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

CONTENTS

SECTION A. General description of the project

A.1. Title of the project:

Installation of three gas turbines SGT-800 type at GTES “Kolomenskoe”, Moscow, Russian Federation. (ex. Installation of three combined cycle gas turbine SGT-800 at GTES “Kolomenskoe”, Moscow, Russian Federation.)

Sectoral scope 1: Energy industries (renewable/non-renewable sources) [1].

PDD version 1.4.

16 of March, 2012

A.2. Description of the project:

Project objective

The project’s purpose is construction of a Gas Turbine Power Plant “Kolomenskoe” (here in after referred as GTES -“Kolomenskoe” with the use of natural gas as a fuel and intended for the combined production of electricity and heat. This project will allow increasing of natural gas combustion efficiency and reducing of CO_2 emissions due to the use of modern equipment and combined heat and electricity generation.

Project concept

- **Situation existing prior to the project**

Prior to the project implementation electricity to meet residential needs of municipalities Moskvorechye - Saburovo, Nagatino - Sadovniki and Tsaricino of the Southern Administrative District of Moscow was imported from a centralized power system (URES “Centre”). The URES “Centre” is composed of 18 provincial electricity systems (PESs), while these systems have interconnections with the neighboring ones. Supply of heat energy was carried through: district heating station (DHS) Kolomenskoe, DHS Nagatino, DHS Lenino-Dachnoe, Quarter heating station (QHS)-16 and QHS-17.

- **Baseline scenario**

The baseline scenario represents Business as Usual (BAU) practice. In the absence of the project activity the current heat generation from the DHSs and QHSs using natural gas and electricity supply from the centralized power system (URES “Centre”) would continue.

- **Project scenario**

The project includes the construction and operation of the GTES “Kolomenskoe”. The GTES “Kolomenskoe” was commissioned in May 2009. The GTES “Kolomenskoe” has power capacity 136 MW and heat capacity 171 Gcal/h. The project includes construction of 3 gas turbine units (GTU), with capacity 45.3 MW each, while exit gases will be used in the 3 heat-recovery boilers with capacity 57 Gcal/h each. Natural gas will be the main and back-up fuel for the new GTES Kolomenskoe. The main technical data of the units are presented in the Table A.2.1 below.

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[1] http://ji.unfccc.int/Ref/Documents/List_Sectoral_Scopes_version_02.pdf

Table A.2.1: Main technical data of energy units at GTES-Kolomenskoe

N	Type of energy unit	Producer	No.	Unit capacity	Type	Fuel
1-3	GTU	"Siemens"	3	45.3 MW	SGT-800	Natural gas
4-6	Heat recovery boiler	JSC Machine-Building Plant ZiO-Podolsk	3	57 Gcal/h	KUV 60/150	-

Electricity and heat at the GTES "Kolomenskoe" will be generated using more efficient technology. Electricity will replace electricity that otherwise would be generated using less efficient technologies at the power plants connected to the grids of the Russian Federation. Heat generated at GTES Kolomenskoe will replace heat supplied to the consumers by the DHS and QHS. The heat generated by GTES Kolomenskoe is transmitted into the heating network of OJSC "MOEK" (Moscow Joint Energy Company)

History of the project

The decision to construct the GTES was taken in 2006 on the working meeting. Benefits and disadvantages of constriction of the new GTES were discussed. The idea to attract Kyoto financing was announced at this meeting. After due discussions and research regarding possibilities to implement this project as a JI project activity the decision to implement this project within the framework of the Kyoto protocol was taken. The project had been started in 2007 and commissioned in May 2009.

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)	LLC NaftaSib Energy	No
Party B: The Netherlands	Global Carbon BV	No

Roles of the project participants:

- LLC NaftaSib Energy was established in August 2005. The main activities of the Company - production of electricity and thermal energy and operation of power plants. LLC NaftaSib Energy is the owner of the GTES Kolomenskoe, as well as the operating GTES organization. Operation of GTES Kolomenskoe is carried out by own personnel of the NaftaSib Energy. Staff has necessary qualification. Operational staff was trained at educational center 'Siemens' in Germany and in a specialized training center in Moscow.

- Global Carbon BV is the leading expert on environmental consultancy and financial brokerage services in the international greenhouse emissions trading market under the Kyoto Protocol. Global Carbon has developed the first JI project that has been registered at the United Nations Framework Convention on Climate Change (UNFCCC). The first verification under JI mechanism was also completed for Global Carbon B.V project. Company focuses on Joint Implementation (JI) project development in Bulgaria, Ukraine and Russia. Global Carbon BV is responsible for preparation of the investment project as a JI project including PDD preparation, obtaining Party approvals, monitoring and transfer of ERUs. Global Carbon BV is a project participant.

A.4. Technical description of the project:

A.4.1. Location of the project:

Project area location – Russian Federation, Central Federal District, city of Moscow (see Figure A.4.1.1 below).

A.4.1.1. Host Party(ies):

The Russian Federation.

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

Central Federal District is one of the eight federal districts of Russia. The word "Central" is of political and historical meaning; geographically, the district is situated in the extreme west of Russia. The district spans an area of 652,800 square kilometres (252,047.5 sq mi), with a population of 38,000,651 (80.6% urban) according to the 2002.

Figure A.4.1.1: Map of Russia with location of Central Federal District (highlighted in brown)

Source: http://en.wikipedia.org/wiki/File:Map_of_Russia_-_Central_Federal_District.svg

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

Moscow city
Moscow is the capital, the most populous city, and the most populous federal subject of Russia. Moscow is situated on the banks of the Moskva River, which flows for just over 500 km through the East European Plain in central Russia. Moscow has a humid continental climate.

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

GTES-Kolomenskoe is located within the Moscow city boundaries in the south part of the city. Its location is presented on the Figure A.4.1.2 below. The coordinates of GTES are 55°38'N, 37°38'E.

Figure A.4.1.2: Location of GTES-Kolomenskoe

Source: http://www.bing.com/maps or http://maps.google.ru/maps

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

The Project involves installation of all elements of power units: three gas engines, three heat-recovery boilers, and auxiliary equipment. Application of the cogeneration can significantly increase utilization of fuel heat (design efficiency value equals to 88.58%). Natural gas for use in gas turbines (GTU) supplied from two independent threads of gas pipeline P = 1.2 MPa (the main source of fuel) and P = 0.6 MPa (reserve).

The engine hall contains three gas turbines where potential energy of the combustion products produced in the combustion chamber is converted into mechanical energy of rotation of the rotor of a gas turbine which causes the compressor and electricity generator. In the boiler hall three waste-heat boilers installed intended for the heating network water from 70 ºC to 150 °C exhaust gases from the gas turbine SGT-800.

The atmospheric air is fed into the inlet of the GTU air compressor; also the fuel enters the combustion chamber of a gas turbine. Natural gas is the fuel for the gas turbine unit. When gas is combusted, the working gases are fed into the gas turbine at the rotor which is driven of compressor and electric generator. Also after gas turbine the working gases are fed into waste-heat boilers. Waste heat boiler is the main process equipment for heating system water to a temperature 150 ^{0}C. Delivery water is fed to the city network for heating and hot water supply. The waste heat boilers is providing heat load of 171 Gcal/h.

At the GTES Kolomenskoe consisting of three gas turbine units (GTU) the following basic equipment is installed:

- Gas turbines SGT-800;
- Waste heat boilers KUV 60/150;
- Auxiliary equipment.

Table A.4.1. Technical characteristics of the gas turbine SGT-800[2]

Parameter	Units	Value
Capacity	MW	45.3
Electrical efficiency	%	36.63
Rotor speed turbine	rpm	6600
Rotor speed EG	rpm	1500
Temperature of the exhaust gases	°C	537

Table A.4.2. Technical characteristics of the heat-recovery boilers

Parameter	Units	Value
Capacity	Gcal/h	57
Gas flow rate at the inlet to the boiler	kg/sec	140.50
The gas temperature at the inlet of waste-heat boilers	°C	523.95
The gas temperature at the outlet of the waste-heat boilers	°C	102
Temperature of water at the inlet	°C	70
Temperature of water at the outlet	°C	150

The technical characteristics of the GTES are described in the Table A.4.3 below.

Table A.4.3. Technical indicators of GTES

Parameter	Unit	Value
Annual electricity supply	mln.kWh	890.62
Electricity consumption for own needs	%	6.16
Annual heat supply	Thou.Gcal	1155.14
Heat consumption for own needs	%	1.56
Number of hours of the installed power use – • Electricity • Heat	hour hour	7020.8 6933.3
Annual natural gas consumption	Mln.m^3	261.05
Specific fuel equivalent consumption • for electricity generation • for heat energy generation	g.f.eq./kWh kg.f.eq./Gcal	157.3 156.5

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[2] Data from project owner

During the project implementation, the training of operational and maintenance personnel was made:
- qualification upgrade courses for personnel;
- training of workers for the new waste heat boilers and gas turbine equipment operations.

Implementation schedule

The project implementation schedule is presented in the Table A.4.4.

Table A.4.4. Project implementation schedule

Operations	Implementation date
Decision making	May 2006
Contract with project developer has been signed	December 2006
Start of the preparatory period	July 2007
Start the principal period	February 2008
Completion	April 2009
Commissioning	May 2009

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 lead to the reduction of the GHG emissions, out of which the primary ones are CO_2. The N_2O and CH_4 emissions during the combustion of the fossil fuel were not considered during the emission reduction estimate for this project.

The reduction of CO2 emissions as a result of this project implementation will occur through the replacement of electricity, generated in the of URES “Centre” and heat generation from the DHS.

The introduction of the cogeneration to generate electricity and heat leads to reduction in fossil fuel consumption comparing separate production of heat boilers using natural gas and electricity - at condensing power plants. Also application of the cogeneration can significantly increase available-heat factor of fuel and effective use of installed equipment to produce electricity and heat.

In the absence of the suggested project implementation, such emission reductions are impossible due to the following reasons:

- No significant changes in the Russian Federation legislation are foreseen, which could force the owners and management of the Center regional power stations to abandon the use of the existing boilers and steam turbines for generation of heat energy and electricity, or to reduce significantly their production capacities;
- Construction of gas turbine units for purposes of electricity generation with the utilization of exhaust gases’ heat for heat generation is not a common practice in the Russian Federation.

In the absence of the project, more greenhouse gases would be emitted to supply the same amount of electricity and heat due to natural gas combustion.

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

	Years
Length of the crediting period within 2008-2012	3.58
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2009	70 279
2010	125 594
2011	205 951
2012	205 951
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	607 776
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	169 612

	Years
Period after 2012, for which emission reductions are estimated	8
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	205 951
2014	205 951
2015	205 951
2016	205 951
2017	205 951
2018	205 951
2019	205 951
2020	205 951
Total estimated emission reductions over the period indicated (tonnes of CO_2 equivalent)	1 647 611

Detailed calculation of project emission reductions is presented in Section E.

A.5. Project approval by the Parties involved:

The project was approved by the Parties involved:

Russia (Host party) – the Letter of approval from the Ministry of Economic Development decision dated 12 March 2012 No 112.

The Netherlands (Investor) – the Letter of approval from NL Agency, Ministry of Economic Affairs dated 01 April 2011 No 2011JI09.

SECTION B. Baseline

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

Methodological approach

The baseline scenario is established in compliance with the "Guidance on criteria for baseline setting and monitoring" (version 02) of the Joint Implementation Supervisory Committee (JISC)[3]. In accordance with this Guidance, the project participants can establish a baseline in accordance with Appendix B of the JI guidelines (JI specific approach, paragraph 9 (a) of the Guidance), or they may apply approved CDM baseline and monitoring methodologies (paragraph 9 (b) of the Guidance).

Also in general, during baseline development the developer suggests using JI specific approach, but definitely coordinating it with the requirements set forth in Decision 9/CMP.1, Annex *B* "Criteria for baseline setting and monitoring"[4]. Everything related to emissions' estimate is sufficiently described and justified.

The choice of baseline scenario is based on the definition of the most probable alternatives:

Step 1: Identification of a baseline based on the selection of the most plausible alternative scenario

Identification and listing of plausible alternatives
Based on the JI specific approach presented above three plausible alternatives is identified:

Alternative scenario 1: Continuation of the existing practice, i.e. supply of the heat energy from the nearest boilers of DHS, QHS and electricity from the URES "Centre"
Alternative scenario 2: The proposed project not developed as a JI project;
Alternative scenario 3: Construction of the new boiler house for heat energy generation, electricity supplied from the URES "Centre"
Alternative scenario 4: Construction gas turbine unit and autonomous heat boiler for heat supply
Alternative scenario 5: Construction of combined cycle gas turbine power plant (CCGT)
Alternative scenario 6: Construction of the common steam turbine (CHP)

Given below is the estimate of the proposed scenarios with the purpose of identifying the opportunity for their consideration as the baseline in relation to the Project.

Alternative scenario 1 - *Continuation of the existing practice, i.e. supply of the heat energy from the nearest boilers of DHS, QHS and electricity from the URES "Centre"*

According to this scenario the operations of the existing DHS, QHS will continue as before the project implementation and electricity will be supplied from the grid.

The possibility of electricity supply
The demand for heat and power is determined based on the different parameters:

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[3] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

[4] Report of the Conference of the parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005. Decision 9/CMP.1 Guidelines for the implementation of Article 6 of the Kyoto protocol. Appendix B Criteria for baseline setting and monitoring. p.12-13.

- socio-economic development
- population growth dynamics
- structural changes in economy

Consumption and generation of electricity in the URES Centre, according to the data of the Russian Federation statistical service, are presented in the Table B.1.1[5]. Throughout 2002-2008, the URES "Centre" remained energy surplus and during of this period the electricity consumption not exceeded the respective generation

Table B.1.1. Balance of electricity generation and consumption in the URES "Centre" (2005 - 2008), mln kWh/year

	2005	**2006**	**2007**	**2008**
Generation of electricity in the URES "Centre"	209 838.4	224 685	228 233.3	229 879
Consumption of electricity in the URES "Centre"	191 174.5	200 668.3	202 939.3	202 591
Surplus (+) / deficit (-) of electricity	18 663.1	24 016.7	25 294	27 288

Furthermore after the OJSC RAO "UES of Russia" reforms, the obligations pertaining the development of the Russian Federation electricity (power) balances was assigned to the CJSC "Agency for Prediction of Balances in Electric energy" (CJSC "APBE").

As per the APBE prediction, the Russian Federation energy system in 2009-2015 will remain with the energy capacity surplus (Table B.1.2)[6]. Also the greatest excess of power is concentrated in the area of the URES "Centre". It means that the electricity to be generated by project could be provided by the existing power plants in the URES Centre.

Table B.1.2. Russian Federation capacity balance prediction, GW

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**
Generation of electricity in the Russian Federation	**213.5**	**219.3**	**227.1**	**236.2**	**239.7**	**244.9**	**251.2**	**276.8**
Consumption of electricity in the Russian Federation	**204.9**	**206.5**	**213.6**	**219.4**	**226.0**	**231.3**	**236.9**	**273.5**
Surplus (+) / deficit (-) of electricity	**8.6**	**12.8**	**13.6**	**16.8**	**13.6**	**13.6**	**14.2**	**3.3**
North-West UPS	0	0	0	0.1	0	0	0.5	0
Center UPS	4.2	5.6	7.0	7.4	6.8	6.3	5.3	1.4
Middle Volga UPS	1.7	3.3	2.4	3.4	3.5	3.6	3.7	1.5
South UPS	0	0	0	0.9	0	0.1	1.2	0
Ural UPS	0	0.8	0.9	1.2	0.9	0.8	0.9	0
Siberia UPS	2.7	3.1	3.3	3.8	2.4	2.7	2.6	0.4
East UPS	1.5	1.2	0.7	0.5	0.4	0.3	0.2	1.1

On the basis of forecasted capacity balance it can be seen that there is a possibility of additional electricity supply under preservation of the current situation.

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[5] http://www.gks.ru/free_doc/new_site/business/prom/el_balans.htm

[6] http://www.e-apbe.ru/5years/detail.php?ID=19193

Possibility of heat supply

Before the project implementation the heat was supplied from the DHS or QHS systems. The project was implemented in Moscow, the site is located near metro station Kashirskaya. The capacity of heat boilers is sufficient to cover heat generation needs (about 250 Gcal/h extra available). The heat supply and capacity of the DHS and QHS before the project are presented in Table. B.1.3.

Table. B.1.3

The productive energy supply from the DHS and QHS

Heat source	Heat load (contracted) Gcal/h	Heat generation capacity Gcal/h
DHS Kolomenskoe"	297.1	390
DHS "Nagatino"	189.22	240
DHS "Lenino-Dachnoe"	225.55	300
QHS-16	17.93	40
QHS-17	18.35	30
Total:	**748.21**	1 000

The existing city heating systems are in good condition, also pipelines are constantly updated and it is possible to replace some parts. Therefore the continued supply of heat from the DHS and QHS is good practice and do not lead to an emergency with the termination of the heat supply.

Thus, with the preservation of the current situation, the existing heat supply system will be able to cover the needs in the heat energy.

Therefore, this alternative can be viewed as the probable baseline scenario.

Alternative scenario 2 - ***The proposed project not developed as a JI project***

The project is installation of GTES that will produce heat and electricity. The electricity generated will replace electricity which otherwise would be generated at the other power plants of URES "Centre".

Heat will be generated by utilizing heat energy of the exhaust gases consumption from the GTES will replace heat generated by DHS and QHS**.** The GTES will be fuelled by natural gas.

As is shown in Section B.2 this project is not economically attractive. Therefore this alternative is a not the most realistic scenario.

Alternative scenario 3: ***Construction of the new boiler house for heat energy generation, electricity supplied from the URES "Centre"***

Possibility of the electricity supply from the URES "Centre" was proven above under the alternative 1 discussion. Also this alternative includes the construction of the new boilers house. New boiler house construction allows lower capital expenses, as compared to the proposed activity under the Project. Such a scenario is not favourable because for the continuation of the existing practice of existing DHS and QHS operation there is no need in any significant financial expenditure. Also the capacity of existing DHS and QHS will be enough to cover the growing demand in heat power. See the Table B1.3. for reference.

Alternative scenario 4: ***Construction gas turbine unit and autonomous heat boiler for heat supplied***

The installation of the gas turbine to produce electricity looks quite realistic. But according to the manufacturers specification the electrical efficiency of GTU unit equals to 36.63 (see Table A.4.1.) that is low comparing to GTU unit with the boilers. Construction of GTU for electricity generation only is not profitable for the company both economically and technically. Installation autonomous heat boiler for example peak hot-water boilers is not appropriate. Because the technical condition of the existing DHS, QHS will allow their further operations and capacity will be enough to cover the growing demand in heat power. Continuation supply of the heat energy from the nearest boilers was proven during the alternative scenario #1 consideration. This alternative cannot be considered as a baseline

Alternative scenario 5: ***Construction of combined cycle gas turbine power plant (CCGT)***
The construction CCGT requires different equipment. CCGT is highly efficient but CCGT requires large area. The project owner (here and after PO) does not have sufficient land for CCGT construction. Therefore this alternative cannot be viewed as the probable baseline scenario

Alternative scenario 6: ***Construction of the common steam turbine (CHP)***
The alternative cannot be considered as the baseline because CHP construction has several disadvantages. CHP includes many different peaces of equipment: large water- cooling towers, steam boilers or steam turbine which covers most part of area. PO does not have sufficient land to start CHP construction. This alternative cannot be viewed as the probable baseline scenario

Conclusion
Alternative 1 is the most realistic and credible and is selected as the baseline scenario.

Baseline scenario description
Baseline scenario represents the continuation of the current practice i.e. business as usual situation. Under the baseline scenario electricity will be supplied from the power plants of URES “Centre” and heat will be generated by the existing DHS and QHS and supplied to the centralized heat supply system. The natural gas emission factor 0.0561 tons of CO_2 /GJ is assumed based on the standard emission factors of energy carriers according to the data of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[7]. To establish the emissions associated with the baseline scenario a baseline emission factor has been calculated in accordance with the article 19 of the Guidance and using the CDM Tool “Tool to calculate the emission factor for an electricity system”, version 02. The baseline emission factor calculations are provided in Annex 2.

The key data and information used to establish the baseline are presented in tabular form below:

Data/Parameter	$EG_{PJ,y}$
Data unit	MWh/year
Description	Annual GTES Kolomenskoe electricity supply
Time of determination/monitoring	Annually
Source of data (to be) used	Form of Federal Statistical observation 6-TP
Value of data applied (for ex ante calculations/determinations)	<table><tr><td>Year</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr><tr><td>Value</td><td>243 351</td><td>429 831</td><td>714 110</td><td>714 110</td></tr></table>
Justification f the choice of data or description of measurement methods and procedures (to be) applied	Determined using a electricity meter
OA/QC procedures (to be) applied	The procedures will be regulated by the procedures approved by the management of the company
Any comment	-

Data/Parameter	$FC_{i,y}$
Data unit	Tonnes of coal equivalent (t.c.e)
Description	Amount of fossil fuel *i* (coal, heavy fuel oil, natural gas, peat and other fuels) consumed in the project electricity system in year *y* (for 2007-

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[7] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2. Energy. Chapter 2 Stationary combustion. p 2.16

	2009)
Time of determination/monitoring	Ex-ante
Source of data (to be) used	Federal Service of State Statistics (RosStat)
Value of data applied (for ex ante calculations/determinations)	Please see Table 2.2 in Annex 2
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$NCV_{t.c.e.}$
Data unit	kcal/ t.c.e.
Description	Net calorific value of ton of fuel equivalent
Time of determination/monitoring	Ex-ante
Source of data (to be) used	Federal Service of State Statistics (RosStat)
Value of data applied (for ex ante calculations/determinations)	7,000 kcal/ t.c.e. (or 7,000 kcal/ t.c.e. × 4.19 kJ/kcal / 1,000 = 29.33 GJ/t.c.e.)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

<table>
<tr><td>Data/Parameter</td><td>$EF_{CO2\,i,y}$</td></tr>
<tr><td>Data unit</td><td>tCO_2/GJ</td></tr>
<tr><td>Description</td><td>CO_2 emission factor of fossil fuel type <i>i</i> in year <i>y</i></td></tr>
<tr><td>Time of determination/monitoring</td><td>Ex-ante</td></tr>
<tr><td>Source of data (to be) used</td><td>2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 chapter 2, Table 2.2 p2.16-2.17</td></tr>
<tr><td>Value of data applied (for ex ante calculations/determinations)</td><td>Please see Table 2.3 in Annex 2
<table>
<tr><th rowspan="2">Fuel type</th><th>Default emission factor[8]</th></tr>
<tr><th>tCO2/GJ</th></tr>
<tr><td>Natural gas</td><td>0.0561</td></tr>
<tr><td>Heavy fuel oil</td><td>0.0774</td></tr>
<tr><td>Coal</td><td>0.0946</td></tr>
<tr><td>Peat</td><td>0.106</td></tr>
</table></td></tr>
</table>

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[8] Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006

	Other fuel types[9]	0.0
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-	
OA/QC procedures (to be) applied	-	
Any comment	The four main types of fuels are considered: coal, heavy fuel oil, natural gas and peat. The emission factor of the other types of fuels were assumed zero. It is conservative.	

<table>
<tr><td>Data/Parameter</td><td>$EG_{m,y}$</td></tr>
<tr><td>Data unit</td><td>MWh</td></tr>
<tr><td>Description</td><td>Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year <i>y</i></td></tr>
<tr><td>Time of determination/monitoring</td><td>Ex-ante</td></tr>
<tr><td>Source of data (to be) used</td><td>Federal Service of State Statistics (RosStat)</td></tr>
<tr><td>Value of data applied
(for ex ante calculations/determinations)</td><td>Please see Table 2.2 in Annex 2
<table>
<tr><th>Indicator</th><th>Unit</th><th>2007</th><th>2008</th><th>2009</th></tr>
<tr><td>Net electricity generation</td><td>MWh</td><td>146,230,953</td><td>148,962,737</td><td>119,827,664</td></tr>
<tr><td rowspan="2">Natural gas</td><td>t.c.e</td><td>42,757,580</td><td>42,941,363</td><td>34,148,007</td></tr>
<tr><td>GJ</td><td>1,254,079,816</td><td>1,259,470,180</td><td>1,001,561,051</td></tr>
<tr><td rowspan="2">Heavy fuel oil</td><td>t.c.e</td><td>480,474</td><td>534,282</td><td>287,576</td></tr>
<tr><td>GJ</td><td>14,092,297</td><td>15,670,500</td><td>8,434,619</td></tr>
<tr><td rowspan="2">Coal</td><td>t.c.e</td><td>4,025,757</td><td>3,200,880</td><td>1,940,377</td></tr>
<tr><td>GJ</td><td>118,075,457</td><td>93,881,816</td><td>56,911,249</td></tr>
<tr><td rowspan="2">Peat</td><td>t.c.e</td><td>152,049</td><td>114,689</td><td>40,038</td></tr>
<tr><td>GJ</td><td>4,459,598</td><td>3,363,841</td><td>1,174,300</td></tr>
<tr><td rowspan="2">Other</td><td>t.c.e</td><td>25,165</td><td>1,164,935</td><td>1,042,130</td></tr>
<tr><td>GJ</td><td>738,077</td><td>34,167,539</td><td>30,565,670</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>-</td></tr>
<tr><td>OA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td></td></tr>
</table>

Data/Parameter	$EF_{grid,OMsimple,y}$
Data unit	tCO_2/MWh
Description	Simple operating margin CO_2 emission
Time of	Ex-ante

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[9] Emission factor for other types of fuel is taken as zero. It is conservative

determination/monitoring	
Source of data (to be) used	Parameter is calculated according to the formula 1 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.546
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	BM emission factor
Time of determination/monitoring	Ex-ante
Source of data (to be) used	Parameter is calculated according to the formula 2 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.489
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin emission factor
Time of determination/monitoring	Ex-ante
Source of data (to be) used	Parameter is calculated according to the formula 4 of Annex 2
Value of data applied (for ex ante calculations/determinations)	0.532
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$HG_{PJ,y}$
Data unit	Gcal /year
Description	Annual GTES Kolomenskoe heat supply
Time of	Annually

<table>
<tr><td>determination/monitoring</td><td></td></tr>
<tr><td>Source of data (to be) used</td><td>Form of Federal Statistical observation 6-TP</td></tr>
<tr><td>Value of data applied
(for ex ante calculations/determinations)</td><td><table><tr><td>Year</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr><tr><td>Value</td><td>378 938</td><td>683 989</td><td>929 280</td><td>929 280</td></tr></table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Determined using a heat meter</td></tr>
<tr><td>OA/QC procedures (to be) applied</td><td>The procedures will be regulated by the procedures approved by the management of the company</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

Data/Parameter	η_{heat}
Data unit	
Description	Average efficiency of boilers of central heating workshop DHS
Time of determination/monitoring	Ex-ante
Source of data (to be) used	Tool to determine the baseline efficiency of thermal or electric energy generation systems
Value of data applied (for ex ante calculations/determinations)	0.87%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	4.187
Data unit	Gcal /GJ
Description	Conversion factor
Time of determination/monitoring	Ex-ante
Source of data (to be) used	http://www.ru.convert-me.com/ru/convert/units/energy/energy.cal.ru.html
Value of data applied (for ex ante calculations/determinations)	4.187
Justification of the choice of data or description of measurement methods and procedures (to be) applied	-
OA/QC procedures (to be) applied	-
Any comment	-

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

The “Tool for the demonstration and assessment of additionality” (version 05.2)[10] approved by the CDM Executive Board was used in order to prove the project additionality. Upon the proof of the additionality, the following series of steps is stipulated by the tool:

1. Identification of alternatives to the project activity consistent with current laws and regulations;
2. Investment analysis (including the sensitivity analysis);
3. Barrier analysis;
4. Common practice analysis.

For the setting of the project baseline the analysis of alternatives is done in order to select the most plausible baseline scenario

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

Sub-step 1a: Define alternatives to the project
Plausible alternatives to the project were identified in Section B.1 above:
Alternative scenario 1: Continuation of the existing practice, i.e. supply of the heat energy from the nearest boilers of DHS, QHS and electricity from the URES “Centre”
Alternative scenario 2: The proposed project not developed as a JI project;
Alternative scenario 3: Construction of the new boiler house for heat energy generation, electricity supplied from the URES “Centre”;
Alternative scenario 4: Construction gas turbine unit and autonomous heat boiler for heat supply
Alternative scenario 5: Construction of combined cycle gas turbine power plant (CCGT)
Alternative scenario 6: Construction of the common steam turbine (CHP)

Only alternatives 1 and 2 were identified as realistic and credible.

Sub-step 1b: Consistency with mandatory laws and regulations
All the alternatives defined in sub-step 1a are in compliance with mandatory legislation and regulations.

Step 2: Investment analysis
The main goal of the investment analysis is to determine whether the proposed project is not:
(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of ERUs associated with the JI project.

To conduct the investment analysis, the following sub-steps have to be applied.

Sub-step 2a: Determine appropriate analysis method
In principle, there are three methods applicable for an investment analysis: simple cost analysis, investment comparison analysis and benchmark analysis.

A simple cost analysis (Option I) shall be applied if the proposed JI project and the alternatives identified in step 1 generate no financial or economic benefits other than JI related income. The proposed JI project results in additional sales revenues due to the electricity that will be generated. Thus, this analysis method is not applicable.

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[10] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

The Additionality Tool allows for an investment comparison analysis which compares suitable financial indicators for realistic and credible investment alternatives (Option II) or a benchmark analysis (Option III). For this project a benchmark analysis (Option III) is appropriate in accordance with the attached guidance to the Additionality Tool (paragraph 15).

Sub-step 2b: Option III. Apply benchmark analysis

The internal rate of return (IRR) was chosen as the financial indicator during the comparative financial analysis, as it allows the comparison of projects with different levels of required investments. IRR benchmark analysis is calculated according to the Table B.2.1.

Table B.2.1. Financial indicators used to set benchmark

#	Factor	Rate	Description	Source
1	Risk-free rate	4.56%	German long-term interest rate in euro as a secondary market yields of government bonds with remaining maturity close to ten years, June 2007. This rate is taken as Germany is the largest Euro economy.	European Central Bank[11]
2	Country risk premium	**1.73%**	This portion of the risk reflects unique risks of investment being made in Russia. The additional return (premium) is required to cover political uncertainty, ownership risks, profit repatriation risk etc	*Country risk*[12]
3	Euro inflation	2.30%	Inflation in euro zone	Eurostat[13]
4	Real risk-free rate	**2.21%**	*Real interest rate=(1+Nominal Interest Rate)/(1+Inflation)-1*	*Source:* *http://ru.wikipedia.org/*
5	Company related risk premium	**4 %**	Company-specific risk premium associated with company stability, reputation, overall estimation.	
6	Project risk premium	**8%**	This type of projects has the medium risk factor of 8-10%. Thus the lowest range is applied to be conservative.	Methodological recommendations on evaluation of investment projects efficiency. Approved by Ministry of Economy of the RF, Ministry of Finance of the RF, State Committee of the RF on Construction, Architecture and Housing Policy of the RF 21.06.1999 N BK 477.

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[11] The calculation at constant prices as of the time of decision-making provides an objective view of the long-term future. It allows to perform a “pure” sensitivity analysis not impacted by expert estimations of inflation levels, prices etc., and to identify the most important factors actually impacting the project’s financial performance.

[12] http://www.stern.nyu.edu/~adamodar/pc/archives/ctryprem06.xls

[13] http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&language=en&pcode=tsieb060&tableSelection=1&footnotes=yes&labeling=labels&plugin=1

#	Factor	Rate	Description	Source
7	Total expected return	**15.94%**	This rate takes into account real (inflation adjusted) risk-free rate increased by a general expected market return, country risk and specific project risk.	

Sub-step 2c: Calculation and comparison of financial indicators
The financial analysis refers to the time of investment decision-making.

The following assumptions have been used based on the information provided by the enterprise:

1. The project requires investments of approximately RUR 6 519,030 million during five years or 187 275 kEuro;
2. VAT rate: 18%;
3. Profit tax rate: 24%;
4. Depreciation period 20 years
5. Date of project realization commencement: June 2007
6. Installed CHPP capacity:
   - electricity – 136 MW;
   - heat energy – 171 Gcal/h.
7. Supplied electricity and heat energy price: according to the market data;
8. Natural gas price: according to the market data;
9. Personnel headcount: 106 people of operational staff ;
10. The scrap value is calculated as GTES equipments weight (documented) multiplied by scrap price;
11. Production is assumed at the maximum technical capacity.

The project's financial indicators are presented in the Table B.2.2 below.

Table B.2.2. Financial indicators of the project

Scenario	**IRR (%)**
Project	7.6
Benchmark	15.94

Therefore, the construction of the GTES "Kolomenskoe" has lower financial figures than benchmark and the activity under the project cannot be considered as baseline scenario.

Sub-step 2d: Sensitivity analysis
Sensitivity analysis was performed varying the following factors:
1. Investment expenses;
2. Heat and electricity price;
3. Natural gas price.

Table B.2.3 Results of the sensitivity analysis

Parameters	**IRR %**		
	+10%	**0%**	**-10%**
Investment change	6.2%	7.6%	8.7%
Natural Gas price change	6.7%	7.6%	7.8%

Parameters	IRR %		
Electricity price change	8.7%	7.6%	6.0%
Heat energy price change	7.7%	7.3%	6.8%

Hence, the sensitivity analysis consistently supports (for a realistic range of assumptions) the conclusion that the project is unlikely to be financially/economically attractive.

Step 3: Barrier analysis

In line with "Tool for the demonstration and assessment of additionality" a barrier analysis is not conducted.

Step 4: Common practice analysis

Sub-step 4a: Analysis other activities similar to the proposed project activity:
The thermal power stations using simple cycle for electricity generation is dominated power generation in Russia. Share of GTU units, based on the analytical report "Functioning and development of electric energy in the Russian Federation in 2007", which was prepared by the CSJC "Agency for Prediction of Balances in Electric energy", amounts to only less than 2% of the total installed capacity of energy units in the Russian Federation (Table B.2.4). Until now, these were pilot projects with the main purpose to try new technologies.

Table B.2.4. Total installed capacity of heat power plant equipment by type

Power plant/unit	Average annual installed capacity, MW	Share of the total capacity, %
Condensation power units	60 719	45.4
Units of CPP-90 type	3 361	2.5
Unit of TPP -240 type	5 220	3.9
Unit of TPP -130 type	45 497	34.0
Unit of TPP-90 type	11 372	8.5
CCGT	2 503	1.9
Gas turbine plants	1 528	1.1
Other	3 443	2.6

The new GTU energy units (of more than 50 MW having been installed during the last 10 years in the URES "Centre") are presented in the Table B.2.5.

Table B.2.5: New energy units (more than 50MW) in the URES "Centre" Russia

Power plant/unit	Commissioning	Capacity, MW	Technology	Fuel	Cycle
URES "Centre"					
"Lutch" CHP	2005	60	GTU	Gas	Cogeneration
Belgorod CHPP[14]	2008	60	GTU	Gas	Cogeneration

In line with the Tool's requirements only the Lutch" CHP (60 MW) can be considered as other activities similar to the proposed project activity.
The plant was constructed during the time that RAO UES as a monopolistic company still existed. It was the biggest energy company almost fully controlled by the state. This project was of the high priority as a pilot project to demonstrate the quality and applicability of gas turbines produced in Russia. The project was implemented due to the high political importance and thus cannot be considered as project implemented in a common environment relevant for this common practise analysis
Also according to the "Tool for the demonstration and assessment of additionality" JI projects activities are not to be included in this analysis. Therefore such JI project Belgorod CHPP (0067) was not included in this analysis.
GTES "Kolomenskoe" was one of the first project in Russia in the energy sector, implemented the principles of project finance and to been built on private investment.
Therefore there are no other activities similar to the proposed project activity. Therefore it is proved that the JI project is not a common practice.

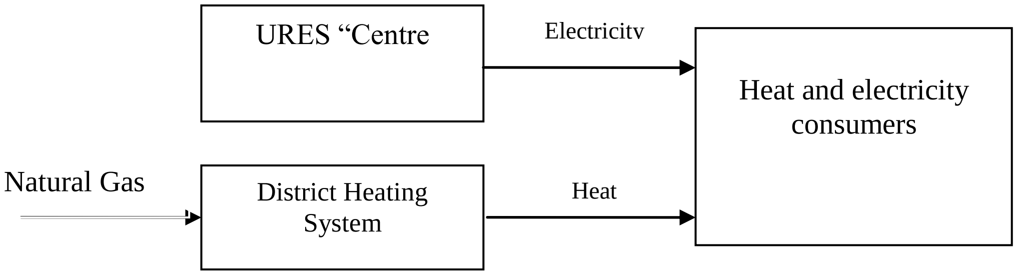
Sub-step 4b: Discuss any similar Options that are occurring:
The similar activities are not widely observed so this sub-step is not applicable.

Conclusion
The application of the Additionality Tool demonstrates that the emission reductions by the proposed JI project are additional to any that would otherwise occur.

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

The project boundary and baseline situation is presented in Figure B.3.1.-3.2.

Figure B.3.1: Baseline



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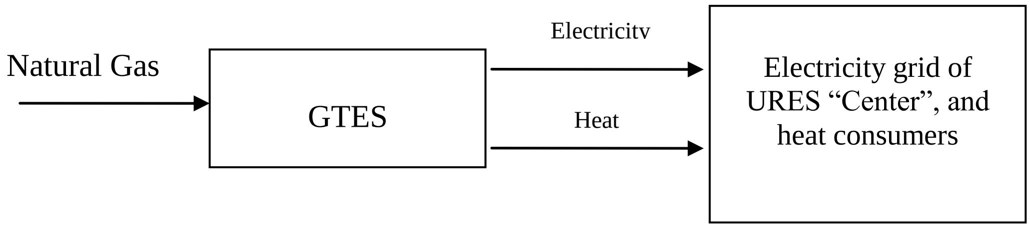
[14] http://ji.unfccc.int/JI_Projects/DB/CUNPF7EIG75Z5ICK38Q91CBBHOG8VY/PublicPDD/J8KOOTRXL3PBNRVGADCZNJ85O5O3WI/view.html

Figure B.3.2: Project boundary



Emissions sources and greenhouse gases types included in or excluded from the project boundary are presented in the Table B.3.1.

Table B.3.1: Emissions sources included or excluded from the project boundary

№	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity generation under baseline (URES “Centre”)	$\mathbf{CO_2}$	**Included**	**Main emission source**
		CH_4	Excluded	Excluding these emission from the baseline is conservative and in line with existing CDM methodologies[15]
		N_2O	Excluded	
	Natural gas combustion at DHS and QHS	$\mathbf{CO_2}$	**Included**	**Main emission source**
		CH_4	Excluded	Excluding these emission from the baseline is conservative and in line with existing CDM methodologies
		N_2O	Excluded	
Project activity	On-site natural gas combustion	$\mathbf{CO_2}$	**Included**	**Main emission source**
		CH_4	Excluded	Exclusions is for simplification as the emission are negligible and in line with existing CDM methodologies[16]
		N_2O	Excluded	
Leakage	Reduction of natural gas extraction, processing, transportation and distribution	CO_2	Excl.	Considered negligible. Conservative
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative

The use of new technology at the GTES as compared with separate power production allows reducing of natural gas consumption. Consequently, fugitive emissions of the CH_4 under the baseline are higher than those in the project scenario; therefore they are considered negligible, which is a conservative approach.

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[15] Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas, AM0029/version 03, Approved Methodology, CDM Executive board

[16] Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas, AM0029/version 03, Approved Methodology, CDM Executive board

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 completion of the baseline study: 14/12/2010
Name of person/entity setting the baseline:
Victor Petrochenkov
Global Carbon BV
E-mail: petrochenkov@global-carbon.com
Global Carbon BV is the project participant. Annex 1

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project is 18/07/2007

C.2. Expected operational lifetime of the project:

20 years/240 months.

C.3. Length of the crediting period:

26/05/2009 – 31/12/2012.
3 years 7 month/ 43 months
(The first crediting period under the Kyoto protocol – from January 1st of 2008 till December 31st of 2012)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Selection of baseline and monitoring is made based on the demands of the "Guidance on criteria for baseline setting and monitoring" and given the requirements of Decision 9/CMP.1, Appendix B "Criteria for baseline setting and monitoring". According to the "Criteria for baseline setting and monitoring" the project developer is using the JI specific approach for establishing the monitoring.

Collection of all key parameters required to calculate greenhouse gas emissions is undertaken in compliance with the established practice of GTES "Kolomenskoe". The project monitoring does not require amending the existing system of record and collection of information. All relevant data are calculated and recorded in any case. All leakage were considered, accounted for using the conservative approach and adopted negligible. The monitoring plan data should be stored for at least 2 years after the last transfer of ERUs for the project.

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
P1 $FC_{NG,y}$	Natural gas consumption	Fuel flow meter reading	m^3	m	Continuously	100%	Electronic	The natural gas will be recorded one time per month on the electronic and paper
P2 $NCV_{NG,y}$	Net Calorific Value of natural gas	Passport (quality certificate) from natural gas supplier	GJ/m^3	c	Monthly	100%	Electronic	Weighted average for the gas supplied during the year Annual value is

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
								calculated at the GTES and inserted into the report
P3 $EF_{CO2,NG,y}$	Emission factor for natural gas	IPCC	tCO_2/GJ	e	Annually	100%	Electronic	2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 chapter 2, Table 2.2 p2.16-2.17

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

Emissions of CO_2e in project scenario

The project activity is combustion of natural gas. The CO_2 emissions due to combustion natural gas if will be used as fuel at the (PE_y) are calculated as follows:

$$PE_y = PE_{NG,y} \tag{1}$$

where:

PE_y Project emission in year *y* (tCO_2);

$PE_{NG,y}$ is CO_2 emission due to natural gas combustion under the project scenario over a year *y*, t CO_2

$$PE_{NG,y} = FC_{NG,y} \times NCV_{NG,y} \times EF_{CO2,NG,y} / 1000 \tag{2}$$

where:

$FC_{NG,y}$ is the total volume of natural gas combusted at the new GTES Kolomenskoe unit in year *y* (m^3);

$NCV_{NG,y}$ is the net calorific value per volume unit of natural gas in the year *y* (GJ/m^3);

4.187 – Gcal to GJ conversion coefficient

$EF_{CO2,NG,y}$ is the CO_2 emission factor per unit of energy of natural gas in year *y* (tCO_2/GJ).

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
B1 $EG_{PJ,y}$	Annual electricity supply	Electricity meter readings	MWh/year	m	Annually	100%	Electronic	Federal Statistic form 6TP Electricity supply is determined as the ratio between the amount of electricity generated and consumed for the plant internal needs
B2 $EF_{BL,CO_2,y}$	Baseline emission factor for the electricity generated at URES “Centre”	Annex 2 of PDD	tCO_2/MWh	c	Fixed ex ante	100%	Electronic	Combine margin emission factor of United Regional Electricity System “Centre”. See Annex 2.
B3 $HG_{PG,y}$	Annual heat supply	Heat meter readings	GJ/year	m	Annually	100%	Electronic	Federal Statistic form 6TP Heat supply is determined as

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:

								the ratio between the amount of heat generated and consumed for the plant internal needs -
B4 $EF_{CO2,NG,y}$	Emission factor for natural gas	IPCC	tCO_2/GJ	e	Annually	100%	Electronic	2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 chapter 2, Table 2.2 p2.16-2.17

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

The baseline emission is defined as:

$$BE_y = BE_{Heat,y} + BE_{grid\,y} \qquad (3)$$

where:

BE_y	are the baseline emissions in the year *y* (tCO_2);
$BE_{grid\,y}$	is the annual baseline CO_2 emission due to the Russian Federation energy system electricity generation, t CO_2/year;
$BE_{Heat,y}$	is the annual baseline CO_2 emission due to the heat energy generation at the DHS, t CO_2/year;

The amount of CO_2 emissions due to Russian Federation Unified Energy System based on the project electricity generation in the year, y.

$$BE_{grid_y} = EG_{PJ,y} \times EF_{BL,CO2,y} \qquad (4)$$

where:

$EG_{PJ,y}$ the annual electricity supply by GTES (monitored) in the year y (MWh/year);

$EF_{BL,CO2,y}$ is the baseline emission factor in year *y* (tCO$_2$/MWh). It is an ex-ante fixed value, see Annex 2.

The baseline amount of CO$_2$ emissions due to heat generation based on the project in the year;

$$BE_{Heat,y} = \frac{HG_{PG,y} \times EF_{CO2,NG,y}}{\eta_{heat}} \qquad (5)$$

where:

$HG_{PG,y}$ annual heat energy supply obtained as a result of baseline monitoring in the year y (GJ/year);

$EF_{CO2,NG,y}$ is the CO$_2$ emission factor per unit of energy of natural gas in year *y* (tCO$_2$/GJ);

η_{heat} is the boiler house efficiency for all DHS and QHS[17].

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:

Not applicable.

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):

Not applicable.

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

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[17] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf

Not applicable.

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:

Not applicable.

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

Not applicable.

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):

$$ER_y = BE_y - PE_y \tag{6}$$

Where:

ER_y	JI project emission reduction in year *y* (tCO_2);
BE_y	Baseline emissions in year *y* (tCO_2);
PE_y	Project emissions in year *y* (tCO_2).

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 main relevant Russian Federation environmental regulations:

- Federal law of Russian Federation “On Environment Protection” (10 January 2002, N 7-FZ);
- Federal law of Russian Federation “On Air Protection” (04 May 1999, N 96-FZ).

These laws and other national decrees establish the order and the frequency of the pollution sources inventory, standards of the pollutant emissions and the monitoring.

Control over the contaminants’ emission into the atmosphere will be carried out in compliance with the “Schedule for control over the compliance with the established MAC values”. Besides, the company reports in compliance with the following official annual statistical forms:

- 2-tp (air) *Data on the atmosphere air protection*, including the information on the amount of the collected and neutralized atmospheric pollutants, detailed emissions of specific contaminants, number of emission sources, measures for reduction of emissions into the atmosphere and emissions from separate groups of contamination sources, (prepared according to the resolution of the Russian State Statistical Committee dd. July 27th of 2001 # 53 "On the establishment of the statistical tools for the arrangement of statistical monitoring over the environment and agriculture"[18]);

- 2-tp (water management) *Data on the water usage*, including the information on the water consumption from natural sources, discharge of waste water and content of contaminants in the water, capacity of water treatment facilities etc. (prepared according to the resolution of the Russian State Statistical Committee dd. November 13th of 2000 # 110 "On the establishment of statistical tools for the arrangement by the MNR of Russia of the statistical monitoring over the mineral reserves, geologic exploration operations and their funding, use of water and the accrued payments for environmental contamination"[19]);
- 2-tp (wastes) Data on the generation, use, neutralization, transportation and emplacement of production and consumption wastes, including the annual balance of the wastes management separately for their types and hazard classes, (prepared according to the resolution of the Russian State Statistical Committee dd. January 17th of 2005 #1 "The order of filling out and submission of the form of federal statistical monitoring N 2-TP (wastes)[20]).

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.
P1	Low	Gas flow meter. The meter calibration is carried out in compliance with the manufacturing plant schedule.
P2	Low	Certificates from the fuel supplier. The fuel supplier provides certificates for each fuel shipment with the specification of basic thermal performance
B1	Low	Electric meter is regularly calibrated in compliance with the schedule.Electricity supply will be calculated as the difference between the amount of energy generated and spent for the plant internal needs. The amount of electricity generated and consumed for the plant internal needs, will be measured by electric meter.

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[18] http://infopravo.by.ru/fed2001/ch04/akt16181.shtm

[19] http://n-kodeks.ru/legislation/acts/1240/4300/

[20] http://www.gvir.ru/text2008/n19/gdi19058.htm

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

B3	Low	Heat meter is regularly calibrated in compliance with the schedule. Heat supply will be calculated as the difference between the amount of heat generated and spent for the plant internal needs. The amount of heat generated and consumed for the plant internal needs, will be measured by heat meter.

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

All data on environmental impacts will be collected and archived in accordance with the monitoring statute. The responsible personnel shall fulfil the following measures:

- collection of information on performance of the facilities within the JI project boundary;
- report preparation and approval;
- report submission for calculation of emission reductions.

In general, the operational and management structure for the monitoring implementation structure at GTES “Kolomenskoe” will be looks like the following scheme:

Meters → Specialist (Duty engineer) → Chief of production and technical department → Chief power engineer → Global Carbon BV

Global Carbon BV will prepare annual estimations of emission reductions at the end of each reporting year

CO_2 emissions monitoring stages on the GTES “Kolomenskoe” project:

1. The Chief Engeener Office specialists, measuring the electricity generation and consumption for internal needs based on the meters’ readings, calculate the amount of energy, supplied to the consumers.
2. The Chief Engeener Office specialists, measuring the heat energy generation and consumption for internal needs based on the meters’ readings, calculate the amount of heat energy, supplied to the consumers.
3. Based on the natural gas flow meter, the Chief Engineer Office specialists generate data on the annual natural gas consumption.
4. The Chief Engeener Office specialists prepare the report of the GTES “Kolomenskoe” according to form 6-tp of the Federal Statistical Observation.
5. Global Carbon BV specialists calculate the standard emission factors with the use of the latest versions of documents, specified as data source in sections D.1.1.1 and D.1.1.3
6. Based on the methods, specified in sections D 1.1.2 и D 1.1.4, Global Carbon BV makes calculation of the emission reductions and prepares the report on the joint implementation project monitoring.

All measurement at the GTES Kolomenskoe will be according to the RF law “On uniformity of measurements” N 102-FZ dated 26/06/2008 [21] and in line with modern international requirements. .

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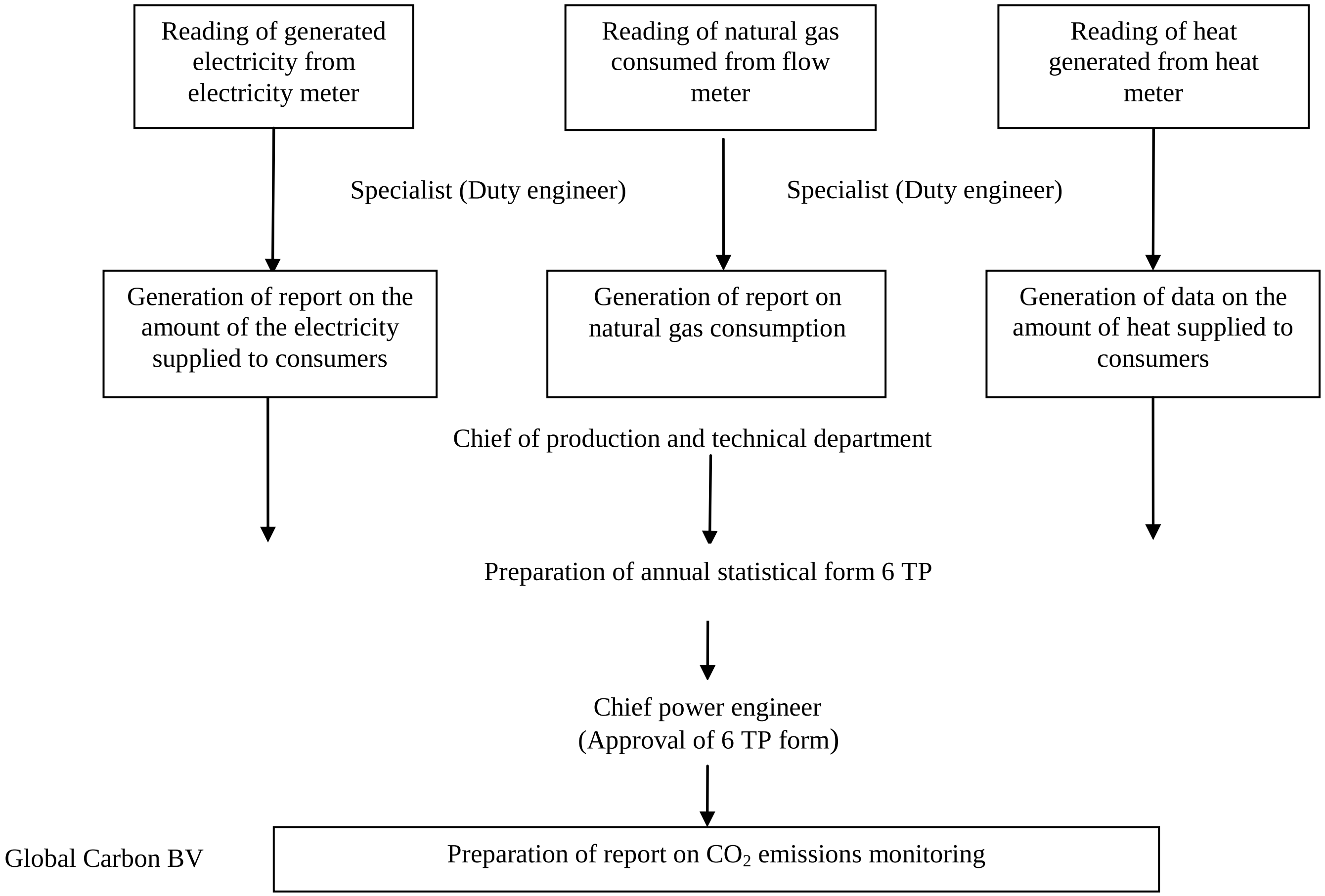
[21] http://www.garant.ru/hotlaw/federal/176805/

All procedures to obtain unavailable data in cases of emergency situation at the enterprise (for instance gas flow meter, heat meter and electricity meter) are defective or failed are indicated in contracts.

Table D.3.1: **Methods are calculate Natural Gas consumption, heat and electricity generation at the GTES Kolomenskoe**

Data	**Description**	**Source**
Natural Gas	The volume of natural gas consumption is determined based on the project capacity of the gas-burning equipment (taking into account 24 hours per day and 365 days per year use of gas)	Natural gas supply and transportation contract with LLC NaftaSib Energy
Heat	The amount of heat for heating is determined $\mathrm{Q_{heating}} = q_{max}^{heating} \times N \times \frac{\mathrm{t_{in}^{f}} - \mathrm{t_{out}^{f}}}{\mathrm{t_{in}^{p}} - \mathrm{t_{out}^{p}}}$ where $q_{max}^{heating}$ – maximum project hourly load, Gcal/hl N-amount of hours, h $\mathrm{t_{in}^{f}} - \mathrm{t_{in}^{p}}$-actual and project indoor air temperature , C^0 $\mathrm{t_{out}^{f}}\mathrm{t_{out}^{p}}$- actual and project outdoor air temperature , C^0 The amount of heat supplied to the needs of hot water is determined $\mathrm{Q_{hws}} = q_{hws}^{Av.per\ hour} \times N \times \frac{\mathrm{t_{hw}^{p}} - \mathrm{t_{cw}^{f}}}{\mathrm{t_{hw}^{p}} - \mathrm{t_{cw}^{p}}}$ where $q_{hws}^{Av.per\ hour}$ - hourly average load of supplied hot water N - amount of working hours, h $\mathrm{t_{hw}^{p}}$- hot water project temperature , C^0 $\mathrm{t_{cw}^{f}}$- actual average cold water temperature, C^0. If the data is unavailable during the heating period the +5C^0 is taken, in non-heating period +15 C^0 $\mathrm{t_{cw}^{p}}$- cold water project temperature , C^0. +5 C^0 is taken	Heat energy in hot water supply contract №1/08 of 28/02/2008 (Annex 5)
Electricity	The electricity is determined based on the electricity meter installed on the other side of consumer and transmission losses are taken into account.	Electricity supply contract №443 of 29/07/2009 between LLC NaftaSib Energy and OJSC "MOESK" (Annex 1)



The scheme of the operational and management structure in implementing the monitoring plan is presented in Figure D.3.1.

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

Monitoring plan was developed by Global Carbon BV

Name of person/entity setting the baseline:
Victor Petrochenkov
Global Carbon BV
E-mail: petrochenkov@global-carbon.com
Global Carbon BV is the project participant

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

As a result of the project realization the GHG emissions include the emissions due to the combustion of natural gas at the GTES Kolomenskoe.

$$PE_y = PE_{NG,y} \qquad (E.1)$$

where:

$PE_{NG,y}$ is CO_2 emission due to natural gas combustion under the project scenario over a year *y*, t CO_2

$$PE_{NG,y} = FC_{tce,y} \times 29.33 \times EF_{CO2,NG,y} \qquad (E.2)$$

where:

$FC_{tce,y}$ is the total volume of natural gas combusted at the new GTES Kolomenskoe unit in year *y* t.c.e

$EF_{CO2,NG,y}$ is the CO_2 emission factor per unit of energy of natural gas in year *y* (tCO_2/GJ).

29,33 – Net calorific value of 1 ton of fuel equivalent, GJ/t.f.e

Table E.1-1. Project GHG emissions, t CO2e

Year	GHG emissions under the project
2009	161 245
2010	302 468
2011	424 125
2012	424 125
2009-2012	1 311 962

E.2. Estimated leakage:

Not applicable in this project.

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

Table E.3-1. Project GHG emissions, t CO2e

Year	GHG emissions under the project
2009	161 245
2010	302 468
2011	424 125
2012	424 125
2009-2012	1 311 962

E.4. Estimated baseline emissions:

The Baseline Emissions are identified as following:

$$BE_y = BE_{Heat,y} + BE_{grid_y} \qquad (E.3)$$

where:

BE_y is the baseline emission in the year *y* (tCO_2);

BE_{grid_y} is the annual baseline CO_2 emission due to the Russian Federation energy system electricity generation, t CO_2/year;

$BE_{Heat,y}$ is the annual baseline CO_2 emission due to the heat energy generation at the DHS, t CO_2/year;

The amount of CO_2 emissions due to Russian Federation Unified Energy System based on the project electricity generation in the year, y.

$$BE_{grid_y} = EG_{PJ,y} \times EF_{BL,CO2,y} \qquad (E.4)$$

where:

$EG_{PJ,y}$ the annual electricity supply obtained as a result of baseline monitoring in the year y (MWh/year);

$EF_{BL,CO2,y}$ is the baseline emission factor in year *y* (tCO_2/MWh). It is an ex-ante fixed value, see Annex 2.

The baseline amount of CO2 emissions due to heat generation based on the project in the y

$$BE_{Heat,y} = \frac{HG_{PG,y} \times EF_{CO2,NG,y}}{\eta_{heat}} \qquad (E.5)$$

where:

$HG_{PG,y}$ annual heat energy supply obtained as a result of baseline monitoring in the year y (GJ/year);

$EF_{CO2,NG,y}$ is the CO_2 emission factor per unit of energy of natural gas in year *y* (tCO_2/GJ).

η_{heat} is the boiler house efficiency whole of DHS

Table E.4-1. Baseline GHG emissions, t CO_2e

Parameters	Unit	2009	2010	2011	2012
Baseline emissions due to production electricity	t CO_2/year	129 219	237 346	379 192	379 192
Baseline emissions due to production heat	t CO_2/year	102 304	190 716	250 884	250 884
Total	**t CO_2/year**	**231 524**	**428 062**	**630 076**	**630 076**

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

The formula to calculate total GHG emission reductions in the year *y* is, t CO_2-eq:

$$ER_y = BE_y - PE_y \tag{E.6}$$

Table E.5-1. The estimation results of GHG emission reductions

Year	Preliminary estimation of the project GHG emission reductions, t CO_2 equivalent
2009	70 279
2010	125 594
2011	205 951
2012	205 951
Total expected emission reductions over the crediting period	607 776

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

Table E.6.1: Project, baseline, and emission reductions within the crediting period

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)
Year 2009	161 245	0	231 524	70 279
Year 2010	302 468	0	428 062	125 594
Year 2011	424 125	0	630 076	205 951
Year 2012	424 125	0	630 076	205 951
Total (tonnes of CO_2 equivalent)	1 311 962	0	1 919 738	607 776

Table E.6.2: Project, baseline, and emission reductions after the crediting period

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)
Year 2013	424 125	0	630 076	205 951
Year 2014	424 125	0	630 076	205 951
Year 2015	424 125	0	630 076	205 951
Year 2016	424 125	0	630 076	205 951
Year 2017	424 125	0	630 076	205 951
Year 2018	424 125	0	630 076	205 951
Year 2019	424 125	0	630 076	205 951
Year 2020	424 125	0	630 076	205 951
Total (tonnes of CO_2 equivalent)	3 392 997	0	5 040 609	1 647 411

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 necessity of an Environmental Impact Assessment (EIA) in Russia is regulated by the Federal Law "On the Environmental Expertise" and consists of two stages: EIA (OVOS –in Russian abbreviation) and state environmental expertise (SEE). Significant changes into this procedure have been made by the Law on Amendments to the Construction Code which came into force on the 1st of January 2007. This Law reduced the scope of activities subject to SEE transferring them to the so called State Expertise (SE) done in line with the Article 49 of the Construction Code of the Russian Federation.

Environmental Impact Assessment is reflected in conclusion the state expertise №77-1-4-0038-08 dd. 29.01.2008. For GTES operation a permission No. 60569 dd. 25.05.2009 from the Moscow inter-regional territorial administration of technological and ecological supervision on emission of harmful (polluting) substances in atmospheric air was received.
During the GTES operations, the following contaminants are emitted into the atmosphere. (according to the permission № 60569)

Contaminant	Hazard Class	The allowed emission of harmful (polluting) substance in limits MPE	
		g/sec	t/year
Nitrogen dioxide	3	9.0	238.8
Nitrogen oxide	3	1.5	38.8
Carbon oxide	4	2.4	186.6
Total		12.9	464.2

Thus, as a result of the project, the concentration of contaminants in the surface layer will not surpass the populated areas' ambient air sanitary quality standards (maximum allowed concentration) and will not negatively impact the population health and sanitary conditions.

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 project does not have any significant negative impacts on the environment. Furthermore, the project leads to a decrease of fossil fuel combustion and a reduction of GHG emissions

SECTION G. Stakeholders' comments

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

During the project realization the public community was informed via the mass-media internet resources. There were no remarks on the project. This information can be found at:
http://www.gtt.ru/content/view/273/1/
http://dgs.mos.ru/d17dr612930m2.html

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

The key data and information used to establish the baseline

Parameter	Data unit	Description
$EG_{PJ,y}$	MWh/year	Annual GTES Kolomenskoe electricity supply
$FC_{i,y}$	Tonnes of coal equivalent (t.c.e)	Amount of fossil fuel *i* (coal, heavy fuel oil, natural gas, peat and other fuels) consumed in the project electricity system in year *y* (for 2007-2009)
$NCV_{t.c.e.}$	kcal/ t.c.e.	Net calorific value of coal equivalent
$EF_{CO2i,y}$	tCO_2/GJ	CO_2 emission factor of fossil fuel type *i* in year *y*
$EG_{m,y}$	MWh	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y*
$EF_{grid,OMsimple,y}$	tCO_2/MWh	Simple operating margin CO_2 emission
$EF_{grid,BM,y}$	tCO_2/MWh	BM emission factor
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin emission factor
$HG_{PJ,y}$	Thou. Gcal /year	Annual GTES Kolomenskoe heat supply

CO_2 baseline emission factor

This baseline emission factor was defined in accordance with approved CDM “Tool to calculate the emission factor for an electricity system” (version 02.) with some deviations, further referred as “The Tool”.

The full version of the Tool is published on the UFCCC website under the following address: http://cdm.unfccc.int/Reference/tools/index.html .

Scope and applicability

This Tool “…determines the CO_2 emission factor … for the purpose of calculating baseline emissions for a project activity substitutes electricity from the grid, i.e. where a project activity supplies electricity to a grid…”.

The GTES Kolomenskoe was commissioned in May 2009. After project implementation the electricity will supply to grid of United Regional Energy System (URES) “Centre”. It will replace electricity that would have been otherwise generated by the other power plants of URES “Centre”. Therefore this Tool can be used for determination of CO_2 baseline emission factor.

Parameters

The Tool provides procedures to determine the following parameters:

Parameter	**SI Unit**	**Description**
$EF_{grid,CM,y}$	tCO_2/MWh	Combined margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,BM,y}$	tCO_2/MWh	Build margin CO_2 emission factor for the project electricity system in

		year *y*
$EF_{grid,OM,y}$	tCO_2/MWh	Operating margin CO_2 emission factor for the project electricity system in year *y*

Data source

The following sources of information were used for the OM development:

- Federal Service of State Statistics (Rosstat RF). This is aggregated data provided by energy companies using the official statistical form 6-TP;
- JSC “Unified Energy System of Russia” (UES);
- OJSC «System Operator of Unified Energy System» (JSC “SO of UES”);
- CJSC “Agency of Energy Balances in the power industry”.

Each power plant submits the electricity and heat generation and fuel consumption data in RosStat RF according to the annually statistic report (6-TP).

CHPs produce electricity predominantly in the prescribed heat supply mode. Therefore they can be excluded from OM and BM calculation. However the reports (according to form 6-TP) do not contain any information about fired fuel amount for cogeneration or simple cycles and it is impossible to exclude from calculation the fired fuel amount and electricity generation with cogeneration cycle. Therefore, the parameters of cogeneration energy units were taken into account in OM and BM calculation. It is deviation from the Tool but it is conservative because the cogeneration cycles is more efficient than a simple (or combine) cycle.

The reports contain information about the total fired fuel amount (for each fuel type), fired amount fuel for electricity and heat generation (separately). The part of the fired amount fuel for electricity generation was used in the OM and BM emission factors calculation.

BM calculation is based on the data from:

- Official annual reports of JSC UES;
- Reports containing information on new power capacities put in operation in recent years, “General Scheme of Power Facilities’ Allocation by 2020” approved by the Government of the Russian Federation (Order of February 22 2008 # 215p);
- Energy companies investment programs.

“General Scheme” is not a legislative act. It is research work which was implemented on a commission from the Government of the Russian Federation. OJSC “RAO UES of Russia” and some research institute prepared the draft of “General Scheme” in 2007. It was based on the electricity consumption forecast and the inquiry of energy companies about their investment plans.

“General Scheme” is compilation of such information and doesn’t contain any recommendations and is not responsible for where, when, what and who will construct energy units etc. Main aim of “General Scheme” is definition of the sufficiency of consumers power supply. In case of insufficiency of consumers power supply the Government of RF will prepare the arrangements on stimulation of the new energy project implementation.

The Government of RF approved this document in 2008 (Order of February 22 2008 # 215p). It is signified that this work was done according to the commission.

Also this Order entrusted to organize the monitoring of the GS implementation to Ministry of Energy. Currently CJSC “Agency of Energy Balances in the power industry” is preparing corrected version of

"General Scheme"[22]. The new power consumption forecast and the corrected investment plans of energy companies are taken into account. In comparison with the previous version of "General Scheme" some supposed power projects are delayed and some supposed power projects are stopped.

"General Scheme" is not an obligatory document for private energy companies but it can be used as recommended document.

This data is relevant and sufficient for emission factors calculation in accordance with the Tool.

Methodology procedure

The Tool determines CO_2 emission factor for an electricity, generated by power plants, displacement in an electricity system, by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM). Operating margin refers to a cohort of power plants that reflects the existing power plants whose electricity generation would be affected by the proposed project activity. Build margin refers to a cohort of power units that reflect the type of power units whose construction would be affected by the proposed project activity.

In line with the Tool the following steps presented in detail below should be followed. Possible deviations should be identified and justified.

STEP 1: Identify the relevant electricity systems

A project electricity system is the system defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. Similarly, a connected electricity system is defined as a system that is connected by transmission lines to the project electricity system. Power plants within connected system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

If the Designated National Authority of the host country (in Russia it is the Ministry of Economic Development RF) has published a delineation of the project electricity system and connected power systems, these delineations should be used. The Designated Focal Point (DFP) of the Russian Federation has not published a delineation of the project electricity system and connected electricity systems. Therefore the recommendation of the Tool is applied: "… to use a regional grid definition in case of large countries with layered dispatch systems (e.g. provincial / regional / national)".

Electric power industry in Russian Federation comprises nearly 400 power plants: thermal power plants (about 70% of total installed capacity), hydro power stations (20% of total installed capacity) and nuclear power stations (10% of total installed capacity). Power stations and consumers are connected by transmission lines. Power stations, consumers and regulatory organizations (JSC "SO of UES" for instance) constitute the national energy system (hereinafter referred to as UES of Russia). The UES of Russia is functioning centralized. JSC "SO of UES" contributes a great value to the operative-dispatching management.

Power stations are unified by transmission lines in 60 area electricity systems (AESs), while these systems have in its turn the electric connections with the neighbouring ones (excluding some isolated area systems). AESs are unified in seven united regional electricity systems (URESs), that are connected between each other through backbone and interconnection networks: "North-Western", "Centre", "South", "Volga", "Ural", "Siberia" and "The East". The scheme of UES of Russia is presented in Figure Anx.2.1.

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[22] http://www.e-apbe.ru/scheme/

Figure Anx.2.1: Scheme of UES of Russia

Source: JSC "SO of UES"

URES "East" is the isolated system and URES "Siberia" is the semi-isolated system. Other systems are independent of other. Annual import/export of electricity between URESs is less than 1% (excluding from URES "Volga" to URES "South" and URES "Ural" – about 6%).

GTES Kolomenskoe is located in URES "Centre". Installed capacity of this URES is 48,257 MW (status 2009). It is the largest unified power system in UES of Russia. Power plants located at the Moscow-city territories, areas of Yaroslavl, Tver, Smolensk, Moscow, Ivanovo, Vladimir, Vologda, Kostroma, Nizhegorodskaya, Ryazan, Tambov, Bryansk, Kaluga, Tula, Orel, Kursk, Belgorod, Voronezh and Lipetsk constitute about 25% from the total generating capacity of UES of Russia.

The structure of installed capacity of URES "Centre" is as follows:

- 63% – TPPs (including combined heat and power plants and units);
- about 30% – Nuclear power stations (NPSs);
- about 6% – Hydro power stations (HPSs);
- Other capacities based on wind, geothermal, solar, low-cost biomass, etc. are negligible for the URES power balance.

NPS operate as "must-run" resources and HPSs – as "low-cost".

Thus URES "Centre" is the project electricity system. As is shown above the annual import/export of electricity between URES "Centre" and other URESs (connected electricity system) is less than 1%. It means that URES "Centre" can be considered as independent system.

Project capacity (136 MW) is only 0.28% of the URES "Centre" total electric capacity, therefore project capacity '"…can be dispatched without significant transmission constraints"[23].

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[23] Tool to calculate the emission factor for an electricity system, version 01.1, Methodological Tool, CDM Executive board

The expected balance of the power industry development during 2009-2015 and till 2020"[24] by CJSC "Agency of Energy Balances the rate electrical capacity reserve will be from 8,000 to 11,000 MW in URES "Centre". It is enough for replacement of the electric energy generated by GTES Kolomenskoe - under the baseline.

As a result URES "Centre" is selected as a relevant electric power system.

STEP 2 Choose whether to include off-grid power plants in the project electricity system (optional)

The quantity off-grid power plants and power generation from off-grid in URES "Centre" is not significant

STEP 3: Select an operating margin (OM) method

The Tool recommends to calculate the $EF_{grid,OM,y}$ based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis, or
(d) Average OM.

Any of these listed methods can be used, however, the simple OM method (a) can only be used if low-cost/must run resources constitute less than 50% of total grid generation calculated:

1) As average of the five most recent years or,
2) Based on long-term averages for hydroelectricity production.

Low-cost/must run resources are defined as power plants with low marginal generation costs or that are dispatched independently of the daily or seasonal load of the grid. Typically they include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. In URES "Centre" geothermal, wind, low-cost biomass, and solar generation are negligible for the power balance. Therefore only nuclear stations (as "must-run") and hydro plants (as "low-cost") are defined as low-cost/must run resources. Table 2.1 represents" total electricity generation during the five last years and the five year average share of low-cost/must run resources in URES "Centre (2005-2009).

Table2.1: Share of RES's low-cost/must run net electricity generation (MWh)

URES "Centre"	**2005**	**2006**	**2007**	**2008**	**2009**	**Five year average % of low-cost**
All power plants	193,147,189	205,325,854	227,146,629	228,827,872	201,135,720	36.9
hydro	3,581,856	2,907,517	5,061,950	5,195,890	3,842,120	
nuclear	67,458,244	73,201,563	75,853,726	74,669,245	77,465,936	

Source: JSC "SO of UES" and Rosstat RF

As this indicator is lower than 50% the nuclear and hydro energy generation may not be taken into account. Therefore simple OM (method "a") can be used and is selected for calculation of emission factor of URES "Centre".

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[24] http://www.e-apbe.ru/5years/detail.php?ID=19193

STEP 4: Calculate $EF_{grid,OM,y}$ according to the selected method

The Tool specifies how simple OM is calculated - as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must run plants/units (e.g. hydro and nuclear).

The Tool suggests making calculations based on:

- the net electricity generation and CO_2 emission factor of each power unit (Option A);
- total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option B).

The Option B was chosen because:

(a) The necessary data for Option A is not available;

(b) Only nuclear and renewable power generation are considered as low-cost/must run power sources and the quantity of electricity supplied to the grid by these sources is known;

(c) Off-grid power plants are not included in the calculation.

As soon as in the Russian Federation individual plant based data is considered strictly confidential the official statistical format 6–TP aggregates the data on the regional basis. This is the only data source publicly available for emission factor calculation. Thus only Option B is feasible.

Where the simple operating margin is defined by the following formula:

$$EF_{grig,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2i,y}}{EG_y} \qquad (1)$$

Where:

$EF_{grig,OMsimple,y}$ – simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh);

$FC_{i,y}$ – amount of fossil fuel ***i*** consumed in the project electricity system in year *y* (mass or volume unit);

$NCV_{i,y}$ – net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit);

$EF_{CO2i,y}$ – CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ);

$EG_{m,y}$ – net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year ***y*** (MWh);

i – all fossil fuel types combusted in power plants in the project electricity system in year *y*;

y – the three most recent years for which data is available (2007-2009).

The net electricity generation and fossil fuels consumed in the project electricity system are received from Rosstat RF. The amount of fossil fuels are expressed in tonne of coal equivalent with net calorific value is equal to 7,000 kcal/kg c.e. or 29.33 GJ/t c.e.

The net electricity generation and fuel consumption data at the TPPs of URES “Centre” in 2007-2009 are presented in the Table 2.2.

Table 2.2: The net electricity generation and fuel consumption data

Indicator	Unit	2007	2008	2009
Net electricity generation	MWh	146,230,953	148,962,737	119,827,664
Natural gas	t.c.e	42,757,580	42,941,363	34,148,007
	GJ	1,254,079,816	1,259,470,180	1,001,561,051
Heavy fuel oil	t.c.e	480,474	534,282	287,576
	GJ	14,092,297	15,670,500	8,434,619
Coal	t.c.e	4,025,757	3,200,880	1,940,377
	GJ	118,075,457	93,881,816	56,911,249
Peat	t.c.e	152,049	114,689	40,038
	GJ	4,459,598	3,363,841	1,174,300
Other	t.c.e	25,165	1,164,935	1,042,130
	GJ	738,077	34,167,539	30,565,670

Source: Rosstat RF

The default fuel emission factors are presented in the Table 2.3.

Table 2.3: The default fuel emission factors

Fuel type	Default emission factor[25]
	tCO2/GJ
Natural gas	0.0561
Heavy fuel oil	0.0774
Coal	0.0946
Peat	0.106
Other fuel types[26]	0.0

The results of CO_2 emissions calculation at the TPPs of URES “Centre” in 2007-2009 are presented in the Table2.4.

Table 2.4: Results of CO_2 emissions calculation

Indicator	Unit	2007	2008	2009
Natural gas	tCO_2	70,353,878	70,656,277	56,187,575
Heavy fuel oil	tCO_2	1,090,744	1,212,897	652,839
Coal	tCO_2	11,347,051	9,022,043	5,469,171
Peat	tCO_2	472,717	356,567	124,476
Total	**tCO_2**	**83,264,390**	**81,247,783**	**62,434,061**

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[25] Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion (corrected chapter as of April 2007), IPCC, 2006

[26] Emission factor for other types of fuel is taken as zero. It is conservative

The results of $EF_{grig,OMsimple,y}$ and the average electricity weighted OM emission factor calculation are presented in the Table 2.5.

Table 2.5: Results of $EF_{grig,BM,y}$ and the average electricity weighted OM emission factor calculation

Indicator	**Unit**	**2007**	**2008**	**2009**
OM emission factor	tCO_2/MWh	0,568	0,544	0,520
Average electricity weighted OM emission factor	**tCO_2/MWh**	**0.546**		

OM emission factor is ex-ante for period 2008-2012.

STEP 5: Identify the group of power units to be included in the build margin
The Tool provides the recommendations on how to form the sample groups of power units used to calculate the BM. They consist of either:

(a) The set of five power units that have been built most recently, or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

If the recommended approach does not reasonably reflect the power plants that would likely be built in the absence of the project activity, the participants are encouraged to submit alternative proposals.

The main principle stated by the Tool is that the cohort should reasonably “reflect the type of power plants that would likely be built in the absence of the project activity” (quoted from the Tool) which means that the BM capacity is counterfactual and the cohort is assembled just to determine the parameters of such a capacity to calculate GHG emissions.

The sample group of power units used to calculate the BM consists of either:

(a) The set of five power units that were built most recently (in 10 years period), or
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that were built most recently.

Capacity additions from retrofits of power plants should not be included in the calculations of $EF_{grid,BM,y}$. In case if it is impossible to fulfil conditions (a) and (b) the Tool recommends increasing the time period (to cover more than 10 years) for the new capacities so that five new plants (a) or 20% additions (b) are available.

From mid ‘90s Russia has been recovering after a long and deep economic crisis. Construction of new power capacities was not a common practice that means that in some URESs there were less than five new capacities built. In this case the Tool recommends increasing the time period of new capacities sample. It is proposed to extend the 10 years period to 15.

In this case conditions (a) and (b) are still not met. So an approach, deviating from the Tool recommendations will be used, namely the actual sample is extended by the new plant(s)/unit(s) which are currently under construction.

Table 2.6 lists all the plants/units commissioned since 2000 and under construction in URES “Centre”.

Table 2.6:. Power plants/units commissioned since 2000 and under construction in URES "Centre".

N	Power plant/unit	Year of commissioning	Capacity, MW	Technology	Fuel
Commissioned since 2000					
1	"Lutch" CHP	2005	60	GT	Gas
2	Moscow CHP-27	2008	450	CC GT	Gas
3	Moscow CHP-21	2008	450	CC GT	Gas
4	Ivanovo Combined Cycle	2008	325	CC GT	Gas
5	Ivanovo CHP-1	2005	12	CC GT	Gas
6	Kashira TPP (unit No. 3)	2009	330	Steam cycle	Coal
	Total		Less than 20% of URES's capacity		

Source: Energy companies

The table presents six units while only five should be selected. The Ivanov CHP-1 12 MW unit is too small capacity for the group. Therefore five units built since 2005 to be included in the BM[27]:

- 3 CC GT of 2x450 MW and 325 MW units;
- 1 GT of 60 MW unit;
- 330 MW steam cycle with coal

For the Kyoto Protocol first commitment period projects participants can chose between one of the two options:
(1) ex-ante based on the most recent information available on units already built;
(2) ex-post based on information updated during each relevant monitoring period.

The approach presented above is based upon ex-ante option.

STEP 6: Calculate the build margin emission factor

In line with the Tool the BM emission factor is the generated-weighted average emission factor of all power units *m* during the year y and is calculated as follows:

$$EF_{grig,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{5} EG_{y}} \qquad (2)$$

Where:

$EF_{grig,BM,y}$ – BM emission factor in year y (tCO_2/MWh);

$EG_{m,y}$ – net quantity of electricity generated and delivered to the grid by the power unit *m* in year *y*;

$\sum_{5} EG_{y}$ – net quantity of electricity generated and delivered to the grid by the cohort of 5 units in year y;

$EF_{EL,m,y}$ – CO_2 emission factor of the power unit m in year *y* (tCO_2/MWh);

m – power units included in the BM;

y – year for which power generation data is available.

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[27] This cohort reflects the type of power plants that would likely be built in the absence of the project activity

Method of $EF_{EL,m,y}$ calculation here is the same as for $EF_{grig,OMsimple,y}$ described under Step 3, i.e. by using specific fuel consumption per 1 kWh of energy output $b_{m,y}$ (kg c.e./kWh).

$$EF_{EL,m,y} = b_{m,y} \times EF_{CO2,fuel} \qquad (3)$$

Where:

$EF_{CO2,fuel}$ – fuel emission factor (fuel type weighted) in tCO_2/MJ or $tCO_2/t.c.e$; the IPCC factors for main types of fuel values;

$b_{m,y}$ – specific fuel consumption by the unit *m* (MJ/MWh or t.c.e./MWh).

b_m is accepted according either to the operational reports, or from the projects' designs or from the standards established by the "Concept of Technical Policy of JSC UES" (2005) for the new equipment.

In the Russian Federation individual plant based data is considered strictly confidential. Therefore the specific factors of the power units (or similar power units) from open sources were used.

The background data for $EF_{grigBM,y}$ calculation is presented in the Table 2.7.

Table 2.7: background data for $EF_{grigBM,y}$ calculation

Indicator	**Unit**	**Natural gas-fired CC GT unit 450 MW***	**Natural gas-fired CC GT unit 450 MW***	**Natural gas-fired CC GT unit 325 MW****	**Natural gas-fired GT unit 60 MW*****	**330 MW steam cycle with coal*******
Electric capacity,	MW	450	450	325	60	330
Capacity utilization	%			60*****		60*****
Annual net generation of electricity	MWh	2,567,626	2,567,626	1,708,200	235,290	1,734,480
Specific fuel consumption	kg c.e. /kWh	0.2508	0.2508	0.2343	0.2268	0.295
	MJ/MWh	7.356×10^3	7.356×10^3	6.872×10^3	6.652×10^3	8.6524×10^3
Fuel		Natural gas	Natural gas	Natural gas	Natural gas	Coal
Fuel emission factor	tCO_2/MJ	0.0561×10^{-3}	0.0561×10^{-3}	0.0561×10^{-3}	0.0561×10^{-3}	0.946×10^{-3}

Source: * *average of the reported data for similar plants (Kaliningrad CHP-450 and North-Western CHP-450);*
** *characteristics of GTs and CC GT typical projects;*
*** *the report of GT "Lutch";*
**** *according to the standards from the Concept of Technical policy of JSC UES;*
***** *assumed based on the 2007 figure from RosStat RF of 52% for TPPs; for high capacity and TPPs of condensed type assumed as 60%.*

The results of $EF_{EL,m,y}$ calculation are presented in the Table 2.8.

Table 2.8: Results of $EF_{grig,BM,y}$ calculation

Indicator	Unit	Natural gas-fired CC GT unit 450 MW	Natural gas-fired CC GT unit 450 MW	Natural gas-fired CC GT unit 325 MW	Natural gas-fired CC GT unit 60 MW	330 MW steam cycle with coal
Power unit CO_2 emission factor	tCO_2 /MWh	0.4127	0.4127	0.3855	0.3732	0.8185
Average weighted BM emission factor	tCO_2 /MWh	0.486				

BM emission factor is ex-ante for period 2008-2012.

STEP 7: Calculate the combined margin emission factor

The combined margin emission factor (CM) is calculated as follows:

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y} \qquad (4)$$

Where:

$EF_{grid,CM,y}$	CM emission factor in year *y* (tCO_2/MWh);
$EF_{grid,OM,y}$	OM emission factor in year *y* (tCO_2/MWh);
$EF_{grid,BM,y}$	BM emission factor in year *y* (tCO_2/MWh);
w_{OM}	weight of OM emission factor;
w_{BM}	weight of BM emission factor.

In most cases the Tool recommends to apply $w_{OM} = w_{BM} = 0.5$. But developers may propose other weights, as long as $w_{OM} + w_{BM} = 1$.

As a starting point the weighting factor for w_{OM} is taken as 0.5.

When looking at the factor for w_{BM} the specific of the Russian power system have to be taken into account. The Russian power system has a big quantity of old, worn-out low efficient power plants being in operation for decades. According to the JSC “UES of Russia” average turbines operational life time is around 30 years. Most of these capacities were put in operation in 1971-1980 that corresponds to 31.4% of the whole installed capacities.

In accordance with General Scheme[28], dated 22 February 2008, it was planned to approximately 33 GW of old capacity has to be dismantled by 2015. To meet the growth in demand new energy units with total capacity of 120 GW will be commissioned by 2015. This means that the JI project will not only avoid the construction of new power plants, but also accelerate the decommissioning of existing capacities. Given the impact of the financial crises on demand growth and the capability to finance new projects, the new estimation[29] (September 2008) expects that out of the planned 120 GW only about 80 GW will be operational by 2015. Out of the 33 GW of old capacity only 10 GW will be dismantled. This means that 1 GW of any project delay is a delay of 0.5 GW of old capacity dismantling. So the effect of the JI

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[28] http://www.e-apbe.ru/library/detail.php?ID=11106

[29] http://www.e-apbe.ru/library/detail.php?ID=11106

project on the acceleration of decommissioning of existing capacities will only be stronger as result of the financial crisis.

The estimation, that the effect of the JI project on the decommissioning of power plants and the delays of new power plants construction is approximately 50% / 50%. For the avoidance of new power plants the emission factor of the BM is representative whereas for the accelerated decommissioning effect the emission factor of the OM is representative.

Therefore effective w_{OM} = 0.50 + 0.25 = 0.75 and w_{BM} = 0.25.

The resulting grid factor is $EF_{grid,CM,y}$ = 0.531 tCO_2/MWh. CM emission factor is ex-ante for period 2008-2012, because OM and BM emission factors are ex-ante as well. This emission factor is the baseline emission factor ($EF_{BL,CO2,y}$) which is used to establish the baseline emissions of the baseline scenario.

Annex 3

MONITORING PLAN

See Section D for monitoring plan.