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 conservation at Khimki District Heating Company
Version 03
Date: January 15, 2007.

A.2. Description of the project:

Khimki District Heating Company (KDHC) is situated at the northern border of the capital Moscow in the Russian Federation. KDHC possesses four heating networks of which the eldest is by far the largest. It is here where the energy conservation project (Project Activity) is implemented. This network has four boiler-houses (numbered 3, 6, 56 and 24) with a total of 16 boilers and has a heat transportation & distribution network with a total length of approximately 160 km. Furthermore this network has 48 substations for distribution to the end-users. All boilers are more than 20 years old. The substations were built 10 to 30 years ago. The equipment and networks are supposed to continue to function up to at least 2012. Experts, amongst others Kotlomontazhservis and Royal Haskoning, confirm that this is achievable with applying normal maintenance as is common practice with Khimki DHC.

The total natural gas consumption of KDHC is around 100 million m^3 of natural gas per year. KDHC uses only natural gas as fuel for thermal energy (heat) generation. The total electrical energy consumption in 2005 amounted some 32 million kWh. All electrical energy is taken from the grid (from Mosenergo). At the moment KDHC has no own electricity production. Total thermal energy (heat) production is around 3,179 TJ (2005). Mosenergo also supplies thermal energy (heat) to the heat network of KDHC. This amounted in 2005 1,552 TJ. KDHC suffers from high energy losses at all stages of heat production, including generation, transportation & distribution and consumption. The heat losses in the transportation & distribution network alone constitute around 25-30%.

Investigation by KDHC, Kotlomontazhservice, Lighthouse and Royal Haskoning proved that certain energy saving measures in heat generation, transportation & distribution, the introduction of small scale Combined Heat and Power (CHP) generation and at the end-users could reduce the consumption of the natural gas by up to 35 million m^3 per year

The following energy conservation technologies are identified and scheduled to be implemented at Khimki DHC:

- Renovation of substations (complete renewal)
- Reduction of water leakages in the transportation system
- Improvement of insulation of the district heat piping
- Flow control of pumps in transport & distribution system
- Refurbishment of boilers including:
  - Conversion from steam to hot water production
  - Air preheating
  - Replacement of fans
  - Cleaning of tubes
  - Automatic control
  - Regularly emission measurements for optimizing boiler operation
- Introduction of efficient (approx.) 50 MW_{th} boiler that replace heat purchase from “Mosenergo”
- Introduction of small scale Combined Heat and Power (CHP) generation

The purpose of the project is energy conservation and efficient production.

It is calculated that total investments required for project implementation that qualifies under JI would constitute around 14 million euros, financed as follows:

Funding	**Name of financier**	**Amount (estimation)**	**Status**	**For investment in:**
Bank loan *	Vozrozhdenie Bank	4.1 million euro	expecting the final resolution	In transportation network and boiler houses & substations
Public money	Khimki Administration	0.9 million euro		All measure in boiler houses & substations
Public money	Moscow Region Administration	2.5 million euro		All measure in boiler houses & substations
Through "Investment" levy on heat price *	KDHC	0.6 million euro	confirmed by an instruction from the Khimki administration	All measure in boiler houses & substations
Equity	Privatization (shareholders)	6.2 million euro	planned within two years	CHP units
Total		14.3 million euro		

* Khimki Administration has approved that an "Investment" levy on the heat price for the end-users. This shall generate 0.6 million euro for contributing to the investments in improving the boiler houses & substations.

The investment figures have been verified by Kotlomontazhservis, Lighthouse and Royal Haskoning during an extensive audit executed in July 2005.

A.3. Project participants:

The project is developed by Khimki District Heating Company (KDHC), a 100% municipal (Khimki) owned company. KDHC is the investor and has contractual title to emission reductions resulting from the project.

KDHC will be responsible for the project implementation. OOO Kotlomontazhservice will be the main contractor of KDHC who will do all engineering and constructions works. Haskoning and Lighthouse are advisors to the project.

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Part A (Host party) Russian Federation	• Khimki District Heating Company, a 100% municipal (Khimki) owned company • OOO Kotlomontazhservice, a (Russian) private owned engineering & construction company • Lighthouse Business Management Russia B.V. (Lighthouse), a (Netherland) private consultant on Energy Business Development • Haskoning Netherlands BV, a Netherlands based private engineering consultant	No
Party B (buyer) The Belgium Federal Government		No

Annex 1 provides more information on the project participants.

The PDD was developed by Haskoning Netherlands BV with assistance of Lighthouse Business Management Russia B.V. (Lighthouse), OOO Kotlomontazhservice and Khimki District Heating Company.

The Russian Federal Services for Hydrometeorology and Environmental Monitoring (Roshydromet), the National Focal Point (see for address etc. website: http://maindb.unfccc.int/public/nfp.pl) will requested to issue Letter of Approval.

A.4. Technical description of the project:

A.4.1. Location of the project:

Khimki Region

A.4.1.1. Host Party(ies):

Russian Federation

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

Moscow region

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

Khimki

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

Khimki District Heating Company (KDHC) is situated in Khimki region, north of the municipality of Moscow (19 km from city centre of Moscow). It covers an area of 11,000 ha and has some 135,000 inhabitants. Within its city boundary is located Sheremetyevo International Airport. Furthermore many large international enterprises are located in Khimki region, making it a relative rich municipality.

Figure 1: Location of Khimki Region north of Moscow, Russian Federation (in blue)

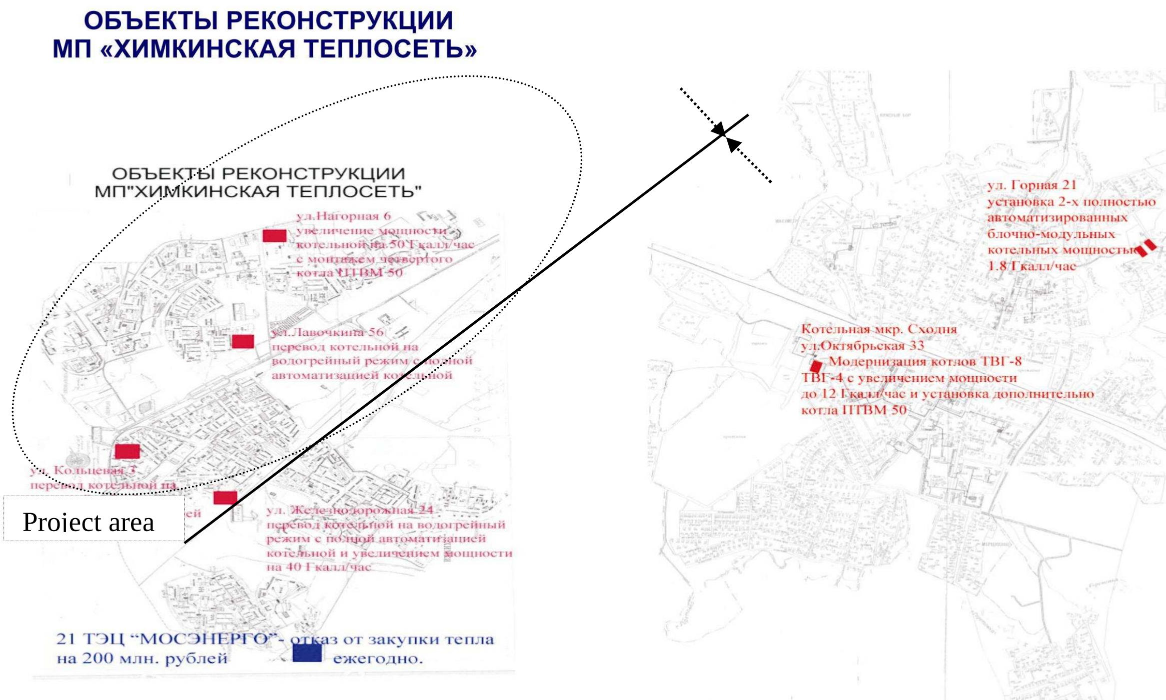

Figure 2: Location of the project area within Khimki Municipal Region (Red blocks are the positions of the four boiler houses)

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

The project area is limited to the eldest and largest heat network system of KDHC including the end-users attached to this heat network. It contains the thermal energy (heat) generation, the transportation & distribution of the thermal energy including the substations and end-users. Figure 3 visualizes the main activities and gives the project boundary.

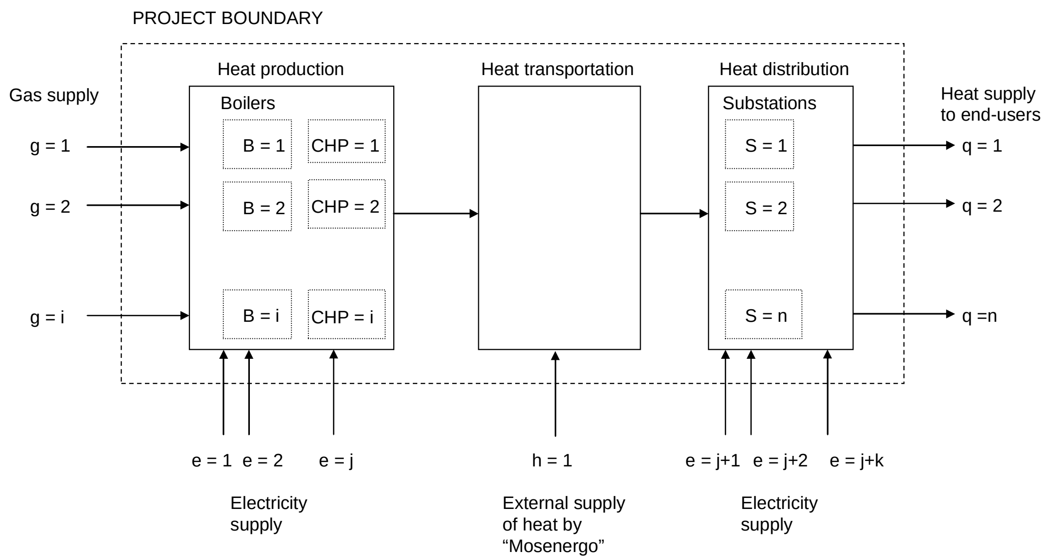

Figure 3: Project boundary

Symbol notation used in figure 1

g = natural gas (boilers, no CHP present in baseline)
h = heat from thermal plants consumed in the project area
e = electricity from the grid consumed in the project area
q = heat supplied to the end-users

B = boiler house (can contain more then one boilers)
S = substation

The following energy conservation technologies are identified and scheduled to be implemented at Khimki DHC within the project boundary:

- Renovation of substations (complete renewal)
- Reduction of water leakages in the transportation system
- Improvement of insulation of the district heat piping
- Flow control of pumps in transport & distribution system
- Refurbishment of boilers including:
  - Conversion from steam to hot water production
  - Air preheating
  - Replacement of fans
  - Cleaning of tubes
  - Automatic control
  - Regularly emission measurements for optimizing boiler operation
- Introduction of efficient (approx.) 50 MW_{th} boiler that covers some autonomous growth and replace heat purchase from “Mosenergo”
- Introduction of small scale Combined Heat and Power (CHP) generation

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:

Renovation of substations
Replacement of all substations with modern plate heat exchangers equipped with automatic control units will result in a total system efficiency savings of 20%.

Reduction of water leakages in distribution system
The reported amounts of leakages are varying from 40 (summer) to 80 (winter) m^3/h. Renovating the heat network in such a way that these leakages are reduced to 25% of its original amount gives the following gas savings. About 3.5 million m^3 of gas can be saved when 75% of the water leakages are prevented.

Insulation
Insulation of the district heat piping is poor. Using pre-insulated piping (steel – PUR – PE) can save some 10% of the reported total heat losses in the distribution system excluding those related to leakages (424 TJ annually). Some 60 km out of the 160 km distribution network will be replaced in the coming two years or some 38%.

Flow control
Variable flow pumping will significantly reduce pumping electricity consumption in the distribution system, especially during periods of low heat demand. The primary energy savings amounts to about 1,280,000 Nm^3 of natural gas.

Refurbishment of boilers
Introduction of energy efficiency measures at the existing boilers including:

- Rebuilding from steam to hot water production;
- Air preheating
- Replacement of fans: expected savings: 6% on heat production
- Cleaning of tubes: 5% on heat production
- Automatic control: 6% on heat production

The normative annual heat production in the steam boilers amounts to some 1,000 TJ. The measure results in a gas saving of about 4.8 million m^3 per year.

Efficient boiler
A thermal efficient heat boiler that produces hot water for the heat network. It shall replace (less efficient generated) heat purchase from Mosenergo thus it is not a capacity increase.

Combined Heat and Power Production
Small scale CHP production, to be designed in such a way that the own base electricity consumption in the boiler-houses can be covered. No delivery to the grid is foreseen. The heat will be delivered to the heat network

The CHP units will be based on gas fuelled reciproking engines connected to generators and are sized between 0.5 and 3.0 MWatt electrical output. The following capacities are foreseen:

Boiler house	**Electrical power output max. (approx.)**
Boiler house 24	1.0 MWatt
Boiler house 56	1.0 MWatt
Boiler house 3	0.5 MWatt
Boiler house 6	3.0 MWatt

The individual energy saving opportunities are summarized in table below.

Energy saving opportunity	**Annual energy saving**		
	x 1,000 m^3 natural gas	**kWh**	**TJ**
Replacement of all substations	38,000		1,265
Reduction of water leakages	2,000		67
Insulation of distribution piping	590		20
Variable flow pumping		4,5000,000	16
Rebuilding the boilers	5,000		167
Air pre-heating	1,250		42
Other measures	3,800		127
Boiler 50 MWth	1,000		33
Small scale CHP application in the boiler houses	3,190		106
TOTAL	54,830	4,5000,000	1,842

The individual energy saving opportunities influences each others. It's therefore not correct to add all saving in order to come to a total saving. For example:

- Variable flow pumping reduces the electricity consumption. This influence the size of the CHP units (they become smaller), as no delivery of electricity to the grid is allowed. The savings with the CHP units therefore becomes less (2.6 instead of 3.2 million m^3 gas/year).
- The replacement of the substations gives a/o lower return temperatures, requires less distribution flows, less losses etc. This influences (reduces) the energy consumption of boilers and pumps.

It is expected that the total (added) gas energy saving achievable after implementing opportunities is some 50% of the sum of the individual savings (almost 55 million m^3 of gas), resulting in some 27 million m^3 equivalents – 921 TJ **-** annually savings. This is a conservative approach.

In the Russian Federation there is no legislation enforcing energy conservation in the District Heating Sector. Energy conservation measures have hardly been implemented to date because they require large investments and are hardly or not economically attractive due to the fact that heat prices are low according Western standards and can not be raised because of political reasons. The project will not be viable unless JI**-**assistance is acquired (see section B.2 for further details).

Furthermore energy efficiency measure in the Russian District Heating Sector is not a common practice as indicated in section B.2.

The Project is additional in that emissions reductions would not occur in the absence of the proposed JI activity.

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

Please indicate the length of the crediting period and provide estimates of total as well as annual emission reductions. Information shall be provided using the following tabular format.

	Years
Length of the crediting period before January 2008	
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2007	0
Total estimated emission reductions over the crediting period before January 2008 (tonnes of CO_2 equivalent)	0

Please indicate the length of the crediting period and provide estimates of total as well as annual emission reductions. Information shall be provided using the following tabular format.

	Years
Length of the crediting period within 2008 -2012	
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2008	36,544
Year 2009	72,386
Year 2010	71,918
Year 2011	71,456
Year 2012	70,997
Total estimated emission reductions over the crediting period within 2008 - 2012 (tonnes of CO_2 equivalent)	323,301
Annual average of estimated emission reductions over the crediting period within 2008 - 2012 (tonnes of C CO_2 equivalent)	64,660

323,301 ERUs over the period 2008 – 2012 (first crediting period) is estimated to be generated.

A.5. Project approval by the Parties involved:

The PDD and the Determination Report will be presented to the Russian Federal Services for Hydrometeorology and Environmental Monitoring (Roshydromet), the National Focal Point of the Russian Federation and to the Belgium Federal Government to obtain a Letter of Approval.

The PIN of the project and the draft version of the PDD have already been presented to Roshydromet. Roshydromet endorses the project.

SECTION B. Baseline

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

There is no approved methodology for energy conservation project in the District Heating Sector that meet different type of efficiency measures. A new methodology titled “Energy conservation in the District Heating Sector” is proposed and has been used for estimation of emission reduction. The methodology has been developed according the CDM guidelines and is attached to annex 2.

The methodology covers a range of improvements, including co-generation, in the process of generating thermal energy, in transportation and distribution of thermal energy and thermal energy saving with the end-users.

Key conditions described in the proposed baseline methodology are in accordance with Appendix B of the Marrakech Accords and are met in the following matter:

- The Project Activity is implemented in existing district heating facilities;
- The methodology is applicable as it concerns improvement of existing district heating facilities, the implementing of small scale combined heat and power (CHP) generation without electricity delivery to the grid and the implementing of thermal energy generating boilers that replace existing thermal energy generating capacity, in or out-site the project area., that also covers the autonomous thermal growth in demand in the project area up to 5% per year. No new facilities are to be built;
- It can be shown that the baseline is the continuation of the system for heat production, transportation and distribution;
- Only natural gas is used in the project area for electrical and thermal energy (heat) production.

Baseline Scenario selection

Baseline scenario selection requires identification of all possible alternatives project alternatives and then evaluation of each of these alternatives is done to identify the most likely alternative:

Step 1: Identification of all possible baseline scenarios

Altt-1: Continuation of as is scenario (Historical Emissions coupled with autonomous improvements)

Alt-2: Continuation of as is scenario (Dynamic Baseline)

Alt-3: National or Sectoral policies which mandate Energy Consumption levels and which are strictly enforced.

Alt-4: Improved energy efficiency and GHG emissions as a result of the Project Activity.

Step 2: Selection of Baseline scenario amongst plausible scenarios

Step 2.1: Screening for compliance with National or Sectoral policies in the country

All above scenarios are in compliance with national or Sectoral policies in Russian Federation

Step 2.2: Barrier Analysis for possible baseline scenarios

Alt-1: Continuation of as is scenario (Historical Emissions coupled with autonomous improvements)

This is the most likely scenario as there are no barriers prohibiting it. There are no Government rules/regulation mandating the use of any particular technology or achieving any energy levels at present for the District Heating Sector in the Russian Federation. No new investments would be required in this scenario. Equipment currently used is the common practice in the Russian Federation

Autonomous changes will happen as part of business as usual scenario. Effect of these changes will be taken into account by capping the performance levels in KDHC.

Alt-2: Continuation of as is scenario (Dynamic Baseline)

Deterioration in 'Performance' with time – For conservative estimation of emissions reduction, this scenario is excluded.

Improvements in 'Performance' with time – Technology deployed in KDHC do not give improved performance levels with time.

- No available literature/standards identifies/records the improve of equipment/technologies in KHC
- The pattern of 'No improvement with time" has been verified with technology suppliers

Replacement of existing equipment/normal capital stock turnover in business as usual scenario-
The equipment in KDHC is 20 to 30-years old. With normal maintenance the equipment is able to operate for many more years as is shown in the District heating Sector in the Russian Federation. It is the opinion of Kotlomontazhservis and Royal Haskoning that with normal maintenance the present equipment can operate till at least 2012.
There is no replacement plan for existing equipment within the crediting period of 10 years.
Performance of these equipment is proven to be steady with no major trouble witnessed in their operations, hence it is expected that in the absence of the Project Activity equipments would not be replaced in near future.

Hence Alt-2 is not applicable as it does not create a unique scenario.

Alt-3: National or Sectoral policies which mandate Energy Consumption levels and which are strictly enforced.

There are no Sectoral policies for the District Heating Sector which mandate specific energy Consumption levels, either for gas, thermal energy and/or electrical energy generation

Hence Alt-3 is not applicable as it does not create a unique scenario.

Alt-4: Improved energy efficiency and GHG emissions as a result of the Project Activity.

The Project Activity faces significant barriers (see section B.3) and is not a baseline scenario.

Step 2.3: Selecting Baseline Scenario

- From the scenarios only Alt-1 and Alt-2 passes stage 2
- Against baseline scenario Alt-1 the Project Alternative (Alt-4) is shown as additional

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:

Description of the of the baseline scenario:

Continuation of as is scenario (Historical Emissions coupled with autonomous improvements) - Existing performance levels
In the District Heat Sector energy efficiency improvements also might take place as a normal course of business (due to incremental process improvements over a period of time, commonly called as autonomous improvements) and the effect of these should be eliminated to capture the true emission reduction, ascribable only to the Project Activity. (Described in annex-1of the baseline methodology).

Applicable baseline specific energy consumption levels: Past performance using 1 year data prior to start of the Project Activity. The incremental effect of autonomous improvements is accounted for by keeping the baseline at past levels and keeping the improvements post project activity capped.

Key 'performance' parameters for defining the baseline scenarios are as follows:

$esE_{b,p}$ = Specific Electrical Energy consumption in baseline scenario (for period = p), $kWh_{electricty}/GJ_{end\text{-}users}$

$gsE_{b,p}$ = Specific (Natural) Gas consumption in baseline scenario (for period = p), $GJ/GJ_{end\text{-}users}$

$hsE_{b,p}$ = Specific Thermal Energy (Heat) consumption in baseline scenario (for period = p), $GJ_{supplied}/GJ_{end\text{-}users}$

$eEffy_{b,p}$ = Efficiency of generation of electrical energy within the project area, %

$hEffy_{b,p}$ = Efficiency of generation of thermal energy that is consumed in (= supplied to) the project area, %

Q = Quantity of thermal energy consumed by the end-users, $GJ_{end\text{-}users}$

Description of the Project Activity
The Project Activity proposes to reduce specific gas - and electrical energy consumed in and specific thermal energy supplied to the project area by implementing a range of improvements, including co-generation, in the process of generating thermal energy, in transportation and distribution of thermal energy and thermal energy saving with the end-users. This results in GHG emission reduction as fossil fuels are used for energy generation. The Project Activity thus reduces GHG emissions from the levels in the baseline scenario.

Analyses of Project Activity
The Project Activity is demonstrated as additional using the latest version of the ***"Tool for the demonstration and assessment of additionality"*** agreed by the CDM Executive Board.

Step 1: Identification of alternatives to the Project Activity consistent with current laws and regulations

This have been disused in section B.2

Step 2: Investment Analysis

Investment analysis has not been selected.

Step 3: Barrier Analysis

Investment barrier: This is not a significant barrier for Khimki DHC.

Technology barrier – The technologies involved are known and available for in the Russian Federation but not always used in the DHS. Kotlomontazhservice has the technology and experience

Prevailing Practice barriers – The DHS in the Russian Federation is known to be very conservative regarding changes. Investment in modern equipment and technologies are not practised. This is also due to:

- The limited funds that can be obtained are required for capacity increase in order to provide thermal energy to the many housing projects realized in recent and to be realized and future years
- Energy conservation projects are not financially attractive

Step 4: Common practice analysis

A recent study[1] into the Energy Efficiency sector in Russia give the following major obstacles for the development of Energy Efficiency (EE) in Russia:

1. Poorly developed administrative and legal basis;
2. Lack of information;
3. Outdated technologies;
4. Poor market organisation;
5. Lack of financial resources.

Poorly Developed Administrative and Legal Basis
Most governmental EE programs that have been developed over the past few years are poorly implemented. The legal framework of EE is rather seen as a set of recommendations that are not always followed. Local authorities are not very active in promoting EE due to the following
reasons:

1. They often do not realise how EE increase can stimulate economic growth;
2. As local administration teams are changed rather frequently, they are not interested in long term EE projects;
3. The level of corruption at local authorities is rather high and decisions are not always based on cost efficiency.

Lack of Information
There is a lack of practical information on EE for energy suppliers, as well as for energy consumers. Market participants do not share experiences on EE. Some measures to overcome the lack of information could be:
1. Organisation of specialised events (seminars, conferences, exhibitions);
2. Development and distribution of learning and reading materials on EE among stakeholders;
3. Development of specialised databases on legislative and administrative norms, EE equipment, etc.

Local authorities and regional EE centres should play the main role in the distribution of information on EE.

[1] Energy Efficiency Sector in Russia: Market Study of Equipment and Services, Lighthouse February 2006 (EVD, Dutch Government financed),

Outdated Technologies
Technologies currently used in the energy sector in generation, distribution and consumption do not always allow the measurement of energy expenditures (consumption and losses). This is one of the major obstacles for implementation of energy saving measures, because it is not always possible to trace where losses are being made. For example, heat meters are almost never used in Russia. Amounts of payments are tied to the size of the space being heated, which is not very efficient.

Another problem is that existing technologies do not always allow the regulation of energy consumption by every individual end-user, especially heat consumption. In most buildings, heating systems are centralised and all end users get the same amount of heat.

Poor Market Organisation
Market mechanisms are almost failing to function in the Russian energy sector. On one hand, competition between companies involved in energy generation, distribution and consumption is weak; on the other hand, the Government strictly regulates pricing.

The heat sector is still almost totally under governmental control. At the same time the power sector is just in the starting phase of being restructured. Currently only 30% of power can be traded on the free market and free trade is only allowed in the Ural and Central regions.

Tariffs are still regulated by the Government and residential end users get large discounts on energy prices. That strongly undermines motivation for efficient energy use by residential end users.

Lack of Investments
There are three major sources of finance for EE projects:
1. Financing from companies involved in energy supply and end users themselves;
2. Governmental financing;
3. Bank financing.

Investments in EE measures from the side of the Government and local authorities are limited, as only projects with a payback period of one year and less are likely to get financing.

Investments from the side of energy suppliers are also limited, as the profitability of these companies is in general very low due to inefficient production and low tariffs. Residential end users are not interested in investing in EE as tariffs are rather low and there is no culture of efficient energy use.

Banks are not ready to provide financing for EE projects because risks and profits in these projects are hard to assess.

Due to the above-mentioned reasons the techniques and technologies as being implemented in this Project Activity are not common practice in The Russian Federation.

Step 5: Impact of JI registration

Registration of the project Activity as a JI project will enable the implementation of the Project Activity:
- It improves the IRR
- It will promote JI in the District Heating Sector and will generate more JI-projects in the DHS.

Summary:

Since the project is financially not sufficient attractive and will not been undertaken without JI. With ERU income the project becomes attractive however it has for investors still a low IRR. The JI-income is required in order to let the PA be implemented.

The PA of this scale is rare and using many new technologies for modifying equipment in a DHS is NOT COMMON practise in the Russian Federation.

On basis on the above analysis, in particular the NOT COMMON practice in the Russian Federation, the PA qualifies the Additionality Test.

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

Project boundary includes the

- Whole of the district heating system where Project Activity is implemented (including the boiler houses, the transportation network system and substation buildings with equipment;
- Power plants connected physically to electricity grid that the proposed Project Activity will affect;
- Thermal plants connected physically to transportation network that the proposed Project Activity will affect.

See also figure 2 'Project boundary"

	Source	Gas	Included?	Justification / Explanation
Baseline	Fuel use in boilers within project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Grid electricity used within project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Fuel use out-site project area for heat production that is supplied to project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Fuel use in boilers within project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Grid electricity used within project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Fuel use out-site project area for heat production that is supplied to project area	CO_2	Included	Main source emission
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

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

The baseline study was concluded on February 15, 2006 by Royal Haskoning, who is one of the project participants. Revisions were made on April 4, 2006 and September 13, 2006

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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The time line of the project is as follows:

- Project starting date : April 1st 2006
- Construction starting date : May 1st 2006
- Construction finishing date : October 15th 2006 (first phase), October 2007 (second phase), October 2008 (third and final phase)
- Start operating of equipment : first equipments starts operating around October 15th 2006 (starting new heating season). All equipment will start operating around October 15, 2008 (start crediting period)

C.2. Expected operational lifetime of the project:

At least 15 years.

C.3. Length of the crediting period:

7 years

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

No approved monitoring methodology for energy conservation in the District Heating Sector exits. Therefore a new monitoring methodology titled "*Energy conservation in the District Heating Sector*" is proposed and has been used for estimating of emission reduction. This new monitoring methodology, according to the CDM guidelines, is as an appendix attached to Annex 3.

The monitoring is designed for monitoring system levels improvements in the District heating sector, for the following parameters:

- Specific Electrical Energy consumption
- Specific (natural) gas consumption
- Specific Thermal Energy (Heat) supplied to the project area
- Efficiency of generation of electrical energy
- Change in ratio of electrical power sourced from grid
- Efficiency of generation of thermal energy that is supplied to the project area
- Changes in thermal production plants that supply the project area

The Project Activity involves improvements in the first 4 parameters mentioned above.

The methodology is therefore able to cover these improvements. The methodology requires monitoring of the following:

- Quantity of thermal energy (heat) consumed by the end-users. If this quantity cannot be monitored it shall be calculated. Input data for this calculation shall be monitored;
- Data needed to calculate emission factor of grid;
- Data needed to calculate emission CO_2 emissions from fossil fuel used for thermal energy production either within the project area or outside.

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	*gE natural gas consumption in project area*	*Gas meters*	*kg*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*
2	*eEP electricity produced in project area*	*Record of generating unit – electricity meters*	*kWh*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*
3	*eEG electricity purchased from grid*	*Electricity meters*	*kWh*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*
4	*gE thermal energy supplied to project area*	*Heat meters*	*GJ*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*

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
5	*GEF –emission factor of grid*	*Published statistics by national Electricity Authority or other such body*	*TCO_2/kWh*	*e*	*Annual*	--	*Electronic*	*Published data is used that can be verified easily* *Method of estimation as defined in ACM 0002 or AMS II.D*
6	*TD Transmission losses*	*Published statistics by national Electricity Authority or other such body*	*%*	*e*	*Annual*	--	*Electronic*	*Public information source is used* *In absence of verifiable data conservative estimate of 0% shall be used*
7	*EF Emission factor for natural gas and other fuels*	*IPPC default value*	*TCO_2/GJ*		*Annual*	*100%*	*Electronic*	*IPPC default values to be used*

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
8	*QF Quantity of fuel used for thermal energy generation that is supplied to project area*	*Meters*	*kg*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice(s) to heat supplying company*
9	*hCV Caloric value of fuels used for thermal energy generation that is supplied to project area*	*Data from fuel supplier or laboratory record*	*kJ/kg*	*c*	*Annual*	*100%*	*Electronic*	*Data from supplier shall be certified*
10	*Tr Transmission losses*	*Published statistics by national Energy Authority or other such body*	*%*	*e*	*Annual*	*--*	*Electronic*	*Public information source is used* *In absence of verifiable data conservative estimate of 0% shall be used*

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
11	*qF Water mass flow leaving substation for end-users or leaving boiler houses*	*Flow meters*	*kg/s*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*
12	*T Temperatures of water mass flow leaving from / returning to substation or boiler houses*	*Temperature meters*	*oC*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*

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

This analysis estimates the emissions from Project Activity in period p.

Actual parameters as observed in period p during verification:

$esE_{a,p}$ = Specific Electrical Energy consumption in the Project Activity $kWh/GJ_{end\text{-}users}$

$gsE_{a,p}$ = Specific (natural) gas consumption, $GJ/GJ_{end\text{-}users}$

$hsE_{a,p}$ = Specific Thermal Energy (Heat) supplied, $GJ_{supplied}/GJ_{end\text{-}users}$

$eEffy_{a,p}$= Efficiency of generation of electrical energy within the project area, %

$hEffy_{a,p}$ = Efficiency of generation of thermal energy that is supplied to the project area, %

Q_p = thermal energy supplied (for period=p) by the project area to (external) end-users, $GJ_{end\text{-}users}$

Specific energy consumption levels and efficiency of generation of electrical energy determined in the Project Activity shall be used to estimate GHG emissions in the Project Activity in a period=p in following manner.

<u>Total Emission Factor in period p</u>

$$\mathbf{TEF_{a,p} = (eEF_{a,p} \times esE_{a,p} + gEF_{a,p} \times gsE_{a,p} + hEF_{a,p} \times hsE_{a,p})}$$

Where:

$TEF_{a,p}$ = Total Emission Factor for Project Activity (for period=p), TCO_2/ $GJ_{end\text{-}users}$

$eEF_{a,p}$ = Emission Factor for Electrical Energy consumed in the project area, TCO_2/kWh

$gEF_{a,p}$ = gEF_0 because fuel mix change is not part of the project scope; it is a different Project

$hEF_{q,p}$ = Emission Factor for fuel mix used for thermal energy that is supplied to the project area, $TCO_2/GJ_{supplied}$

<u>Emission Factor for Electrical Energy Consumed in the project area:</u>

$$\mathbf{eEF_{a,p} = [reE_p \times e_pEF_{a,p} + (1\text{-}reE_p) \times e_GEF_p]}$$

$e_pEF_{a,p}$ = Emission Factor for electrical power produced in the project area, TCO_2/kWh

reE_p = Ratio of production electrical power tot total electrical power consumed eEP_p/eE_p

eE_p = Total electrical energy consumed in the project area, kWh (eEP_p/eEG_p)

eEP_p = Total electrical energy Produced within the project area using a mix of fuels, kWh

eEG_p = Total electrical energy purchased from the Grid and consumed by the project area, kWh

e_GEG_p = Emission Factor for electricity purchased from grid, TCO_2/kWh

Emission factor for electrical energy imported from Grid

$$\mathbf{e_GEF_p = GEF_p / (1-TD_p)}$$

GEF_p = Grid Emission Factor TCO_2 emission /kWh of power

TD_p = Average Transmission and Distribution losses for grid power, %

Emission Factor for Electrical Energy generated within the project area

As this methodology is only applicable for natural gas as the only fuel source for electrical and thermal energy generation within the project area:

$$\mathbf{e_pEF_{a,p} = gEF_0 \times K}$$

Emission Factor for Thermal Energy (Heat) produced within the project area:

As this methodology is only applicable for natural gas as the only fuel source for electrical and thermal energy generation within the project area:

$$\mathbf{gEF_{a,p} = gEF_0}$$

Emission Factor for Thermal Energy consumed in (supplied to) the project area:

$$\mathbf{hEF_p = (\Sigma(hQF_p \times hCV_p \times hEF_f) / \Sigma (hCV_p \times hQF_p)) / (1- hTr_p)}$$

hQF_p = Fuel Quantity used for thermal energy generation that is supplied to the project area, kg

hCV_p = Calorific Value of fuel used for thermal energy generation that is supplied to the project area kJ/kg

hEF_f = Emission Factor for fuel used for thermal energy generation that is supplied to the project area, TCO_2/GJ (IPCC default values)

hTr_0 = Average transportation losses for thermal heat supplied, %

Fuel quantity for thermal energy generation used by a supplying plant

$$\mathbf{hQF_p = hsE_p / hCV_p / hEffy_{a,p}}$$

hsE_p = Amount of heat production of thermal plant concerned that supplies the project area, GJ

$hEffy_{a,p}$ = Efficiency of generation of thermal energy (heat) generation of plant that supplies to the project area, %

Capacity heat production – Just after Project Activity implementation emission factor - verified by DOE
(this factor will be used to cap emission reductions to eliminate effects of autonomous changes)

Subscript T will denote the values established for various parameters just after completion and stabilization of Project Activity.

esE_T = Specific Electrical Energy consumption. $kWh_{electricty}/GJ_{end-users}$

gsE_T = Specific (natural) gas consumption, $GJ/GJ_{end-users}$

hsE_T = Specific Thermal Energy (Heat) supplied, $GJ_{supplied}/GJ_{end-users}$

$eEffy_T$ = Efficiency of generation of electrical energy within the project area, %

$hEffy_T$ = Efficiency of generation of thermal energy that is supplied to the project area, %

Q_T = Quantity of thermal energy (Capacity Supply) consumed by end-users, $GJ_{end\text{-}users}$

Total Emission Factor for capacity production (TCO_2/ $GJ_{end\text{-}users}$), TEF_T

$$TEF_T = (eEF_T \times esE_T + gEF_T \times gsE_T + hEF_T \times hsE_T)$$

Where:

eEF_T = Emission Factor for Electrical Energy consumed in the project area, $TCO_2/kWh_{electricity}$

gEF_T = $gEF_{0,}$ because only natural gas is used for thermal energy generation (fuel mix change is not part of the scope of the project;

hEF_T = Emission Factor for fuel mix used for thermal energy that is supplied to the project area, $TCO_2/GJ_{supplied}$

Emission Factor for Electrical Energy Consumed in the project area:

$$eEF_T = (reE_T \times e_pEF_T + (1-reE_T) \times e_GEF_T)$$

Where:

reE_T = Ration of generated electrical power to total electrical power consumed
= eEP_T / eE_T

eE_T = Total electrical energy consumed in the project area, kWh
= $(eEP_T + eEG_T)$

eEP_T = Total electrical energy produced within the project area using a mix for fuels, kWh

eEG_T = Total electrical energy purchased from the grid and consumed by the project area, kWh

e_pEF_T = Emission Factor for electrical power produced in the project area, TCO_2/kWh

e_GEF_T = Emission Factor for electricity purchased from grid, TCO_2/kWh

Emission factor for electrical energy imported from grid

$\mathbf{e_GEF_T = GEF_T / (1-TD_T)}$

GEF_T = $GEF_{0;}$ because Project Activity doesn't impact the grid and the implementation time is small

TD_T = TD_0; because Project Activity doesn't impact the grid and the implementation time is small

Emission Factor for Electrical Energy generated within the project area

As this methodology is only applicable for natural gas as the only fuel source for electrical and thermal energy generation within the project area:

$\mathbf{e_pEF_T = gEF_0 \times K}$

Emission Factor for Thermal Energy (Heat) produced within the project area:

As this methodology is only applicable for natural gas as the only fuel source for electrical and thermal energy generation within the project area:

$\mathbf{gEF_T = gEF_0}$

Emission Factor for Thermal Energy supplied to the project area:

$\mathbf{hEF_T = (\Sigma(hQF_T \times hCV_T \times hEF_f) / \Sigma (hCV_T \times hQF_T)) / (1- hTr_T)}$

hQF_T = Fuel Quantity used for thermal energy generation that is supplied to the project area, kg

hCV_T = Calorific Value of fuel used for thermal energy generation that is supplied to the project area kJ/kg

hEF_f = Emission Factor for fuel used for thermal energy generation that is supplied to the project area, TCO_2/GJ (IPCC default values)

hTr_0 = Average transportation losses for thermal heat supplied, %

Fuel quantity for thermal energy generation used by a supplying plant

$\mathbf{hQF_T = hsE_T / hCV_T / hEffy_T}$

hsE_T = Amount of heat production of thermal plant concerned that supplies the project area, GJ

$hEffy_T$ = Efficiency of generation of thermal energy (heat) generation of plant that supplies to the project area, %

<u>Quantity of thermal energy supplied (Capacity Supply) by the project area to (external) end-users</u>

$$\mathbf{Q_T = \sum_{time} \sum_{S} (qF_T \times Cp \times (T_{send,T} - T_{return,T}))}$$

qF_T = Water mass flow leaving substation S, kg/s

Cp = Specific heat of water, kJ/kg.^oC

$T_{send,T}$ = Temperature of water mass flow leaving a substation (project boundary), ^oC

$T_{return,T}$ = Temperature of water mass flow returning from end-users to substation (project boundary), ^oC

In case the water mass flow(s) and/or the temperatures are not measured at the substations the water mass flow from the boiler houses are to be used instead. This is the case in the baseline situation at Khimki DHC. Therefore the water mass flow(s) and temperatures that are measured in the boiler houses are used.

Applicable Project Activity emission factor:

$$TEF_{A,p} = MAX(TEF_T, TEF_{a,p})$$

$TEF_{A,p}$ = Total emission factor to be accounted for emissions reduction calculations (for period p).

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*gE natural gas consumption in project area*	*Gas meters*	*kg*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*
2	*eEP electricity produced in project area*	*Record of generating unit – electricity meters*	*kWh*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*
3	*eEG electricity purchased from grid*	*Electricity meters*	*kWh*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*
4	*gE thermal energy supplied to project area*	*Heat meters*	*GJ*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice*

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
5	*GEF –emission factor of grid*	*Published statistics by national Electricity Authority or other such body*	*TCO_2/kWh*	*e*	*Annually*	--	*Electronic*	*Published data is used that can be verified easily* *Method of estimation as defined in ACM 0002 or AMS II.D*
6	*TD Transmission losses*	*Published statistics by national Electricity Authority or other such body*	*%*	*e*	*Annually*	--	*Electronic*	*Public information source is used* *In absence of verifiable data conservative estimate of 0% shall be used*
7	*EF Emission factor for natural gas and other fuels*	*IPPC default value*	*TCO_2/GJ*		*Annually*	*100%*	*Electronic*	*IPPC default values to be used*

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-referen-cing 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
8	*QF Quantity of fuel used for thermal energy generation that is supplied to project area*	*Meters*	*Kg*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly. Cross check with billing invoice(s) to heat supplying company*
9	*hCV Caloric value of fuels used for thermal energy generation that is supplied to project area*	*Data from fuel supplier or laboratory record*	*kJ/kg*	*c*	*Annually*	*100%*	*Electronic*	*Data from supplier shall be certified*
10	*Tr Transmission losses*	*Published statistics by national Energy Authority or other such body*	*%*	*e*	*Annually*	--	*Electronic*	*Public information source is used* *In absence of verifiable data conservative estimate of 0% shall be used*

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-referen-cing 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
11	*qF Water mass flow leaving substation for end-users or leaving boiler houses*	*Flow meters*	*kg/s*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*
12	*T Temperatures of water mass flow leaving from / returning to substation or boiler houses*	*Temperature meters*	*^oC*	*m*	*Minimal hourly*	*100%*	*Electronic*	*Meter readings. Meter accuracy shall be checked regularly*

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

Key 'performance' parameters for defining the baseline scenarios are as follows:

$esE_{b,p}$ = Specific Electrical Energy consumption in baseline scenario (for period = p), $kWh_{electricty}/GJ_{end-users}$

$gsE_{b,p}$ = Specific (Natural) Gas consumption in baseline scenario (for period = p), $GJ/GJ_{end-users}$

$hsE_{b,p}$ = Specific Thermal Energy (Heat) supplied in baseline scenario (for period = p), $GJ_{supplied}/GJ_{end-users}$

$eEffy_{b,p}$ = Efficiency of generation of electrical energy within the project area, %

$hEffy_{b,p}$ = Efficiency of generation of thermal energy that is consumed in (= supplied to) the project area, %

Q = Quantity of thermal energy consumed by end-users, $GJ_{end\text{-}users}$

Specific energy consumption levels and efficiency of generation of electrical and thermal (heat) energy determined in baseline scenario shall be used to estimate baseline emissions in a period = p in the following manner.

Total Emission Factor for baseline scenario ($TCO_2/GJ_{end\text{-}users}$), $TEF_{b,p}$

$$TEF_{b,p} = eEF_{b,p} \times esE_{b,p} + gEF_0 \times gsE_{b,p} + hEF_{b,p} \times hsE_{b,p}$$

Where:

$TEF_{b,p}$ = Emission Factor for Baseline Scenario (for period = p), $TCO_2/GJ_{end\text{-}users}$

$eEF_{b,p}$ = Emission Factor for Electrical Energy consumed in the project area, $TCO_2/kWh_{electricity}$

gEF_0 = Emission Factor for gas used for thermal energy generation in project area, TCO_2/GJ

$hEF_{b,p}$ = Emission Factor for fuel mix used for thermal energy that is supplied to the project area, $TCO_2/GJ_{supplied}$

1. Emission Factor for Electrical Energy Consumed in the project area:

$$eEF_{b,p} = (reE_p \times e_pEF_{b,p} + (1 - reE_p) \times e_GEF_p)$$

reE_p = Ratio of electrical power produced in the project area to total electrical power consumed = eEP_p / eE_p

eE_p = Total electrical energy consumed in the project area, kWh

= $eEP_p + eEG_p$

eEP_p = Total electrical energy produced within the project area using natural gas as fuel, kWh

eEG_p = Total electrical energy purchased from the grid and consumed by the project area, kWh

$e_pEF_{b,p}$ = Emission factor for electrical power produced in the project area, TCO_2/kWh

e_GEF_p = Emission factor for electrical purchased from grid, TCO_2/kWh

1.1 Emission factor for electrical energy imported from grid

e_GEF_p = GEF_p / (1- TD_p)

GEF_p = Grid Emission Factor of the grid for the region /country where the project area is located (TCO_2 emission /kWh of power generated). As electrical energy savings from the Project Activity are < 15 GWh_e/annum AMS - II.D is used. .

TD_p = Average Transmission and Distribution losses for grid power (last three years average performance for the grid – including the 'baseline year'). For a conservative approach this factor shall be taken as 0%.

1.2 Emission Factor for Electrical Energy generated within the project area

As this methodology is only applicable for natural gas as the only fuel source for electrical and thermal energy generation within the project area:

e_pEF_p = gEF_0 x K

gEF_0 = Emission Factor for (natural) gas used for thermal energy generation, TCO_2/GJ
(IPCC default value)

K = Conversion factor for converting GJ to kWh (GJ/kWh = 3.6 x 1,000)

2. Emission Factor for Thermal Energy (Heat) produced within the project area:

As this methodology is only applicable for natural gas as the only fuel source for thermal energy generation within the project area:

gEF_0 = gEF_0

gEF_0 = Emission Factor for (natural) gas used for thermal energy generation, TCO_2/GJ

(IPCC default value)

3. Emission Factor for Thermal Energy consumed in (supplied to) the project area:

$hEF_{b,p}$ = $(\Sigma(hQF_p \times hCV_0 \times hEF_f) / \Sigma(hCV_0 \times hQF_p)) / (1- hTr_0)$

hQF_p = Fuel Quantity used for thermal energy generation that is supplied to the project area, kg

hCV_0 = Calorific Value of fuel used for thermal energy generation that is supplied to the project area kJ/kg

hEF_f = Emission Factor for fuel used for thermal energy generation that is supplied to the project area, TCO_2/GJ (IPCC default values)

hTr_0 = Average Transportation losses for thermal heat supplied, % (As this is kept constant over the crediting period as this is hardly changing).

The autonomous growth in heat demand in the project area is expected to be 1.0% per year and will be covered by the external heat supply to the project area.

3.1 Fuel quantity for thermal energy generation used by a supplying plant

hQF_p = $hsE_p / hCV_0 / hEffy_p$

hsE_p = Amount of heat production of thermal plant concerned that supplies the project area, GJ

$hEffy_p$ = Efficiency of generation of thermal energy (heat) generation of plant that supplies to the project area, %

4. Quantity of thermal energy consumed by end-users

$$Q = \sum_{time} \sum_{S} (qF \times Cp \times (T_{send} - T_{return}))$$

qF = Water mass flow leaving substation S, kg/s

Cp = Specific heat of water, kJ/kg.°C

T_{send} = Temperature of water mass flow leaving a substation (project boundary), °C

T_{return} = Temperature of water mass flow returning from end-users to substation (project boundary), °C

In case the water mass flow(s) and/or the temperatures are not measured at the substations the water mass flow from the boiler houses are to be used instead. This is the case in the baseline situation at Khimki DHC. Therefore the water mass flow(s) and temperatures that are measured in the boiler houses are used.

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

Not applicable.

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:

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

No leakages are expected from the plan. Hence no monitoring mechanism is being suggested.

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):

Emission reduction factor ($ER_{p,}$ $TCO_2/GJ_{end\text{-}users}$)

ER_p = MAX (($\mathbf{TEF_{b,p}} - \mathbf{TEF_{a,p}}$), 0)

Net GHG Emission Reduction ($Ne_{p,}$ TCO_2)

Ne_p = aQ_p x ER_p

aQp = Quantity of heat consumed by the end-users which should be accounted for as the effect of the Project Activity, $GJ_{end\text{-}users}$
= MIN ($Q_{T,}$ $Q_{p)}$ Capping done to eliminate effect of increase in capacity)

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:

The project activity does not require infrastructure or equipment that would yield any local or regional environmental impact.

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.
1	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
2	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
3	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
4	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
5	*L*	*Published statistics by national Energy Authority or other such body to calculate grid emission factor*
6	*M*	*Published statistics by national Energy Authority or other such body*
7	*L*	*IPPC default values to be used*
8	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
9	*L*	*Laboratory results to be used or certified supplier data*
10	*M*	*Published statistics by national Energy Authority or other such body*
11	*L*	*This is measured by accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*
12	*L*	*This is measured by very accurate meters. Meter accuracy shall be checked periodically that should be part of standard operating practice*

With the following uncertainty levels: *L <1%*
M < 2%
H <5%

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

KDHC will make a qualified employee responsible for monitoring energy consumptions. This employee will also track the projects emission reductions. Lighthouse and Haskoning will continue supervising this monitoring.

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

Mr H. Oosterdijk
Haskoning Nederland B.V. (Royal Haskoning)
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6500 AD Nijmegen
The Netherlands
Telephone: +31 24 32 84 671
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email: h.oosterdijk@royalhaskoning.com
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SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Parameter	Unit	KDHC
Total emission factor for capacity production TEF_T	TCO_2/GJ	0.07078 (2009)
Total emission factor for Project Activity TEF_{PA}	TCO_2/GJ	0.05548 (2009)
Total project emissions	TCO_2	72,386 after full implementation of PA in 2009

On October 15, 2008 the PA will be implemented for 100%.

Reference is made to the appendix were the calculations according the methodology as well as for the baseline and Project Activity are attached.

E.2. Estimated leakage:

Leakages are not considered as:

- The methodology analyzes total system impact of the proposed change (translated finally in total energy consumption in and attributable to the project area). Thus it avoids potential leakage which may arise due the local analysis (Ex: energy reduction in one place resulting in increased energy consumption in another part of the project area).
- Reduction in emissions due to lesser fuel transported to project area and external thermal plants that supplies the project area, for generating electrical & thermal energy - To have conservative approach; this leakage is to be ignored.

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

Summarized:

Parameter	Unit	KDHC
Total emission factor (2009)	TCO_2/GJ	0.05548
Total project emissions (2009)	TCO_2	262,596

E.4. Estimated baseline emissions:

Summarized:

Parameter	Unit	KDHC
Total emission factor (2009)	TCO_2/GJ	0.07078
Total project emissions (2009)	TCO_2	334,982

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

334,982 -262,596 = 72,386 TCO_2 in 2009 after full implementation of Project Activity.

The annual emission reductions per year do slightly change due to:

- some limited autonomous growth in heat demand, that is in the baseline is covered by the external heat supply,
- and by the assumed efficiency increase of external heat supply (conservative approach)

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

The result of the application of the formulae above shall be indicated using the following tabular format.

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	299,723	0	336,267	36,544
2009	262,596	0	334,982	72,386
2010	261,792	0	333,710	71,918
2011	260,995	0	332,451	71,456
2012	260,207		331,204	70,997
Total (tonnes of CO_2 equivalent)	1,345,313		1,668,614	323,301

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 Activity results in net reduction of fuel consumption.

As for environmental assessment of the project, the equipment that will be installed at Khimki DHC in the course of the project activity conforms to requirements of environmental standards set by the Russian legislation. The equipment goes with special labels that indicate that the equipment is environmentally friendly. It is obvious that newly manufactured equipment is more energy efficient and environmentally friendly that the equipment manufactured a few decades ago – that is the equipment that Khimki DHC is planning to replace

Except for energy used while producing equipment used in the project and during project implementation, no adverse impact on the environment occurs. On the contrary due to lesser fuel consumption local emissions are reduced

During construction works some emissions may occur, in particular (non-fine) dust, however this is limited in quantity and time as most of the construction works takes place inside buildings (boiler houses and substation buildings) and in day-time during the summer season. All metal scrap is recycled. Non-reusable or non-recyclables are disposed off to sanitary landfills with the minimum standard being the prevailing legislation in force.

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:

The EIA is included into technical design documentation which has been submitted to environmental expertise and get the appropriate endorsement".

SECTION G. Stakeholders' comments

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

On July 16, 2005 a stakeholders' assessment was organized in the municipal office of Khimki. Stakeholders were invited by an advertisement in the local newspaper.

Present were a/o:
- Khimki Administration officials
- Inhabitants of Khimki municipality
- Vozrozhdenie Bank
- Private investors
- Local television and newspaper
- Project partners (Khimki DHC, Kotlomontazhservice, Lighthouse and Royal Haskoning)

The project was presented by several presentations of Khimki Administration officials and project partners. The programme of the stakeholder assessment is given in the annex.

Some impression photos is given below.

No adverse comments were received.

Due to no adverse comments were received no actions were required.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Khimki District Heating Company (Khimki DHC)
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City:	Khimki
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Country:	Russian Federation
Phone:	
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E-mail:	
URL:	None
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Annex 2

BASELINE INFORMATION

BASELINE INFORMATION

KDHC DATA 2005

Khimky District Heating Company, Moscow region

Data obtained in February,17 2006
from DHC Khimki

DHW = Domestic Hot Water

Boiler house	Max. load at T = - 26 °C	Max. load for ventilation at T = - 26 °C	Averag load for DHW at T = 5 °C	No. of end users	Av. consp. of water on DHW production	Max. load for DHW	Max.losses in transportation	Total max load including losses	Annual sales	Annual losses Total	Annual losses leakage
	Gcal/h	Gcal/h	Gcal/h	x1,000 persons	m^3/day	Gcal/h	Gcal/h	Gcal/h	Gcal/year	Gcal/year	Gcal/year
Boiler house No. 6	96.50	7.21	21.77	41.20	8,123.20	49.00	9.40	162.11	419,246.00	53,059.00	14,561.00
Boiler house No. 56	20.48	0.57	4.13	10.90	1,532.80	9.30	1.30	31.65	82,337.00	7,090.00	842.00
Boiler house No. 24	26.16	0.01	2.90	7.20	1,222.50	6.70	1.90	34.77	86,069.00	11,223.00	1,486.00
Boiler house No. 3	13.25	0.62	1.07	2.50	401.80	2.70	0.90	17.47	43,395.00	5,014.00	699.00
	-	-	-			-	-	-	658.00		
Boiler houses total	156.39	8.41	29.87	61.80	11,280.30	67.70	13.50	246.00	631,705.00	76,386.00	17,588.00
Mosenergo	108.50	6.50	38.00					115.00	494,288.00	24,801.00	
	264.89	14.91	67.87	61.80	11,280.30	67.70	13.50	361.00	1,125,993.00	101,187.00	17,588.00

Conversion Gcal ---> GJ
1 Gcal = 4.19 GJ

DHW = Domestic Hot Water

Boiler house	Max. load at T = - 26 °C	Max. load for ventilation at T = - 26 °C	Averag load for DHW at T = 5 °C	No. of end users	Av. consp. of water on DHW production	Max. load for DHW	Max.losses in transportation	Total max load including losses	Annual sales	Annual losses Total	Annual losses leakage
	GJ/h	GJ/h	GJ/h	x1,000 persons	m^3/day	GJ/h	GJ/h	GJ/h	GJ/year	GJ/year	GJ/year
Boiler house No. 6	404.34	30.21	91.22	41.20	8,123.20	205.31	39.39	679.24	1,756,640.74	222,317.21	61,010.59
Boiler house No. 56	85.81	2.39	17.30	41.20	8,123.20	38.97	5.45	132.61	344,992.03	29,707.10	3,527.98
Boiler house No. 24	109.61	0.04	12.15	41.20	8,123.20	28.07	7.96	145.69	360,629.11	47,024.37	6,226.34
Boiler house No. 3	55.52	2.60	4.48	41.20	8,123.20	11.31	3.77	73.20	181,825.05	21,008.66	2,928.81
	-	-	-	41.20	8,123.20	-	-	-	2,757.02	-	-
Boiler houses total	655.27	8.41	125.16	206.00	40,616.00	283.66	56.57	1,030.74	2,646,843.95	320,057.34	73,693.72
Mosenergo	454.62	27.24	159.22	41.20	8,123.20	-	-	481.85	2,071,066.72	103,916.19	-
	1,109.89	35.65	284.38	247.20	48,739.20	283.66	56.57	1,512.59	4,717,910.67	423,973.53	73,693.72

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LHV = Lower Heating value

SNIP = Sanitary Norms and Standards

LHV = 7,950.00 Kcal/m^3

Annual normative supply	Supply in 2005	Own consump. of heat	Annual production acc. to SNIP	Total production in 2005	Production in heating season Oct. - April		Average Annual efficiency	Standard coal consumption	Normative annual gas consumption	Gas consumption in 2005	Consumption of electricity in 2005
Gcal/year	Gcal/year	Gcal/year	Gcal/year	Gcal/year	Gcal/year			kg/Gcal	x 1,000 m^3	x 1,000 m^3	x 1,000 kWh
472,305.00	526,805.75	7,890.00	480,195.00	534,025.88	424,815.00	79.0%	92.40%	157.19	65,370.01	72,336.00	14,237.00
89,427.00	83,019.56	1,721.00	91,148.00	85,812.10	81,133.00	94.0%	90.68%	160.58	12,643.53	11,745.00	2,037.00
97,292.00	105,007.13	2,388.00	99,680.00	107,173.42	91,857.00	86.0%	90.58%	161.60	13,842.31	14,830.00	2,247.00
48,409.00	43,403.54	1,607.00	50,016.00	44,857.53	39,741.00	88.0%	90.68%	162.77	6,937.94	6,179.00	954.00
658.00	708.07	4.00	662.00	710.40	410.00	57.7%	80.80%	178.60	103.06	111.00	125.00
708,091.00	758,944.05	13,610.00	721,701.00	772,579.33	637,956.00	82.6%			98,896.85	105,201.00	19,600.00
519,089.00	370,404.00										6,701.00
1,227,180.00	1,129,348.05	13,610.00	721,701.00	772,579.33	637,956.00						26,301.00

LHV = Lower Heating Value

SNIP = Sanitary Norms and Standards

LHV = 7,950.00 kcal/m^3 = 33.31 MJ/Nm^3

Annual normative supply	Supply in 2005	Own consump. of heat	Annual production acc. to SNIP	Total production in 2005	Production in heating season Oct. - April		Average Annual efficiency	Standard coal consumption	Normative annual gas consumption	Gas consumption in 2005	Consumption of electricity in 2005
GJ/year	GJ/year	GJ/year	GJ/year	GJ/year	GJ/year			kg/Gcal	x 1,000 m^3	x 1,000 m^3	x 1,000 kWh
1,978,957.95	2,207,316.09	33,059.10	2,012,017.05	2,237,568.44	1,779,974.85	79.5%	92.40%	157.19	65,370.01	72,336.00	14,237.00
374,699.13	347,851.96	7,210.99	381,910.12	359,552.70	339,947.27	94.5%	92.40%	157.19	12,408.18	11,745.00	2,037.00
407,653.48	439,979.87	10,005.72	417,659.20	449,056.63	384,880.83	85.7%	92.40%	157.19	13,569.66	14,830.00	2,247.00
202,833.71	181,860.83	6,733.33	209,567.04	187,953.05	166,514.79	88.6%	92.40%	157.19	6,808.79	6,179.00	954.00
2,757.02	2,966.81	16.76	2,773.78	2,976.58	1,717.90	57.7%	92.40%	157.19	90.12	0.03	125.00
2,966,901.29	3,179,975.57	57,025.90	3,023,927.19	3,237,107.39	2,673,035.64	82.6%			98,246.75	105,090.03	19,600.00
2,174,982.91	1,551,992.76				-		90.00%	157.19	-	65,804.00	6,701.00
5,141,884.20	4,731,968.33	57,025.90	3,023,927.19	3,237,107.39	2,673,035.64				98,246.75		26,301.00

Grid data

(Data of Mosenergo's energy plants. Source: Mosenergo Annual Report 2005, www.mosenergo.ru)
http://www.mosenergo.ru/eng/index.php)

2004 energy production data of Mosenergo

Fuel	Station name	Type	Production in 2004 Electricity x 10^6 kWh	Production in 2004 Heat x 10^3 GJ	Total energy production TJ	Total average efficiency of CHP park	Average fuel emission factor TCO_2/GJ fuel	CO_2 emssion TCO_2
Hydro +fossil fuel	ГЭС-1(hydro part)	Hydro + Boiler *	380.1		1,368.4		-	
Hydro +fossil fuel	ГЭС-1(fossil part)	Hydro + Boiler *		7,940.5	7,940.5	65.1%	0.0575	700,626
Fossil fuel	ГРЭС-3	CHP	138.1	1,830.2	2,327.4	65.1%	0.0575	205,354
Fossil fuel	ГРЭС-4	CHP	5,803.2	1,662.2	22,553.7	65.1%	0.0575	1,990,023
Fossil fuel	ГРЭС-5	CHP	3,135.6	2,059.0	13,347.1	65.1%	0.0575	1,177,682
Fossil fuel	ТЭЦ-6	CHP	34.3	741.6	865.1	65.1%	0.0575	76,333
Fossil fuel	ТЭЦ-8	CHP	2,770.1	9,965.9	19,938.3	65.1%	0.0575	1,759,252
Fossil fuel	ТЭЦ-9	CHP	1,221.1	6,528.0	10,924.0	65.1%	0.0575	963,876
Fossil fuel	ТЭЦ-11	CHP	1,867.9	8,521.6	15,246.1	65.1%	0.0575	1,345,235
Fossil fuel	ТЭЦ-12	CHP	2,614.8	14,033.6	23,446.8	65.1%	0.0575	2,068,830
Fossil fuel	ТЭЦ-16	CHP	2,396.7	16,829.6	25,457.7	65.1%	0.0575	2,246,255
Fossil fuel	ТЭЦ-17	CHP	565.4	2,857.6	4,893.0	65.1%	0.0575	431,735
Fossil fuel	ТЭЦ-20	CHP	3,768.9	19,458.8	33,026.8	65.1%	0.0575	2,914,118
Fossil fuel	ТЭЦ-21	CHP	9,113.6	47,853.6	80,662.5	65.1%	0.0575	7,117,250
Fossil fuel	ТЭЦ-22	CHP	8,199.6	38,656.9	68,175.5	65.1%	0.0575	6,015,458
Fossil fuel	ТЭЦ-23	CHP	8,734.3	39,099.4	70,542.9	65.1%	0.0575	6,224,344
Fossil fuel	ГРЭС-24	CHP	1,492.8	-	5,374.1	65.1%	0.0575	474,181
Fossil fuel	ТЭЦ-25	CHP	8,313.0	30,126.9	60,053.7	65.1%	0.0575	5,298,836
Fossil fuel	ТЭЦ-26	CHP	8,932.2	36,733.3	68,889.2	65.1%	0.0575	6,078,434
Fossil fuel	ТЭЦ-27	CHP	1,116.4	9,701.5	13,720.6	65.1%	0.0575	1,210,633
Fossil fuel	ТЭЦ-28	CHP	107.0	837.2	1,222.4	65.1%	0.0575	107,855
Nuclear	ЗаГАЭС (nuclear)	Power	1,950.2	-	7,020.7		-	-
	total		72,655.3	295,437.3	556,996.4			48,406,312
*Tthe electrcity is produced with hydro energy. The heat with fossil fuel in boilers								
						TCO_2/GJ energy produced		**86.91** (value to be used in baseline and PA emssion calculation)
						TCO_2/MWh energy produced		**0.3129** (value to be used in baseline and PA emssion calculation)

Determination of average fossil fuel emisison factor and average total effciency of fossile fired power and/or heat production plants

								IPCC			
Fossil electricity and heat generated in 2004			2004 fossil fuel consumption					CO_2 emission factor			
			Fossil fuel	x 1000 ton fuel eqv.*)				TCO_2/GJ	TCO_2		
Electricity	Heat		Gas	26,470	=	775,580	TJ	0.0561	43,510,026		
x 10^6 kWh	x 10^3 GJ		LDO	1,410	=	41,310	TJ	0.0733	3,028,028		
70,325	295,437		HDO	861	=	25,213	TJ	0.0741	1,868,257		
				28,741		842,103	TJ	**0.0575**	48,406,312		
253,170	295,437	TJ									
				**) 1 kg fuel eqv.*	=	*29.3*	*MJ*	(Average fuel emission factor			
Total (electricity + heat)	548,607	TJ						to be used in baseline and PA emission calculation)			
Fossil fuel used	842,103	TJ									
								IPCC default values used:			
Average total efficiency								- gas: 15.3 TC/TJ			
fossil fueled CHP plants	**65.1%**	(value to be used in baseline and PA emssion calculation)						- LDO as diesel oil have an emission factor of 20.2 TC/TJ			
								- HDO (FO) as fuel oil has an emission factor of 21.1 TC/TJ			
								mass conversion factor 44/12 (TCO_2/TC)			

The grid data is made public available by Mosenergo on a/o the website:

The grid emission factor and efficiencies shall be determined <u>ex-post</u>. For a conservative approach a 1.0% autonomous efficiency improvement (technical improvements and newly build) per year has been taken into account. For example in 2008 the total efficiency therefore will be 68.5%. This efficiency is used in the 2009 baseline (the year that the PA fully implemented).

New Baseline Methodology
(separate document)

Annex 3

MONITORING PLAN

The monitoring is designed for monitoring system levels improvements in the District heating sector, for the following parameters:

- Specific Electrical Energy consumption
- Specific (natural) gas consumption
- Specific Thermal Energy (Heat) supplied to the project area
- Efficiency of generation of electrical energy
- Change in ratio of electrical power sourced from grid
- Efficiency of generation of thermal energy that is supplied to the project area
- Changes in thermal production plants that supply the project area

The Project Activity involves improvements in the first 4 parameters mentioned above.

The methodology is therefore able to cover these improvements. The methodology requires monitoring of the following:

- Quantity of thermal energy (heat) consumed by the end-users. If this quantity cannot be monitored it shall be calculated. Input data for this calculation shall be monitored;
- Data needed to calculate emission factor of grid;
- Data needed to calculate emission CO_2 emissions from fossil fuel used for thermal energy production either within the project area or outside.

Within KDHC a qualified Project Coordinator will be given the task to:

- Monitor consumption en generation performance and other related data as per Monitoring Plan and apply quality assurance measure as outlined in the Monitoring Plan;
- Will estimate Project Emissions and Baseline Emission and emission reductions;
- Will prepare a management report;
- Will keep the record as per Monitoring Plan.

Both Lighthouse and Haskoning will assist in above-mentioned tasks.

New Monitoring Methodology
(separate document)

Annex 4

EVALUATION AND MONITORING PLAN FOR SUSTAINABLE DEVELOPEMNT CRITERIA

Table: Sustainable Development Criteria and Relevant Performance Indicators

COMPONENTS Sustainable development criteria	**Score (-2 to +2)**	**Comments on the score**	**Relevant criteria for the follow-up of the Project (yes/no and why)**	**Relevant Performance Indicators (to be included in the Monitoring Plan *sensu lato*)**
A. Local / regional / global environment				
- Water quality and quantity	0		No	Not relevant (there are no emissions to water)
- Air quality (emissions other than GHGs)	+1	Reduction of emission in project area of NOx	Yes	NOx measurements. Annually performed on all emission sources of Khimki DHC within project area
- Other pollutants (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases)	0		No	Not relevant (there are no other emissions)
- Soil condition (quality and quantity)	0		No	Not relevant (there are no emissions to soil)
- Biodiversity (species and habitat conservation)	0		No	Not relevant (The Project Activity has no impact on species and habitat)
Sub-total for A	+1			
B. Social sustainability and development				
- Employment (including job quality, fulfilment of labour standards)	0		No	Not relevant. The project Activity has no impact job quality, fulfilment of labour standards.
- Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	0		No	Not relevant. The project Activity has no impact job quality, fulfilment of labour standards.
- Access to energy services	+1	Project Activity results in: • Higher reliability of supply • and lower heat prices due to higher efficiency	No	The Project Activity has impact on the access to energy as it saves energy that will result in lower process compared to the baseline of no energy savings. More people will be able to pay for heating energy.
- Human and institutional capacity (including empowerment, education, involvement, gender)	0		No	Not relevant
- Prior, free & informed consent of affected indigenous people and longstanding local communities	0		No	Not relevant
Sub-total for B				

Cont'd next page

C. Economic and technological development				
- Employment (numbers)	0		No	No impact. There will be no net employment increase nether reduction
- Balance of payments (sustainability)	0		No	No impact. Natural gas is of Russian origin.
- Technological self reliance (including project replicability, hard currency liability, skills development, technology transfer)	0		No	No impact. All applied knowledge and technologies are commonly available in Russia.
Sub-total for C	0			

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