to 8 kWh/GJ based on [R5] as it is the most typical for the boiler houses with the similar heat capacity.

The distribution of electricity consumption between the equipment groups of each HPS at their planned operation during the year is shown in Table B.1-6.

In summer period of HPS operation the capacity of its own CHP unit will be sufficient to cover all needs of the station. When the heating season begins CHP unit starts generating maximum possible amount of electricity however its capacity will not be sufficient to cover all needs of the station. Electricity will be partially (not more than 25%) supplied from grid during this period of the year.

The project stipulates construction of SHEP with annual electricity generation of 1 884 MWh fed to the town grid that is also taken into account in the electricity balance (Table B.1-7). It is planned to put SHEP into operation at the end of the third quarter of 2008.

The implementation of the baseline scenario envisages the continuation of electricity consumption from grid. Construction of its own electricity generation capacities is not implied in the baseline scenario. Electricity generation will increase proportionally to the increase of annual heat supply from boiler houses (Table B.1-8).

Table B.1-6. Annual electricity consumption over the groups of HPSs equipment

Name	Units	Values in the corresponding periods			Total
		main winter	transient	summer	
HPU compressors					
HPS-1	MWh	1 946	46	668	2 661
HPS-2	MWh	1 068	747	492	2 307
HPS-3	MWh	8 474	312	2 920	11 706
Drowned pumps					
HPS-1	MWh	104	2	36	142
HPS-2	MWh	57	40	26	124
HPS-3	MWh	494	18	170	683
Other auxiliary needs (as in an ordinary boiler house)					
HPS-1	MWh	379	6	97	482
HPS-2	MWh	177	107	71	355
HPS-3	MWh	1 643	43	425	2 110
Total					
HPS-1	MWh	2 429	55	801	3 286
HPS-2	MWh	1 302	894	590	2 786
HPS-3	MWh	10 611	372	3 515	14 499
Total annual electricity consumption	**MWh**	**14 342**	**1 322**	**4 906**	**20 570**

Table B.1-7. Annual electricity balance under the project scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
Annual electricity consumption									
HPS-1 and the replaced coal boiler houses									
Existing coal boiler houses	MWh	404	143	0	0	0	0	0	0
HPS-1	MWh	0	1 327	3 286	3 286	3 286	3 286	3 286	16 428
Total	MWh	404	1 471	3 286	3 286	3 286	3 286	3 286	16 428
HPS-2 and the replaced coal boiler houses									
Existing coal boiler houses	MWh	150	150	53	0	0	0	0	53
HPS-2	MWh	0	0	1 125	2 786	2 786	2 786	2 786	12 268
Total	MWh	150	150	1 179	2 786	2 786	2 786	2 786	12 322
HPS-3 and the replaced gas boiler house									
Existing gas boiler house	MWh	554	554	554	197	0	0	0	751
HPS-3	MWh	0	0	0	5 857	14 499	14 499	14 499	49 353
Total	MWh	554	554	554	6 054	14 499	14 499	14 499	50 104
Total annual electricity consumption	**MWh**	**1 108**	**2 175**	**5 018**	**12 125**	**20 570**	**20 570**	**20 570**	**78 853**
Annual electricity generation									
HPS-1	MWh	0	1 070	2 648	2 648	2 648	2 648	2 648	13 240
HPS-2	MWh	0	0	984	2 437	2 437	2 437	2 437	10 731
HPS-3	MWh	0	0	0	4 736	11 723	11 723	11 723	39 906
Total, HPSs	MWh	0	1 070	3 632	9 820	16 808	16 808	16 808	63 877
SHEP	MWh	0	0	469	1 884	1 884	1 884	1 884	8 005
Total annual electricity generation	**MWh**	**0**	**1 070**	**4 102**	**11 704**	**18 692**	**18 692**	**18 692**	**71 882**

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
Amount of electricity to be supplied to HPSs and the replaced boiler houses from outside									
HPS-1 and the replaced coal boiler houses	MWh	404	401	638	638	638	638	638	3 188
HPS-2 and the replaced coal boiler houses	MWh	150	150	194	349	349	349	349	1 591
HPS-3 and the replaced gas boiler house	MWh	554	554	554	1 318	2 775	2 775	2 775	10 198
Total	MWh	1 108	1 105	1 386	2 305	3 762	3 762	3 762	14 977
Amount of electricity to be purchased from grid (taking work of SHEP into consideration)									
Total electricity purchase	**MWh**	**1 108**	**1 105**	**917**	**421**	**1 878**	**1 878**	**1 878**	**6 971**

Table B.1-8. Annual electricity balance under the baseline scenario

Name	Unit	Reporting years							
		2006	2007	2008	2009	2010	2011	2012	2008-2012
Annual electricity consumption to be purchased from grid									
Coal boiler houses replaced by HPS-1									
Existing coal boiler houses	MWh	404	404	404	404	404	404	404	2 018
New coal boiler house	MWh	0	32	79	79	79	79	79	394
Total	MWh	404	435	482	482	482	482	482	2 412
Coal boiler houses replaced by HPS-2									
Existing coal boiler houses	MWh	150	150	150	150	150	150	150	751
New coal boiler house	MWh	0	0	83	205	205	205	205	902
Total	MWh	150	150	233	355	355	355	355	1 653
Gas boiler house replaced by HPS-3									
Existing gas boiler house	MWh	554	554	554	554	554	554	554	2 770
New gas boilers	MWh	0	0	0	629	1 556	1 556	1 556	5 298
Total	MWh	554	554	554	1 183	2 110	2 110	2 110	8 067
Total annual electricity consumption	**MWh**	**1 108**	**1 140**	**1 269**	**2 020**	**2 948**	**2 948**	**2 948**	**12 132**

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:

(a) Description of the baseline scenario

To improve the quality of heat supply and cover the deficit of heat the baseline scenario envisages implementation of the following basic measures:

- reconstruction of the existing and/or construction of new coal boiler houses in the town districts which are traditionally supplied with heat owing to coal combustion[1];
- installation of additional gas boilers at the boiler house of the Radio district of the town;
- reconstruction of a part of heat networks.

All the coal boiler houses are divided into two groups: boiler houses replaced by HPS-1 and boiler houses replaced by HPS-2 correspondingly. Relatively new boiler house of Radio district replaced by HPS-3 under the project will be extended owing to additional installation of new gas boilers.

As a result of the implementation of the baseline scenario the quality of heat supply will improve and the deficit of heat energy will be eliminated step-by-step. Heat supply will increase from 138 473 GJ in 2006 to 368 456 GJ in 2010 (i.e. 2.66 times) and will further stop growing and remain at the level of 2010. Annual anthracite consumption will increase 1.5 times and make 6.3 thousand tons. Annual natural gas consumption will increase 3.8 times and make 8.7 million cubic meters. Annual electricity consumption will increase from 1 108 MWh to 2 948 MWh. The baseline scenario does not imply construction of its own electricity generation capacities and all the electricity will be supplied from the grid.

(b) Description of the project scenario

During the implementation of the project scenario the quality of heat supply will improve and the deficit of heat will be eliminated step-by-step owing to the following measures:

- construction of three heat pump stations;
- construction of SHEP;
- reconstruction of a part of heat networks;
- closure of fourteen old coal boiler houses.

The dynamics of heat supply growth in the project and baseline scenarios are identical.

The project implementation envisages applying technology of utilization of abandoned coal mine waters as a source of low-potential heat for heat pumps that is absolutely new technology for Russia. Heat pumps will provide more than a half of annual heat supply. Application of cogeneration gas-engine CHP units will allow generating relatively cheap electricity for HPU compressors drives (compared to electricity from grid) together with heat taken from the cooling systems of CHP units that will considerably increase operation efficiency of heat pump stations. Small amount of grid electricity will be consumed mainly for auxiliary equipment and lighting.

During the periods of the year with low outside temperatures network water is additionally heated using gas hot-water boilers placed in the buildings of heat pump stations.

Its own electricity generation at SHEP will result in decrease of purchase of electricity from grid power producers.

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[1] In relation to GHG emission evaluation it is not principal whether old coal boiler houses will be reconstructed or closed due to full replacement by new coal boiler houses.

As a result of project implementation anthracite consumption will reduce by 6.3 thousand tons per year, natural gas consumption - by 908 thousand cubic meters per year and purchase of electricity from grid - by 1 070 MWh per year in the town.

(c) Additionality of emission reductions

To prove additionality of the project against the baseline, analysis of alternatives as well as investment, barriers and common practice analyses have been applied.

Analysis of alternatives to the project activity

The following alternatives identified for the project activity would allow solving the problem of improvement of heat supply quality and eliminating the existing deficit of heat energy in Novoshakhtinsk:

Alternative 1: Development of gas boiler houses together with stop of coal combustion.

Alternative 2: Development of coal boiler houses together with stop of natural gas combustion.

Alternative 3: Balanced development of gas and coal boiler houses.

Alternative 4: Project activity as not JI.

Let us analyze each alternative in detail.

Alternative 1: Development of gas boiler houses together with stop of coal combustion.

This alternative implies construction of new gas boiler houses together with closure of coal boiler houses and stop of anthracite combustion. The existing gas boiler house in Radio district will be extended by the installation of additional gas boilers.

Natural gas combustion will allow improving ecological situation in the town. Besides the technology of gas combustion is simpler compared to the technology of coal combustion. However the prices for natural gas in Russia will probably grow and soon they will considerably exceed the price for anthracite (converted to a unit of heat supply). It should be noted that there is gas deficit and strict limits for gas consumption in this region, which is traditionally considered to be “coal” region. Besides this alternative will require construction of new network of distribution gas pipelines. Thus *Alternative 1 is excluded from further consideration*.

Alternative 2: Development of coal boiler houses together with stop of natural gas combustion.

This alternative implies reconstruction of old and/or construction of new coal boiler houses with stop of natural gas use for heat supply.

Alternative 2 could be rather realistic due to expected increase of prices for natural gas and strict limits for its consumption as well as the fact that coal industry was historically the city-forming sector of the town economy. The disadvantage of this alternative is that many harmful substances such as flue ash, sulphur dioxide (SO_2), carbon monoxide (CO), nitrous oxides (NO_x) and other substances are thrown out at coal combustion. The concentration of such substances exceeds maximum permissible concentration in many town districts. Increase of anthracite combustion even in modern boiler houses can cause deterioration of the ecological situation in the town, which is rather difficult at present. Besides there is no sense closing relatively new gas boiler house of Radio district. Following the conservative approach for the estimation of GHG emissions this alternative would be the least acceptable variant. Thus *Alternative 2 is excluded from further consideration*.

Alternative 3: Balanced development of gas and coal boiler houses.

This alternative implies reconstruction of the existing and/or construction of new coal boiler houses in the town districts, which are traditionally supplied with heat owing to coal combustion (the districts which will be supplied with heat from HPS-1 and HPS-2 under the project). Heat deficit of Radio district (the district which will be supplied with heat from HPS-3 under the project) will be covered owing to extending the existing gas boiler house by installation of additional gas boilers.

This alternative proposes development of the existing practice of anthracite and natural gas combustion and avoids the necessity of construction of new network of distribution gas pipelines. This alternative will not result in excessive increase of natural gas combustion (as Alternative 1) consumption of which is limited. The technology of coal and natural gas combustion is well proven at the boiler houses of the town, maintenance staff has corresponding skills and knowledge and fuel supplies are well organized. It is also worth mentioning that diversification over the types of fuel increases the reliability of heat supply of the town.

The disadvantage of this alternative is that it can cause deterioration of the ecological situation in the town, which is rather difficult at present.

This alternative is rather realistic and is justified to be conservative. Therefore *Alternative 3 can be considered as most likely baseline scenario.*

Alternative 4: Project activity as not JI.

This alternative requires much more investments compared to implementation of any of the above mentioned alternatives. Economic indexes of the project without JI mechanism would probably be unacceptably low. Difficulties and novelty of technologies of mine water heat utilization in Russia should also be taken into account. Thus *the opportunity of the implementation of Alternative 4 is unlikely.*

Investment analysis

According to the preliminary estimation the amount of investments into construction of four planned energy objects in Novoshakhtinsk (in prices on 01.07.2006) is as follows:

- investments in construction of HPS-1 - 52.3 million roubles
- investments in construction of HPS-2 - 34.2 million roubles
- investments in construction of HPS-3 - 253.0 million roubles
- investments in construction of SHEP - 40.5 million roubles.

Total: - *380.0 million roubles (about €11 million)*

The indicated amount is required for the project implementation in 2006÷2009. The project implementation is impossible due to resources of TNS Ltd only as it does not have necessary capital. TNS Ltd already invested 30.0 million roubles from its own funds when construction of the first heat pump station started in 2006.

TNS Ltd expects to obtain funds of state support and lax loans (NPAF[1] credits) in addition to its own funds. The project implementation is impossible without any of the mentioned sources of finance. Detailed examination shows inefficiency of using loans obtained under common commercial practice due to high loan interest rates compared to NPAF credit.

The distribution structure of the total amount of investments over the planned sources of project finance is as follows:

- own funds of TNS Ltd - 42%
- funds of state support - 8%
- loans (NPAF credit) - 50%

[1] National Pollution Abatement Facility

Table B.2-1 represents comparison of economic indexes of the baseline and project scenarios. Discounting rate was assumed equal to 15%. The assumed discounting rate is likely to be rather understated for such a risky project as construction of heat pump stations under Russian conditions. However social and ecologic purpose of the project should be taken into account.

Table. B.2-1. Investments, NPV and IRR

Data name	Unit	Baseline	Project activity as not JI	Project activity as JI
Investments	thousand roubles	129 500	380 000	380 000
NPV	thousand roubles	45 500	-4 300	7 100
IRR	%	35.5	14.5	15.9

From the economic viewpoint the baseline scenario is certainly more profitable. Construction of boiler houses requires much smaller investments than construction of heat pump stations do and project economic indexes of boiler houses construction are higher even without NPAF lax credits and any kind of state support.

Revenues from ERUs sale are inconsiderable making about 5% from the total amount of necessary investments. However the project is more stable against risks owing to these revenues from sales (see results of sensitivity analysis in Table B.2-2).

Table. B.2-2. Sensitivity analysis of economic indexes

Data name	Unit	Project activity not as JI	Project activity as JI
1) Increase of investment costs by 10%			
NPV	thousand roubles	-26 800	-15 400
IRR	%	12.2	13.3
2) Increase of natural gas consumption by 10%			
NPV	thousand roubles	-7 700	2 700
IRR	%	14.1	15.3
3) Increase of electricity consumption by 10%			
NPV	thousand roubles	-7 600	3 700
IRR	%	14.1	15.4
4) Reduction of electricity generation at SHEP by 10%			
NPV	thousand roubles	-5 000	6 400
IRR	%	14.4	15.8

It is important to note that the project is socially directed first of all and is not aimed at receiving big commercial profit. The project is also directed at reduction of anthropogenic environmental impact. The project cannot be realized under common commercial practice without funds of state support, ERUs sale and lax loans from international and Russian financial organizations that provide funds for the implementation of environmental projects. Predicted GHG emission reduction is one of the most important criteria, which such organizations use to estimate a project. Together with other information predicted GHG emission reduction is indicated in the project documentation submitted for review.

Barrier analysis

Implementation of the project in Novoshakhtinsk faces the following substantial barriers.

Technological barriers

The mode of functioning and technologies applied at heat pump station are much more complicated compared to an ordinary boiler house. This project is a kind of challenge for TNS Ltd. This is the reason why the project is implemented in several stages. The first stage implies construction of HPS-1 with further analysis of operation data and possible changes into the working drafts of HPS-2 and HPS-3.

Operational barriers

Limited natural gas supply in this region is an essential barrier. Combined use of heat pumps and gas-engine CHP units allows solving the problem of increase of heat supply without exceeding the limits of natural gas consumption set in the baseline scenario. It will be accompanied by stop of anthracite combustion.

Finance barriers

The project implementation is connected with risk of finance shortage. The project cannot be implemented owing to the resources of TNS Ltd only. Use of loans from commercial banks is inefficient and ruinous for the project due to big interest rates. The project cannot be realized under common commercial practice without funds of state support, ERUs sale and lax loans from international and Russian financial organizations.

Commercial barriers

The price for natural gas will grow in Russia and will exceed the price for anthracite soon (converted to a unit of heat supply).

At present the price of natural gas at the domestic market of the Russian Federation is much lower compared to world prices (about 40$ against 220$ for 1000 m^3) and is comparable to coal price. However it should be considered that the existing price for natural gas in Russia is artificially understated. According to prognoses in the nearest future (literally during the crediting period of the project) the pricing scheme for natural gas will become more liberal and the domestic price is likely to be 100$ for 1000 m^3 while the price for natural gas is likely to reach the world price taking into account the perspective of the Russian Federation entering into WTO.

Most of Russian enterprises working in the sphere of housing and communal services face the unwillingness of different sections of population to pay for consumed heat.

Common practice analysis

Common practice of heat supply in Russian towns includes:

1. Centralized heat supply of consumers from large CHP plants.
2. Centralized heat supply of consumers from district boiler houses.
3. Heat supply from small boiler houses located inside or nearby the heated buildings.

Use of boiler houses is common practice for the heat supply system of Novoshakhtinsk. Most town boiler houses work on coal as coal industry were historically the city-forming economic sector. The share of this industry was 90.8 % of the total amount of industrial production and 78.8 % of all the industrial workers in Novoshakhtinsk in 1995.

The share of all non-traditional renewables is only 1.5% in the energy balance of Russia.

Russia has a very small experience of application of heat pump stations. Technology of abandoned coal mine waters use as low-potential heat source for HPU working together with gas-engine CHP unit and SHEP has not been ever applied in Russia.

Heat pump stations have not been widely used for heating needs and hot water supply in the energetics of Russia due to more complicated technology which underlies HPU operation as well as to considerable investments compared to construction of an ordinary boiler house. Besides cost of fossil fuel has been low in Russia for a long time and there was no sense introducing expensive technologies with a long payback period.

However some projects based on utilization of renewables have appeared lately due to growing price of fossil fuel. They include projects on construction of heat pump stations. There are only several such projects in Russia which mostly imply utilization of low-potential heat of waste waters[1] and geothermal sources[2]. However heat pump stations based on use of abandoned coal mine waters are applied for the first time. Specific capital costs per a unit of renewables capacity are still essentially higher than specific capital investments into traditional energetics.

To conclude the additionality analysis it is important to note that TNS Ltd started construction works under the project after the agreement on rendering of services on attraction of carbon finance for project implementation was signed between TNS Ltd and MCF Finance and Consulting Co. Ltd on February 27, 2006.

Referencing to the above the reductions obtained as a result of the project are additional to any that would otherwise occur.

[1] http://www.advis.ru/cgi-bin/new.pl?FFD8CB79-B8F5-514F-9B27-EA0664C6A677

[2] http://omsk.rfn.ru/archive/rnews.html?id=2411&date=30-06-2006

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

Fig. B.3-1 and B.3-2 present the principal components and boundaries of the baseline and project scenarios, flows of fuel and electricity.

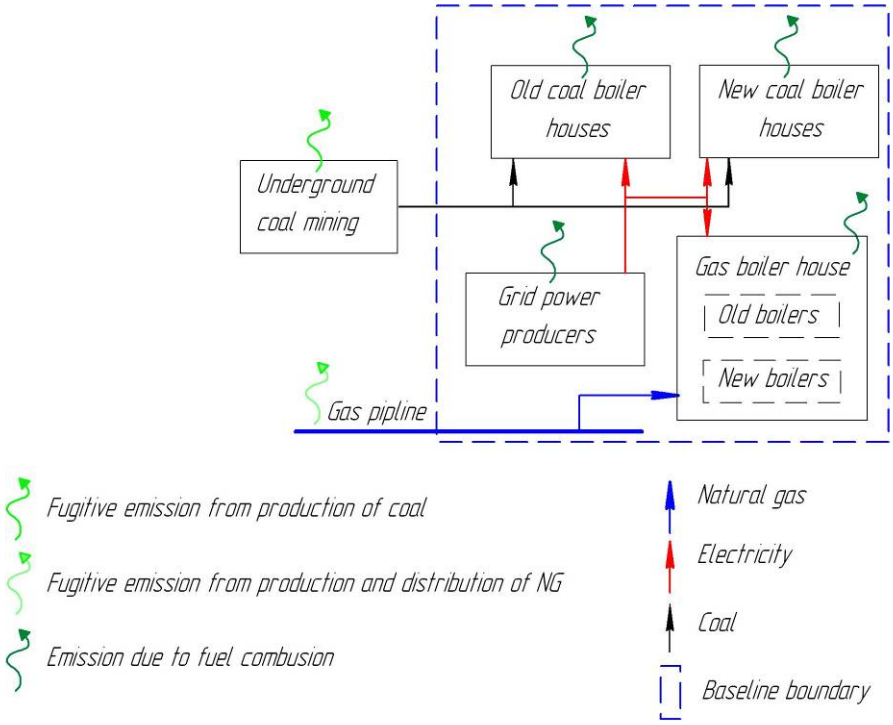

Fig. B.3-1. Principal components and boundaries of the baseline

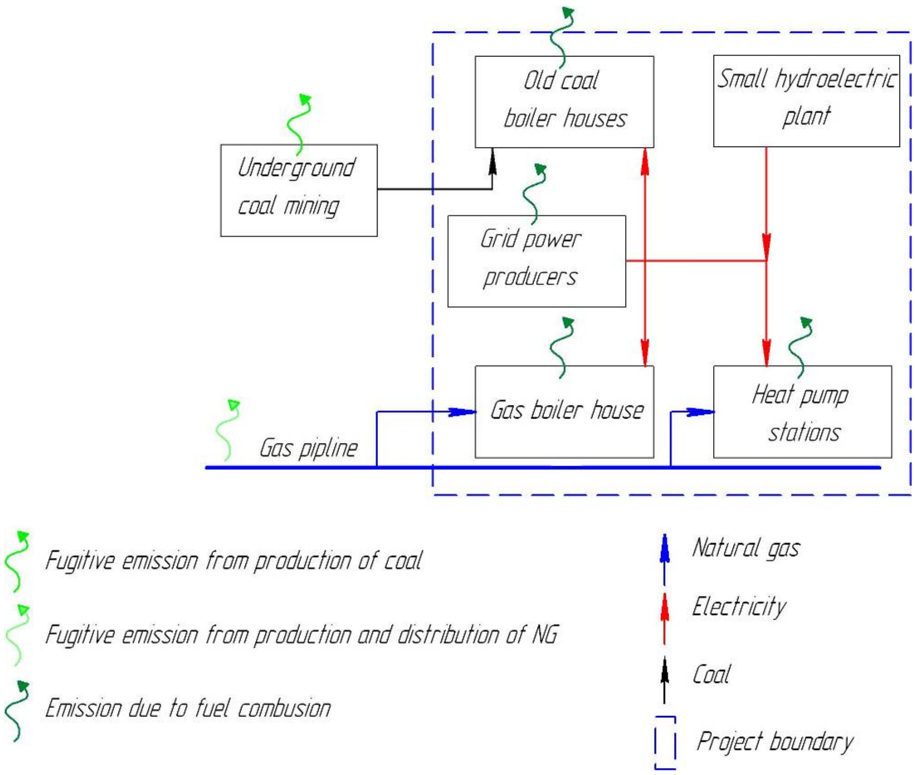

Fig. B.3-2. Principal components and boundaries of the project

Table B.3-1 illustrates which emission sources are included in or excluded from the project and baseline boundaries.

Table B.3-1. Sources of emissions included in consideration or excluded from it

	Source	Gas	Incl./Excl.	Justification / Explanation
Baseline	**Old coal boiler houses, anthracite combustion**	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**
	New coal boiler houses, anthracite combustion	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**
	Gas boiler house, natural gas combustion	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**
	Grid power producers, combustion of fossil fuel	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**
Project Activity	**Heat pump stations, natural gas combustion**	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible**
		N_2O	**Excl.**	**Considered negligible**
	Old coal boiler houses, anthracite combustion	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible**
		N_2O	**Excl.**	**Considered negligible**
	Gas boiler house, natural gas combustion	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible**
		N_2O	**Excl.**	**Considered negligible**
	Grid power producers, combustion of fossil fuel	CO_2	Incl.	Main source of emissions
		CH_4	**Excl.**	**Considered negligible**
		N_2O	**Excl.**	**Considered negligible**
Leakage	**Reduction of coal mining, processing, storage and transporting**	**CO_2**	**Excl.**	**Considered negligible. Conservative**
		CH_4	**Excl.***	**Not taken into account, as the project owner cannot monitor them. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**
	Reduction of natural gas extraction, processing, transportation and distribution	**CO_2**	**Excl.**	**Considered to be an inconsiderable source of emissions. Conservative**
		CH_4	**Excl.***	**Not taken into account, as the project owner cannot monitor them. Conservative**
		N_2O	**Excl.**	**Considered negligible. Conservative**

* Leakages decreasing as a result of project implementation are most significant among the excluded emissions. Numerical evaluations for these leakages are performed below to confirm their significance.

Reduction of methane emissions at underground coal mining

Coal supplied to Novoshakhtinsk is mined at Donetsk coal field by method of underground mining.

According to IPCC [R1] methane fugitive emissions at coal mining are calculated according to the following formula:

CH_4 emissions = CH_4 Emissions Factor×Underground Coal Production×Conversion Factor (B.3-1)

where CH_4 Emissions Factor = 18 m^3/t;

Underground Coal Production equal to 6 299 t/year;

Conversion Factor convert volume of CH_4 to mass of $CH_4 = 0.67\times10^{-6}$ Gg/m^3.

Thus methane emission reduction will make 76 t CH_4 or 1 595 t CO_2-eq./year.

Greenhouse gas emission reduction at coal mining is about 10% of the total reduction as a result of project implementation. However following the conservative approach and due to impossibility to monitor them these leakages are not taken into account.

Decrease of methane emissions at gas extraction, processing, transportation and distribution

According to IPCC [R1] specific methane fugitive emissions for developing countries and countries with transient economy have the following spread of values (Table B.3-2):

Table B.3-2. Fugitive CH_4 emissions from Natural Gas System

Category	Sub-category	CH4			Unit of measure
		Minimum value	Maximum value	Average value	
Gas recovery	Fugitives	0.00038	0.024	0.01219	$Gg/10^6$ m^3
	Flaring	0.00000076	0.000001	0.00000088	$Gg/10^6$ m^3
Gas transfer	Fugitives	0.000166	0.0011	0.000633	$Gg/10^6$ m^3
	Venting	0.000044	0.00074	0.000392	$Gg/10^6$ m^3
Gas distribution	All	0.0011	0.0025	0.0018	$Gg/10^6$ m^3
Total	-			**0.0150**	**$Gg/10^6$ m^3**

We assume the average level of total methane fugitive emissions equal to 0.015 $Gg/10^6$ m^3. Annual reduction of natural gas consumption resulting from project implementation will make 908 thousand m^3. Methane fugitive emission reduction will make 13.62 t CH_4, or 286 t CO_2-eq./year.

Greenhouse gas emission reduction due to decrease of natural gas consumption is about 1.7% of the total reduction as a result of project implementation. This value is inconsiderable and cannot be monitored thus it is not considered.

All the aforesaid are a sufficient ground for neglecting leakages both at the prognosis and monitoring stage.

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 BL setting – 20 May 2007

BL was developed by Camco International (Arkhangelsk, Russia)

Contact person: Ilya Goryashin

E-mail: ilya.goryashin@camco-international.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

July 2006 (start of construction of HPS-1)

C.2. Expected operational lifetime of the project:

20 years/240 months

C.3. Length of the crediting period:

5 years/60 months (from 1st January 2008 to 31st December 2012)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

On the whole, CO_2 emissions monitoring will be based on the data registered in any case.

Project monitoring will include monitoring of the following objects:

- HPS-1, 2, 3;
- SHEP;
- the existing boiler houses to be replaced by HPSs.

Heat supply, natural gas and grid electricity consumption will be monitored at each HPS. Electricity delivered to outside grid will be monitored at SHEP. Modern regularly calibrated devices will be used to collect data on HPSs and SHEP operation.

The boiler houses to be replaced by HPSs will also be monitored since they will be closed by stages as a new HPS is put into operation. Fuel consumption as well as of electricity consumption for auxiliary needs will be monitored at boiler houses in accordance with the existing practice.

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
1. $FC^{m}_{coal,1,y}$	Mass of coal combusted at the boiler house of the children's infectious diseases hospital	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
2. $FC^{m}_{coal,2,y}$	Mass of coal combusted at the boiler house of the children's town hospital	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier

3. $FC^{m}_{coal,3,y}$	Mass of coal combusted at the boiler house of the surgery department of the hospital	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
4. $FC^{m}_{coal,4,y}$	Mass of coal combusted at the boiler house of MMRU	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
5. $FC^{m}_{coal,5,y}$	Mass of coal combusted at the boiler house of geological survey	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
6. $FC^{m}_{coal,6,y}$	Mass of coal combusted at the boiler house of Vodokanal	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
7. $FC^{m}_{coal,7,y}$	Mass of coal combusted at the boiler house of vocational school #58	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
8. $FC^{m}_{coal,8,y}$	Mass of coal combusted at the boiler house of school #27	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
9. $FC^{m}_{coal,9,y}$	Mass of coal combusted at the boiler house of kindergarten #34 “Mishutka”	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier

10. $FC^{m}_{coal,10,y}$	Mass of coal combusted at the boiler house of the House of Culture of the Mine named after Lenin	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
11. $FC^{m}_{coal,11,y}$	Mass of coal combusted at the boiler house of school #1	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
12. $FC^{m}_{coal,12,y}$	Mass of coal combusted at the boiler house of kindergarten #28 "Chaika"	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
13. $FC^{m}_{coal,13,y}$	Mass of coal combusted at the boiler house #1 of mining energy college	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
14. $FC^{m}_{coal,14,y}$	Mass of coal combusted at the boiler house #2 of mining energy college	Annual fuel consumption report of the owner of the boiler house	t	m	For each incoming batch of fuel	100 %	Electronic and paper	Cross-check with the invoices of coal supplier
15. $FC^{v}_{NG,15,y}$	Volume of natural gas combusted at the boiler house of Radio district	Annual fuel consumption report of the owner of the boiler house	thousand m^3	m	Continuously	100 %	Electronic and paper	Gas meter readings
16. $FC^{v}_{NG,HPS-1,y}$	Volume of natural gas combusted at HPS-1	Data submitted by TNS Ltd.	thousand m^3	m	Continuously	100 %	Electronic and paper	Gas meter readings

17. $FC^{v}_{NG,HPS-2,y}$	Volume of natural gas combusted at HPS-2	Data submitted by TNS Ltd.	thousand m³	m	Continuously	100 %	Electronic and paper	Gas meter readings
18. $FC^{v}_{NG,HPS-3,y}$	Volume of natural gas combusted at HPS-3	Data submitted by TNS Ltd.	thousand m³	m	Continuously	100 %	Electronic and paper	Gas meter readings
19. $EC_{grid,1,y}$	Electricity consumed by the boiler house of the children's infectious diseases hospital	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
20. $EC_{grid,2,y}$	Electricity consumed by the boiler house of the children's town hospital	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
21. $EC_{grid,3,y}$	Electricity consumed by the boiler house of the surgery department of the hospital	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
22. $EC_{grid,4,y}$	Electricity consumption by the boiler house of MMRU	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
23. $EC_{grid,5,y}$	Electricity consumed by the boiler house of geological survey	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings

24. $EC_{grid,6,y}$	Electricity consumed by the boiler house of Vodokanal	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
25. $EC_{grid,7,y}$	Electricity consumed by the boiler house of vocational school #58	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
26. $EC_{grid,8,y}$	Electricity consumed by the boiler house of school #27	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
27. $EC_{grid,9,y}$	Electricity consumed by the boiler house of kindergarten #34 “Mishutka”	Annual energy consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
28. $EC_{grid,10,y}$	Electricity consumed by the boiler house of the House of Culture of the Mine named after Lenin	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
29. $EC_{grid,11,y}$	Electricity consumed by the boiler house of school #1	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
30. $EC_{grid,12,,y}$	Electricity consumed by the boiler house of kindergarten #28 “Chaika”	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings

31. $EC_{grid,13y}$	Electricity consumed by the boiler house #1 of mining energy college	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
32. $EC_{grid,14,y}$	Electricity consumed by the boiler house #2 of mining energy college	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
33. $EC_{grid,15,y}$	Electricity consumed by the boiler house of Radio district	Annual electricity consumption report of the owner of the boiler house	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
34. $EC_{grid,HPS-1,y}$	Electricity consumption from grid at HPS-1	Data submitted by TNS Ltd.	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
35. $EC_{grid,HPS-2,y}$	Electricity consumption from grid at HPS-2	Data submitted by TNS Ltd.	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
36. $EC_{grid,HPS-3,y}$	Electricity consumption from grid at HPS-3	Data submitted by TNS Ltd.	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
37. $EC_{SHEP,y}$	Electricity generated at SHEP	Data submitted by TNS Ltd.	MWh	m	Continuously	100 %	Electronic and paper	Power meter readings
38. $NCV_{coal,y}$	Net calorific value of anthracite	Data of the supplier	GJ/t	e	For each incoming batch of fuel	100 %	Electronic and paper	The average value is determined at the end of the year for all boiler houses in the whole

39. $NCV_{NG,y}$	Net calorific value of natural gas	Data of the supplier	GJ/ thousand m^3	e	Quarterly	100 %	Electronic and paper	The average value is determined at the end of the year

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

Total GHG emissions under the project over a year *y*, t CO_2:

$$PE_y = PE_{coal,y} + PE_{NG,y} + PE_{grid,y}, \quad (D.1\text{-}1)$$

where $PE_{coal,y}$ is CO_2 emissions from coal combusted under the project over a year *y*, t CO_2;

$$PE_{coal,y} = FC^m_{coal,PJ,y} \times NCV_{coal,y} \times EF_{CO2,coal} \times 10^{-3}, \quad (D.1\text{-}2)$$

where $FC^m_{coal,PJ,y}$ is mass of coal combusted at the old boiler houses under the project over a year *y*, t;

$$FC^m_{coal,PJ,y} = FC^m_{coal,1,y} + FC^m_{coal,2,y} + FC^m_{coal,3,y} + FC^m_{coal,4,y} + FC^m_{coal,5,y} + FC^m_{coal,6,y} + FC^m_{coal,7,y} + FC^m_{coal,8,y} + FC^m_{coal,9,y} + + FC^m_{coal,10,y} + FC^m_{coal,11,y} + FC^m_{coal,12,y} + FC^m_{coal,13,y} + FC^m_{coal,14,y}, \quad (D.1\text{-}3)$$

where $FC^m_{coal,1,y}$ is mass of coal combusted at the boiler house of the children's infectious diseases hospital over a year *y*, t;

$FC^m_{coal,2,y}$ is mass of coal combusted at the boiler house of the children's town hospital over a year *y*, t;

$FC^m_{coal,3,y}$ is mass of coal combusted at the boiler house of the surgery department of the hospital over a year *y*, t;

$FC^m_{coal,4,y}$ is mass of coal combusted at the boiler house of the MMRU over a year *y*, t;

$FC^m_{coal,5,y}$ is mass of coal combusted at the boiler house of geological survey over a year *y*, t;

$FC^m_{coal,6,y}$ is mass of coal combusted at the boiler house of Vodokanal of the hospital over a year *y*, t;

$FC^{m}_{coal,7,y}$ is mass of coal combusted at the boiler house of vocational school #58 over a year *y*, t;

$FC^{m}_{coal,8,y}$ is mass of coal combusted at the boiler house of school #27 over a year *y*, t;

$FC^{m}_{coal,9,y}$ is mass of coal combusted at the boiler house of kindergarten #34 "Mishutka" over a year *y*, t;

$FC^{m}_{coal,10,y}$ is mass of coal combusted at the boiler house of the House of Culture of the Mine named after Lenin over a year *y*, t;

$FC^{m}_{coal,11,y}$ is mass of coal combusted at the boiler house of school #1 over a year *y*, t;

$FC^{m}_{coal,12,y}$ is mass of coal combusted at the boiler house of kindergarten #28 "Chaika" over a year *y*, t;

$FC^{m}_{coal,13,y}$ is mass of coal combusted at the boiler house #1 of mining energy college over a year *y*, t;

$FC^{m}_{coal,14,y}$ is mass of coal combusted at the boiler house #2 of mining energy college over a year *y*, t.

$EF_{CO2,coal}$ is average emission factor of CO_2 from combusting anthracite over a year *y*, kg CO_2/GJ. According to IPCC [R1] this factor for anthracite with oxidized carbon fraction 0.98 is taken as constant and equal to $EF_{CO2,coal}$ = 96.3 kg CO_2/GJ for the whole project period;

$NCV_{coal,y}$ is low calorific value for anthracite, GJ/t.

$PE_{NG,y}$ is CO_2 emissions from natural gas combusted under the project over a year *y*, t of CO_2;

$$PE_{NG,y} = FC^{v}_{NG,PJ,y} \times NCV_{NG,y} \times EF_{CO2,NG} \times 10^{-3}, \qquad (D.1\text{-}4)$$

where $FC^{v}_{NG,PJ,y}$ is volume of natural gas combusted under the project over a year *y*, thousand m^3;

$$FC^{v}_{NG,PJ,y} = FC^{v}_{NG,HPS-1,y} + FC^{v}_{NG,HPS-2,y} + FC^{v}_{NG,HPS-3,y} + FC^{v}_{NG,15,y}, \qquad (D.1\text{-}5)$$

where $FC^{v}_{NG,HPS-1,y}$ is volume of natural gas combusted at HPS-1 over a year *y*, thousand m^3;

$FC^{v}_{NG,HPS-2,y}$ is volume of natural gas combusted at HPS-2 over a year *y*, thousand m^3;

$FC^{v}_{NG,HPS-3,y}$ is volume of natural gas combusted at HPS-3 over a year *y*, thousand m^3;

$FC^{v}_{NG,15,y}$ is volume of natural gas combusted at the boiler house of Radio district over a year *y*, thousand m^3.

$NCV_{NG,y}$ is low calorific value for natural gas, GJ/thousand m^3;

$EF_{CO2,NG}$ is average emission factor of CO_2 from combusting natural gas over a year *y*, kg CO_2/GJ. According to IPCC [R1] this factor for natural gas with oxidized carbon fraction 0.995 is taken as constant and equal to $EF_{CO2,NG}$ =55.8 kg CO_2/GJ for the whole project period.

$PE_{grid,y}$ is CO_2 emissions from combusting fossil fuel at grid power producers under the project over a year *y*, t of CO_2;

$$PE_{grid,y} = \left(EC_{grid,PJ,y} - EC_{SHEP,y}\right) \times EF_{CO2,grid,y} \times 10^{-3}, \qquad \text{(D.1-6)}$$

where $EC_{grid,PJ,y}$ is amount of electricity consumption from grid under the project over a year *y*, MWh;

$$EC_{grid,PJ,y} = EC_{grid,1,y} + EC_{grid,2,y} + EC_{grid,3,y} + EC_{grid,4,y} + EC_{grid,5,y} + EC_{grid,6,y} + EC_{grid,7,y} + EC_{grid,8,y} + EC_{grid,9,y} + \\ + EC_{grid,10,y} + EC_{grid,11,y} + EC_{grid,12,y} + EC_{grid,13,y} + EC_{grid,14,y} + EC_{grid,15,y} + EC_{grid,HPS-1,y} + EC_{grid,HPS-2,y} + EC_{grid,HPS-3,y}, \qquad \text{(D.1-7)}$$

where $EC_{grid,1,y}$ is amount of electricity consumed by the boiler house of the children's infectious diseases hospital over a year *y*, MWh;

$EC_{grid,2,y}$ is amount of electricity consumed by the boiler house of the children's town hospital over a year *y*, MWh;

$EC_{grid,3,y}$ is amount of electricity consumed by the boiler house of the surgery department of the hospital over a year *y*, MWh;

$EC_{grid,4,y}$ is amount of electricity consumed by the boiler house of the MMRU over a year *y*, MWh;

$EC_{grid,5,y}$ is amount of electricity consumed by the boiler house of geological survey over a year *y*, MWh;

$EC_{grid,6,y}$ is amount of electricity consumed by the boiler house of Vodokanal over a year *y*, MWh;

$EC_{grid,7,y}$ is amount of electricity consumed by the boiler house of vocational school #58 over a year y, MWh;

$EC_{grid,8,y}$ is amount of electricity consumed by the boiler house of school #27 over a year y, MWh;

$EC_{grid,9,y}$ is amount of electricity consumed by the boiler house of kindergarten #34 “Mishutka” over a year y, MWh;

$EC_{grid,10,y}$ is amount of electricity consumed by the boiler house of the House of Culture of the Mine named after Lenin over a year y, MWh;

$EC_{grid,11,y}$ is amount of electricity consumed by the boiler house of school #1 over a year y, MWh;

$EC_{grid,12,y}$ is amount of electricity consumed by the boiler house of kindergarten #28 “Chaika” over a year y, MWh;

$EC_{grid,13,y}$ is amount of electricity consumed by the boiler house #1 of mining energy college over a year y, MWh;

$EC_{grid,14,y}$ is amount of electricity consumed by the boiler house #2 of mining energy college over a year y, MWh;

$EC_{grid,15,y}$ is amount of electricity consumed by the boiler house of Radio district over a year y, MWh;

$EC_{grid,HPS-1,y}$ is amount of electricity consumption from grid at HPS-1 over a year y, MWh;

$EC_{grid,HPS-2,y}$ is amount of electricity consumption from grid at HPS-2 over a year y, MWh;

$EC_{grid,HPS-3,y}$ is amount of electricity consumption from grid at HPS-3 over a year y, MWh.

$EC_{SHEP,y}$ is amount of electricity generated at SHEP over a year y, MWh;

$EF_{CO2,grid,y}$ is emission factor of CO_2 for electricity generated by grid power producers over a year y, kg CO_2/MWh. According to the “Operational Guidelines for Project Design Documents of Joint Implementation Projects” [R3] this factor for grid electricity in Russia depending on the year under consideration has been taken equal to: $EF_{CO2,grid,2008}$ = 565 kg CO_2/MWh, $EF_{CO2,grid,2009}$ = 557 kg CO_2/MWh, $EF_{CO2,grid,2010}$ = 550 kg CO_2/MWh, $EF_{CO2,grid,2011}$ = 542 kg CO_2/MWh, $EF_{CO2,grid,2012}$ = 534 kg CO_2/MWh.

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
40. $HS_{HPS-1,y}$	Heat supply from HPS-1	Data submitted by TNS Ltd.	GJ	m	Continuously	100 %	Electronic and paper	Heat meter readings
41. $HS_{HPS-2,y}$	Heat supply from HPS -2	Data submitted by TNS Ltd.	GJ	m	Continuously	100 %	Electronic and paper	Heat meter readings
42. $HS_{HPS-3,y}$	Heat supply from HPS -3	Data submitted by TNS Ltd.	GJ	m	Continuously	100 %	Electronic and paper	Heat meter readings

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

Total GHG emissions under the baseline over a year *y*, t CO_2:

$$BE_y = BE_{coal,y} + BE_{NG,y} + BE_{grid,y}, \quad (D.1\text{-}8)$$

where $BE_{coal,y}$ is CO_2 emission from coal combusting under baseline over a year *y*, t CO_2;

$$BE_{coal,y} = FC_{coal,BL,y} \times EF_{CO2,coal} \times 10^{-3}, \quad (D.1\text{-}9)$$

where $FC_{coal,BL,y}$ is amount of coal combusted at the boiler houses under baseline over a year *y*, GJ;

$$FC_{coal,BL,y} = FC^{m}_{coal,PJ,y} \times NCV_{coal,y} + (HS_{HPS-1,y} + HS_{HPS-2,y}) / \eta_{coal}, \quad (D.1\text{-}10)$$

where $HS_{HPS-1,y}$ is heat supply from HPS-1 over a year *y*, GJ;

$HS_{HPS-2,y}$ is heat supply from HPS-2 over a year *y*, GJ;

η_{coal} is net efficiency factor of coal boiler house. According to Section B.1 it is assumed equal to: $\eta_{coal} = 0.7$.

$BE_{NG,y}$ is CO_2 emission from natural gas combusting under baseline over a year *y*, t CO_2;

$$BE_{NG,y} = FC_{NG,BL,y} \times EF_{CO2,NG} \times 10^{-3}, \quad \text{(D.1-11)}$$

where $FC_{NG,BL,y}$ is amount of natural gas combusted at the boiler house under baseline over a year *y*, GJ;

$$FC_{NG,BL,y} = FC^{v}_{NG,15,y} \times NCV_{NG,y} + HS_{HPS-3,y} / \eta_{NG}, \quad \text{(D.1-12)}$$

where $HS_{HPS-3,y}$ is heat supply from HPS-3 over a year *y*, GJ;

η_{NG} is net efficiency factor of natural gas boiler house. According to Section B.1 it is assumed equal to: $\eta_{NG} = 0.9$.

$BE_{grid,y}$ is CO_2 emission from fossil fuel combusting at grid power producers under baseline over a year *y*, t CO_2;

$$BE_{grid,y} = EC_{grid,BL,y} \times EF_{CO2,grid,y} \times 10^{-3}, \quad \text{(D.1-13)}$$

where $EC_{grid,BL,y}$ is amount of electricity from grid under baseline over a year *y*, MWh;

$$EC_{grid,BL,y} = EC_{grid,PJ,y} - EC_{grid,TNS-1,y} - EC_{grid,TNS-2,y} - EC_{grid,TNS-3,y} + (HS_{TNS-1,y} + HS_{TNS-2,y} + HS_{TNS-3,y}) \times SEC_{HS} \times 10^{-3}, \quad \text{(D.1-14)}$$

where SEC_{HS} is specific electricity consumption factor for heat supply, kWh/GJ. According to Section B.1 it is assumed equal to: SEC_{HS} = 8 kWh/GJ.

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 applied to the monitoring of the project

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):

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

As shown in Section B.3 all leakages can be neglected.

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

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

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 formula to calculate emission reductions over a year *y* is, t CO_2:

$$ER_y = BE_y - PE_y \quad \text{(D.1-15)}$$

or

$$ER_y = ER_{coal,y} + ER_{NG,y} + ER_{grid,y}, \quad \text{(D.1-16)}$$

where $ER_{coal,y}$ is emission reductions from coal combustion, t CO_2;

$$ER_{coal,y} = BE_{coal,y} - PE_{coal,y}; \quad \text{(D.1-17)}$$

$ER_{NG,y}$ is emission reductions from natural gas combustion, t CO_2;

$$ER_{NG,y} = BE_{NG,y} - PE_{NG,y}; \quad \text{(D.1-18)}$$

$ER_{grid,y}$ is emission reductions from fossil fuel combustion at grid power producers, t CO_2;

$$ER_{grid,y} = BE_{grid,y} - PE_{grid,y}. \quad (D.1\text{-}19)$$

No new measurements or data are needed than those indicated in D1.1.1 and D 1.1.3.

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:

Data on environmental impact will be collected and archived in accordance with the Russian legislation.

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.
Tabl. D.1.1.1 ID 1…14	Low	Coal is weighed by coal supplier at coal shipment.
Tabl. D.1.1.1 ID 15…18	Low	Gas meter are regularly calibrated.
Tabl. D.1.1.1 ID 19…37	Low	Power meters are regularly calibrated.
Tabl. D.1.1.1 ID 38…39	Low	Certificates of fuel suppliers.
Tabl. D.1.1.1 ID 40…42	Low	Heat meters are regularly calibrated and cross-checked with balance data.

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

Annual data will be submitted by a representative of TND Ltd and by the owners of the boiler houses.

Calculations of emission reduction will be prepared by specialists of Camco International at the end of every reporting year.

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

Monitoring plan was developed by Camco International

Contact person: Ilya Goryashin

E-mail: ilya.goryashin@camco-international.com

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The GHG project emissions (Table E.1-1) include the emissions of:

- CO_2 from anthracite combustion at the old coal boiler houses (till their closing);
- CO_2 from natural gas combustion at HPSs and the existing gas boiler house;
- CO_2 from fossil fuel combustion at grid power producers generating electricity for operation of HPSs and boiler houses.

CH_4 and N_2O emissions from fuel combustion are considered negligibly low.

According to IPCC [R1] for the whole period of project operation CO_2 emission factors from fossil fuel combustion taking oxidized carbon fraction into account are assumed equal constant values: from natural gas combustion $EF_{CO2,NG} = 55.8$ kg CO_2/GJ, from anthracite combustion $EF_{CO2,coal} = 96.3$ kg CO_2/GJ.

CO_2 emission factors for grid electricity in Russia are assumed according to "Operational Guidelines for Project Design Documents of Joint Implementation Projects" [R3] depending on the year under consideration: $EF_{CO2,grid,2008}$ = 565 kg CO_2/MWh, $EF_{CO2,grid,2009}$ = 557 kg CO_2/MWh, $EF_{CO2,grid,2010}$ = 550 kg CO_2/MWh, $EF_{CO2,grid,2011}$ = 542 kg CO_2/MWh, $EF_{CO2,grid,2012}$ = 534 kg CO_2/MWh.

Data on fuel and electricity consumption for the specified sources for the period till 2012 are presented in Section B.1.

Table E.1-1. Project GHG emissions, t CO_2-eq

Value name	Reporting years					
	2008	2009	2010	2011	2012	2008-2012
CO_2 from anthracite combustion	1 540	0	0	0	0	1 540
CO_2 from natural gas combustion	7 378	10 898	14 642	14 642	14 642	62 203
CO_2 from grid electricity	518	234	1 033	1 018	1 003	3 806
Total project CO_2 emissions	**9 436**	**11 133**	**15 675**	**15 660**	**15 645**	**67 549**

E.2. Estimated leakage:

As indicated in Section B.3 the leakages under the project may be neglected and, therefore, were taken equal zero.

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

Since leakages can be neglected: E.1 + E.2 = E.1.

E.4. Estimated baseline emissions:

The GHG baseline emissions (Table E.4-1) include the emissions of:

- CO_2 from anthracite combustion at the old and new coal boiler houses;
- CO_2 from natural gas combustion at the extended boiler house of Radio district;
- CO_2 from fossil fuel combustion at grid power producers generating electricity for operation of boiler houses.

CH_4 and N_2O emissions at fuel combustion are considered negligibly low.

CO_2 emissions have been estimated using the same emission factors as under the project.

Data of fuel and electricity consumption for the specified sources for the period till 2012 are presented in Section B.1.

Table E.4-1. Baseline GHG emissions, t CO_2-eq

Value name	Reporting years					
	2008	2009	2010	2011	2012	2008-2012
CO_2 from anthracite combustion	12 301	14 400	14 400	14 400	14 400	69 902
CO_2 from natural gas combustion	4 293	9 165	16 354	16 354	16 354	62 521
CO_2 from grid electricity	717	1 125	1 621	1 598	1 574	6 635
Total project CO_2 emissions	**17 311**	**24 691**	**32 376**	**32 352**	**32 329**	**139 059**

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

Reduction of GHG emissions is presented in Table E.5-1.

Table E.5-1. Reduction of GHG emissions, t CO_2-eq

Value name	Reporting years					
	2008	2009	2010	2011	2012	2008-2012
CO_2 from anthracite combustion	10 761	14 400	14 400	14 400	14 400	68 362
CO_2 from natural gas combustion	-3 085	-1 733	1 712	1 712	1 712	318
CO_2 from grid electricity	199	891	588	580	571	2 829
Total project CO_2 emissions	**7 875**	**13 558**	**16 701**	**16 692**	**16 684**	**71 509**

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	9 436	0	17 311	7 875
2009	11 133	0	24 691	13 558
2010	15 675	0	32 376	16 701
2011	15 660	0	32 352	16 692
2012	15 645	0	32 329	16 684
Total (tonnes of CO_2 equivalent)	**67 549**	**0**	**139 059**	**71 509**

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 project implementation will allow putting fourteen inefficient and ecologically dirty coal hot-water boiler houses out of operation. The application of heat pumps together with CHP units will result in reduction of natural gas consumption for a unit of heat supply. This results in the decrease of harmful substance emissions into the atmosphere (Table F.1-1). This table represents the data for 2010 when the implementation of all the planned project measures will be completed.

Besides the project implementation will result in reduction of ash and slag removal to dumps.

Table F.1-1. Reduction in the harmful substance emissions into the atmosphere against the baseline, t/year

Value name	Unit	Fossil fuel		
		Natural gas	Coal	Total
Harmful substance emissions	**t/year**	**11**	**968**	**979**
Including:				0
solid particles		0	681.9	681.9
sulphur dioxide (SO_2)	t/year	0	192.9	192.9
nitrous oxides (NO_x)	t/year	3	18.7	21.6
carbon oxides (CO)	t/year	7.7	74.8	82.4

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:

As negative environmental impacts are not considered significant, no EIA is required.

SECTION G. Stakeholders' comments

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

Administrations of Rostov region and Novoshakhtinsk expressed a desire to assist TNS Ltd in the implementation of the project on heat pump stations construction and corroborated the mentioned by signing of a tripartite agreement.

REFERENCES

[R1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy

[R2] Decision 9/CMP.1. Guidelines for the implementation of Article 6 of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.2. 30 March 2006

[R3] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Volume 1. General guidelines. Version 2.2. Ministry of Economic Affairs of the Netherlands. June 2003.

[R4] Tool for the demonstration and assessment of additionality. Version 03. UNFCCC.

[R5] Roddatis K.F. Boiler units. M.: Energy, 1977.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

See Section B.

Annex 3

MONITORING PLAN

See Section D.