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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

"Energy efficiency interventions at OJSC Mordovcement Komsomolskiy town, Republic of Mordovia, Russian Federation".

Sectoral scope 4: Manufacturing Industries;
1: Energy industries (renewable / non-renewable sources);
Project design document (PDD) version 6.0

16 of March, 2012

A.2. Description of the project:

Enterprise description

OJSC "Mordovcement", Mordovcement further referred in the text, is a pioneer in Republic of Mordovia heavy industry known as Alexeevskiy cement plant. It is located in the Komsomolskiy town in the central part of Russia, near the city of Saransk. The plant was established in 1948 and started cement manufacturing in 1956. Mordovcement is one of the biggest cement manufacturing enterprises in the Russian Federation. Its production capacity is rounded to 3,750 thousand tonnes of cement per year, produced at 8 wet kilns. A management quality system is being implemented at the enterprise since April of 2007 to ensure production quality. Based on audit studies carried out by Rosstroysertifikacia (certification body in Russian Federation), an ISO 9001-2001 certificate has been issued stating that management quality system is in compliance with ISO 9001-2001 requirements as well as GOST-R and Rosstroysertifikacia requirements. It is planned to get a European certificate from the Organization of German cement plants Union at Dusseldorf, Germany carried out by TUV Cert.

Project purpose and history

In order to increase energy efficiency of cement manufacturing, decision has been made to construct a semi-dry technological line of cement production. Construction of the semi-dry line had started with the contract for the new equipment supplement dated 9 July 2004. It was clear that growing cement demand could not be covered with the only semi-dry line cement manufacturing capacities, so it was planned to construct later the dry line of cement production and to decrease adverse affects of growing electricity tariffs by constructing own electricity generating facility that would supply with electricity and heat both semi-dry and dry lines and also partially old wet technological lines. The board of directors has considered the project as JI during investment decision process and possible revenue from emission reductions sale was taken into account. The semi-dry line was commissioned at 28 September 2007. It has a distinctive advantage over the commonly used wet method of clinker production representing significant fuel (natural gas) consumption decrease due to introduction of raw mixture in to the kiln in the form of dry powder (raw mill), instead of wet slurry for the wet method. Decarbonisation process is completed faster; no water needs to be evaporated from the dry mixture and fuel consumption is reduced significantly.

The dry technology is the most advanced technology as of today and also is the most energy efficient process of cement manufacturing. Growing prices on fuel and electricity have induced further cement manufacturing technology improvement at OJSC "Mordovcement". On 22 April 2006 decision was taken by the board of directors to initiate construction of the dry cement manufacturing line at Mordovcement premises; it is scheduled for commissioning on 1 October 2010.

Fuel prices during recent years have followed the climbing trend causing higher and higher operational expenses for cement producers as major energy resources consumers. High capacity of cement manufacturing and growing electricity prices caused concerns at OJSC "Mordovcement". To prevent substantial losses due to increasing electricity tariffs, it was decided to build a Combined Heat Power Plant at the plant site. On 22 April 2006 the board of directors signed a contract with General Electric Company for delivering and mounting two energy units that use LM2500 gas turbines.
There are three sub-projects and therefore three purposes in the project presented:

- Semi-dry method of clinker manufacturing construction, 690, 000 tonnes of clinker per year and, 760000 tonnes of cement per year capacity;
- Dry method of clinker manufacturing construction, 1,860,000 tonnes of clinker per year and 2350500 tonnes of cement per year capacity;
- Combined heat power plant construction, 72 MW and 61 Gcal/hour output;

Current status

Dry manufacturing method is not widely used and does not represent the current common practice at the moment. Semi-dry method is represented by only one cement plant in the Russian Federation making this technology unique of its kind in Russia. No own energy-generating facilities can be observed among cement plants reviewed, making CHPP construction project also unique of its kind.

Greenhouse gas emissions reduction

Greenhouse gas emissions are reduced due introduction of more energy efficient semi-dry and dry methods of cement manufacturing. Significantly less natural gas is required to produce the same amount of cement compared to conventional wet cement manufacturing process. The combined cycle heat power plant is also more efficient in terms of gas consumption and electricity output which comes with heat output. Summarizing, greenhouse gas emission reduction will occur due to implementation of technologies that require significantly less fossil fuel combustion, natural gas in particular, combustion compared to conventional methods.

Baseline scenario

In the absence of the project cement required for consumers would have been supplied by other cement plants located within the radius of cement transportation (542 km[1] from OJSC "Mordovcement") or would have been produced by the existing wet kilns at OJSC "Mordovcement" and electricity consumed from the GRID by old wet lines. Therefore the baseline scenario will consist of two parts. The first part is the replacement production (capacity) which is (semi-)dry cement production that in the baseline scenario would have been produced on the existing wet kilns. The second part is incremental production (capacity) which is (semi-)dry cement production that in the baseline scenario would have been produced by other cement plants. The JI project consists of the following production capacities (incremental production capacity and replacement production capacity): for the semi-dry line as 690,000 tonnes of clinker and 760,000 tonnes of cement; for the dry line it is 1,860,000 tonnes of clinker and 2,350,500 tonnes of cement.

Emissions associated with incremental capacity are calculated based on the other cement producers' emissions; emissions associated with replacement capacity are calculated based on existing wet kilns operation monitoring. Also, in case of the absence of the JI project, the plant would consume all

[1] NII Cement directory, 2008. Page 49. Table 43.

electricity from the grid. Heat required for raw materials drying at the dry line would have been generated by the gas fuel burning inside special boilers, which usually constructed at cement plants for the raw materials drying purposes; this represents the current common practice. Heat required for facilities warming during winter time and hot water generation would have been supplied by the local CHPP.

A.3. Project participants:

Table A.3.1. 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)	OJSC “Mordovcement”	No
Party B: The Netherlands	Global Carbon BV	No

Roles of the project participants:

- OJSC “Mordovcement” is one of the biggest cement manufacturing enterprises in the Russian Federation. Mordovcement cement plant has two united cement plants located next to each other. Both plants located at one site and have common infrastructure. OJSC “Mordovcement” will implement the proposed JI project and will own ERUs[2] generated by this project. OJSC “Mordovcement” is a project participant;
- 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:

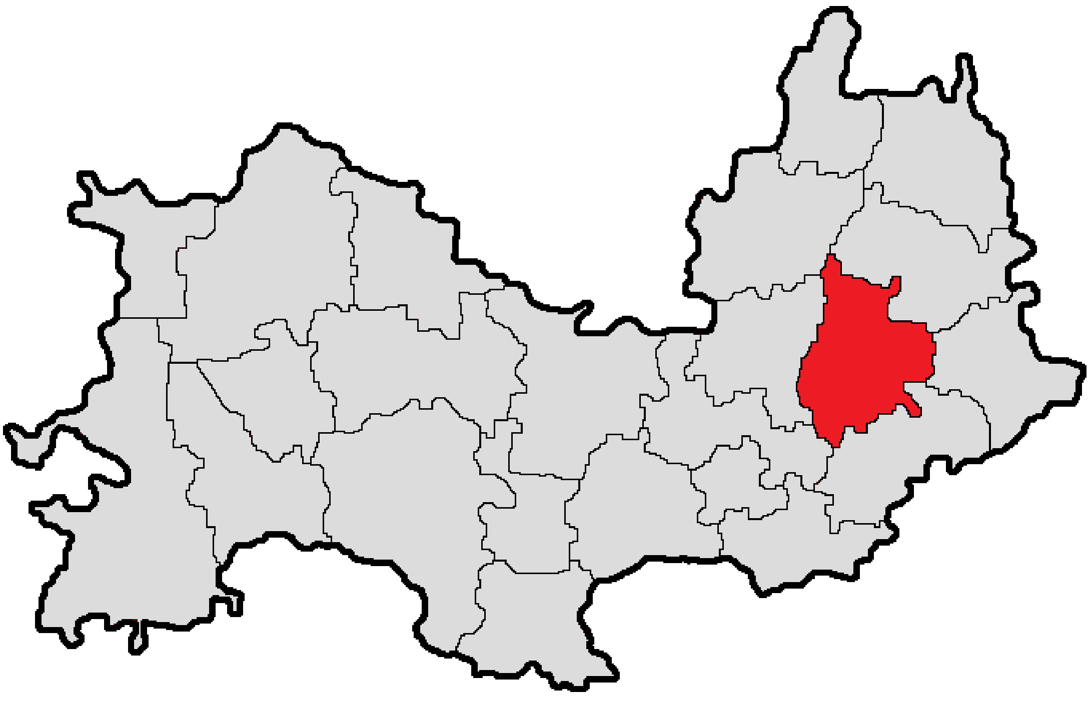
OJSC “Mordovcement” is located in Komsomolskiy rural settlement, Chamzinskiy district near Nuya river, 50 kilometres north-east from Saransk city, Republic of Mordovia, Russian Federation. Komsomolskiy rural settlement comprises two blocks and a number of streets. Geographical locations of Republic of Mordovia, Chamzinskiy district, and Komsomolskiy rural settlement are presented on Figure A.4.1.1, Figure A.4.1.2 and Figure A.4.1.3 respectfully.

[2] Emission reduction units

Figure A.4.1.1: Map of Russian Federation with Republic of Mordovia location (highlighted by red colour)

Source: http://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Map_of_Russia_-_Republic_of_Mordovia_(2008-03).svg

Figure A.4.1.2: Map of Mordovia Republic with Chamzinskiy district (highlighted by red colour)



Source: http://ru.wikipedia.org/wiki/%D0%A4%D0%B0%D0%B9%D0%BB:Mordovia_NN.png

Figure A.4.1.3: Map of Chamzinskiy district with the project location:

Source: http://maps.google.com/

A.4.1.1. Host Party(ies):

The Russian Federation

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

The republic of Mordovia is located in the central European part of the Russian Federation between Oka and Sura rivers. Population of Republic counts 833,000 people; it corresponds to 0.58% of the total Russian population. Cement production, manufacturing industries, wood treatment, electrical equipment production and electricity generation are the main industries in the republic.

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

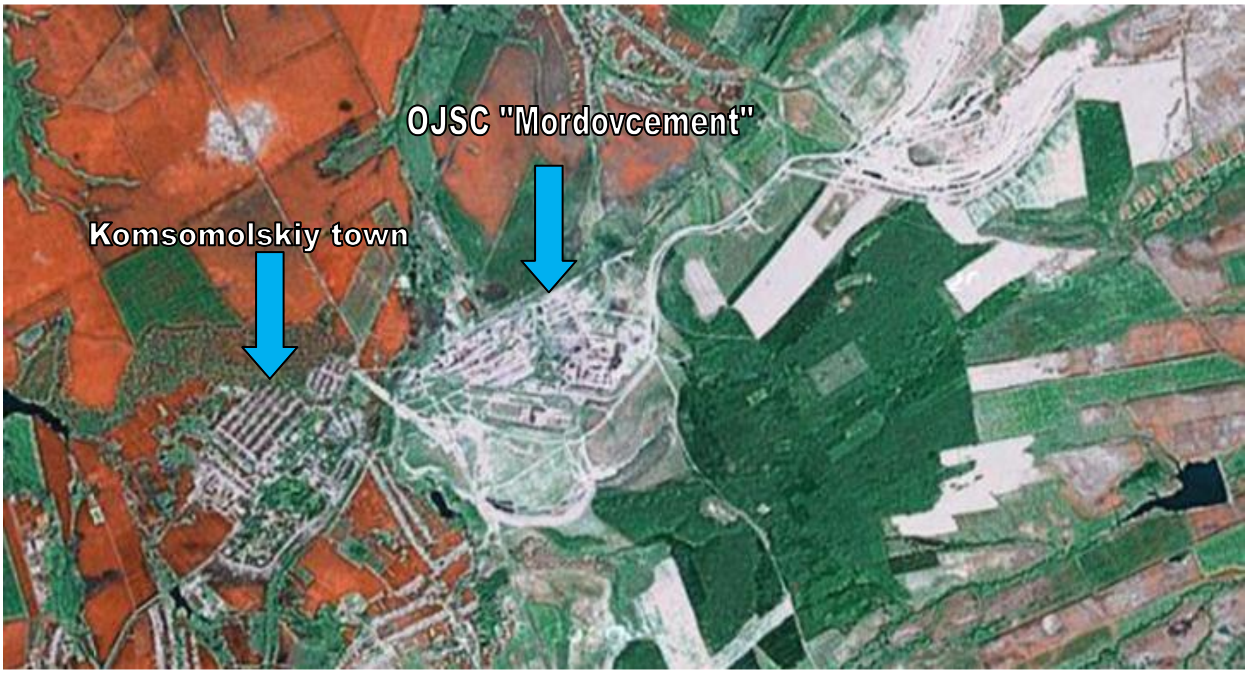
Chamzinskiy district, Komsomolskiy Town. Chamzinskiy district population counts 34,000 citizens. Large industrial producers are the enterprises that form district's economy: OJSC "Mordovcement", OJSC "Lato", Dry construction mixtures manufacturing plant "Magma", Building construction elements manufacturing plant, JSC "Avtozapchast", Department of Ulyanovsk Corporation "AvtoUaz", OJSC "Mechta". There is a big natural mineral deposit field that is suitable for cement production located in the area.

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

OJSC "Mordovcement" is located in Chamzinskiy district, next to Komsomolskiy town, Republic of Mordovia, Russian Federation.

Coordinates are N54.2660 E45.5239.

Figure A.4.1.4.1: Satellite image of Komsomolskiy town with OJSC "Mordovcement" plant site:



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

Presently, there are eight wet lines of cement production at OJSC "Mordovcement". This JI project is directed to gain emission reductions units from the following three subprojects:

- From the semi-dry clinker production method, construction and commissioning of which was completed on 28 September 2007;
- From the dry method of clicker manufacturing at the new cement manufacturing line, that is currently under construction and planned for commissioning on 1 October 2010;
- From the combined heat power plant at the plant site in order to supply cement manufacturing process with own generated electricity eliminating this way grid electricity usage;

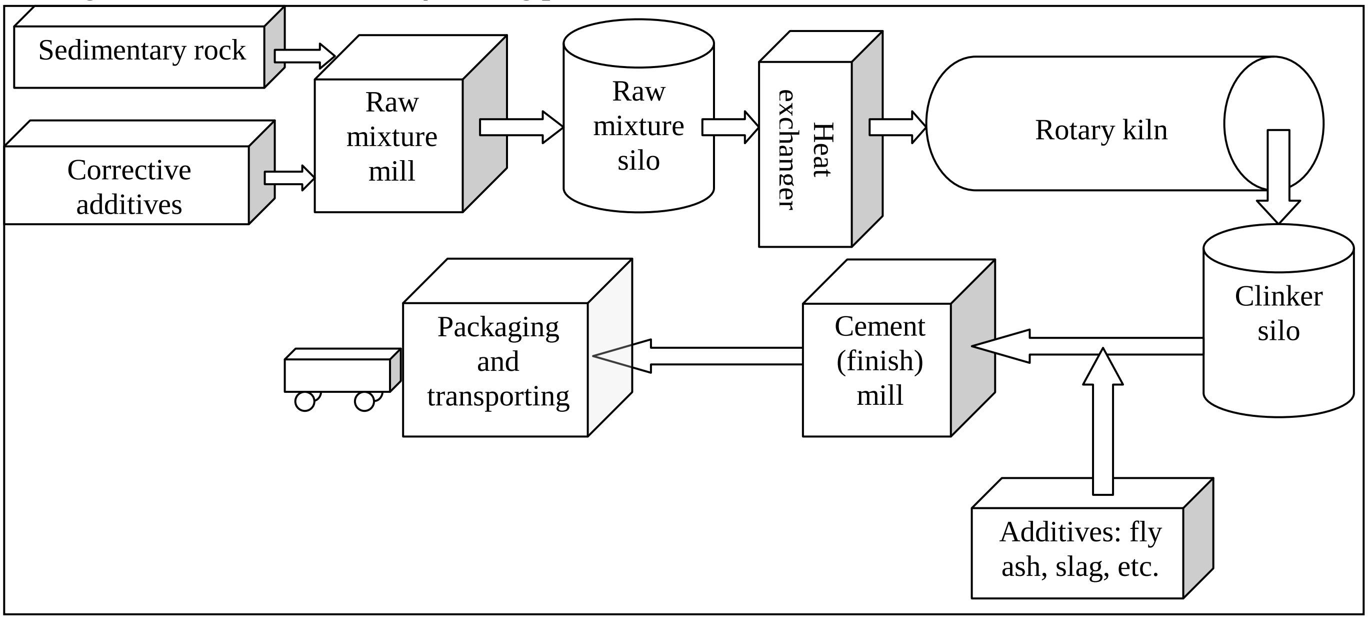
Both semi-dry and dry methods of clinker production are much more energy efficient compared to the wet method of clicker production. Combined heat power plant will supply two existing plants including semi-dry and dry lines with on-site generated electricity and will use recovered heat for facility needs, utilizing this way all recoverable energy and exceeding efficiency of grid generated electricity.

Cement production description

Cement manufacturing process can by grouped into four main stages:

- Raw materials quarrying;
- Raw materials preparation;
- Sintering to form clinker;
- Cement manufacturing from clinker;

Figure A.4.2.1: Cement manufacturing process



Raw materials quarrying

A certain number of chemical elements is required to trigger chemical reactions that form main cement constituent – clinker. These elements are calcium, silicon, iron, aluminium, oxygen. Calcium and silicon are required for the strength-producing calcium silicates forming. Aluminium and iron serve to produce liquid flux in the kiln burning zone, which acts as a solvent for the silicate-forming reactions, and allows these to occur at an economically low temperature. Elements required for cement production are found in sedimentary rocks, such as limestone, chalk, clay. Natural mineral deposits field needs to be in close proximity with cement plant to supply cement manufacturing process with necessary components. Quarry is set at the mineral deposit to extract those rocks from the ground. Extracted rocks are called raw materials. Raw materials are delivered to cement plant by heavy duty trucks or by rail.

Raw materials preparation

Raw materials delivered from the quarry have different size of pieces and contain excessive amount of water and therefore are not suitable for cement manufacturing process without proper treatment and preparation. Preparation of raw materials means crushing rocks to the predefined size, their preliminary blending and grinding. Raw materials stored in the special storage – silos after they have been ground; raw materials are accurately dosed out of silos and introduced to the raw mill where they mixed together and ground to form raw mixture. Grinding is necessary to ensure the mixture is homogeneous so that a chemical reaction between raw mixture components can be initiated later in the process of cement manufacturing.

Sintering to form clinker

Different additives are mixed with raw materials because natural mineral deposits lack some elements required for chemical reactions. Mixed additives are correcting raw mixture to the predefined chemical composition. After grinding to the necessary fineness and correction by additives, raw mixture is delivered to a high tower called cyclone heat exchanger, which serves two purposes: one - is to evaporate any excessive moisture left in raw mixture after preparation and the second purpose – is to gradually warm up raw mixture up to the temperature where chemical reactions, essential for clinker forming, could be initiated. Heat exchanger usually has four stages. Each stage represents cone form cylinder. Cone form allows gasses that are flowing inside the cylinder in a counter flow with raw mixture to form air cyclones, which act like a little tornado creating a whirl made of air and raw mixture. Intensive heat exchange happens inside this whirl allowing cooling down of the kiln exhaust gases and their preparation for release onto the atmosphere; and also heat exchange serves for heating up the raw mixture making it suitable for chemical transformation. Preheated raw mixture is falling in to the cylinder tube at the bottom of the heat exchanger; this tube is the specially designed device intended for limestone or chalk decomposition into the constituting elements. It is called calciner or carbon reactor. Raw mixture is heated up to 870-880 degrees Celsius inside the calciner, which plays very important role in the process of cement manufacturing - about 80 percent of all carbonates (such as limestone or chalk) are decomposed into CaO (calcium oxide) and CO_2 (carbon dioxide). Since all carbon is taken away from carbonates, this reaction is often called decarbonisation. Calcium oxide is the most critical element for cement production. Raw mixture is fed out of the calciner into the upper end of the special furnace, called kiln. Kiln represents long tube with diameters varying approximately from 3 to 5 meters lined with firebrick inside. Kiln slopes slightly, from one to four degrees. It is revolving around its axis and therefore called rotary kiln; it makes from 30 to 250 revolutions per minute. Rotation of the kiln makes the material gradually move from the upper end of the kiln to the lower end. Gas jet burner is set at the lower end of the kiln. Gas is used as fuel. Gas, combusted inside the jet, produces large concentric flame. As the material formed out of the raw mixture goes from the upper cold end to the lower hot end of the kiln, it reaches the maximum flame temperature which is usually set at 1450-1470 degrees Celsius. Flame temperature is set in such way, that sintered, but not fused lumps, can be formed from the material moving inside the kiln on its way from the cold (upper) to the hot (lower) end. This process is called sintering. The new material formed during process of sintering is called clinker and represents the red rounded hot particles, usually 2-15 centimetres in diameter. At the lower end of the kiln clinker is dropped out of the kiln into the clinker cooler. Clinker formed inside of the kiln is hot and needs to cool down before it can be further manipulated. Cooling takes place in clinker cooler. Cooled clinker is stored in silos until further required in the operations.

Table A.4.2.1: Typical clinker components

Clinker	Unit	Mass
Tricalcium silicate $3(CaO) \cdot SiO_2$	%	45-75%
Dicalcium silicate $2(CaO) \cdot SiO_2$	%	7-32%
Tricalcium aluminate $3(CaO) \cdot Al_2O_3$	%	0-13%
Tetracalcium aluminoferrite $(CaO) \cdot Al_2O_3 \cdot Fe_2O_3$	%	0-18%
Gypsum $CaSO_4 \cdot 2\ H_2O$	%	2-10%

Cement manufacturing from clinker

Cooled clinker represents rounded pieces of material with 2-15 centimetres in diameter. In order to produce cement, clinker has to be ground in to a fine powder. Final grinding of clinker happens in cement mills or finish mills in American usage. Cement mill represent the horizontal cylinder, partially filled with steel balls or small steel cylinders, and has two chambers, allowing placement of two different sizes of the grinding media inside the mill. Ball diameter in the first chamber is 60-80 millimetres when in the second chamber ball diameter equals 15-40 millimetres. Two chambers with two different diameters of grinding media allow resolving situation when large grinding media can't produce fine powder and small grinding media can't break big pieces of clinker. Setting qualities of the final product are controlled by adding 2% to 8% of gypsum or anhydrite into clinker during the final grinding of clinker and additives mixture process. Cement formed during the final grinding is transported by belt conveyor and stored in silos. Ready cement is then further transported to the packaging zone, where it is packed and shipped to the final consumer in bulk or packaged. Shipping may be done by trucks or by rail.

Table A.4.2.2: Typical cement components

Cement	Unit	Mass
Calcium oxide, CaO	%	45-75%
Silicon oxide, SiO_2	%	7-32%
Aluminum oxide, Al_2O_3	%	0-13%
Ferric oxide, Fe_2O_3	%	0-18%
Sulfate	%	2-10%

Wet, semi-dry and dry method of clinker manufacturing

There are three methods of clinker production represented in the Russian Federation:

- Wet;
- Semi-dry;
- Dry;

The only difference in these three methods of clinker production is the way the raw mixture is prepared before introduction into the rotary kiln.

Wet method of clinker manufacturing

Raw materials are delivered from quarry, crushed and milled with water adding to form slurry. Then slurry is pumped to blending tanks and homogenized to insure even composition. Slurry is then stored in tanks until required. Slurry is fed to the rotary kiln to form clinker. Heat exchanger and calciner are not present in this method of clinker production.

Semi-dry method of clinker manufacturing

Raw materials are delivered from quarry, crushed. Raw mixture is prepared and pumped in the form of slurry into the storage area. Slurry with moisture content of 40% is dehydrated in press-filters producing lowered moisture content (20%) substance called cake, which is dried and milled in hummer crusher with drying, lowering moisture content to less than 1%, then raw mixture is warmed up, decarbonised in cyclone heat exchangers and in the calciner and further sintered in the rotary kiln.

Dry method of clinker manufacturing

Raw materials are delivered from the quarry, crushed, stored, dried in the mill, milled. Ready dry kiln feed is stored in silos. Kiln feed is accurately dosed into the system of cyclone heat exchangers, into the calciner and, finally, into the kiln. Raw materials are decarbonised inside the calciner and in the kiln. Sintering process takes place inside of the rotary kiln.

Dry, semi-dry and wet methods comparison

The three different methods of clinker production differ from one another in the way the raw mixture is prepared. Also for the dry and *semi-dry methods* it is possible to heat up the dry kiln feed inside the cyclone heat exchangers, up to the temperature of decarbonisation, making it possible to start reaction of decarbonisation in the special device – calciner. Up to 90% of raw materials are decarbonised inside the calciner when semi-dry or dry processes are used. The kiln is mainly used for sintering process in these two methods. Because kiln feed is dried and warmed up before entering inside the kiln, it is possible constructing shorter kilns (45-50 metres long compared to 185 metres during the wet process application), this means that less area (inside the kiln, as the kiln is much shorter, and therefore smaller) needs to be heated up, so that the semi-dry and dry processes require significantly less fuel to be consumed. Semi dry method is less effective in terms of energy consumption compared to the dry method. Semi-dry method shows its advantage over the dry method when initial capital investments for production line construction are dominating over the energy efficiency. Semi-dry method allows using an old raw materials preparation technological chain of the wet method. Changes are coming only after the slurry is ready to be introduced in the kiln, when it is redirected to the press-filter and moisture content is reduced from 40% to 18%-20%, making kiln feed suitable for usage in cyclone heat exchanger system (after drying in crusher) and inside the calciner. Semi-dry method is less energy efficient then the dry method, but at the same time energy consumption for semi-dry method is much less than for the wet process.

Dry method is the most energy efficient and it is the preferred method of modernizing the existing wet clinker manufacturing process when the company has sufficient funds to build entire new chain of raw materials preparation, heat exchanger, calciner and new kiln. As it is shown earlier, dry method requires completely new system of raw materials preparation and clicker sintering equipment. The rest of the technological process may be left without changes, as clinker milling with additives and, essentially, cement manufacturing are the same for all the three methods.

Wet method is traditionally used and very wide spread due to the fact that gas and other fuels were not so expensive when initial production lines were designed and built. The key factor that comes into place when justification for the wet process is needed is that the raw materials can be better mixed in the form of slurry (with water addition), making this way better contact and greater contact surfaces to trigger chemical reactions required for cement manufacturing. Due to the fact of water presence in the slurry, water still needs to be evaporated before decarbonisation and sintering process can be initiated, because these processes temperature is1450 degrees Celsius. Evaporation of water requires longer kilns to be constructed which mean that more gas needs to be combusted in order to maintain temperature suitable for chemical reactions. Wet process of clinker manufacturing is the most energy intensive and less preferable for the new capacity additions.

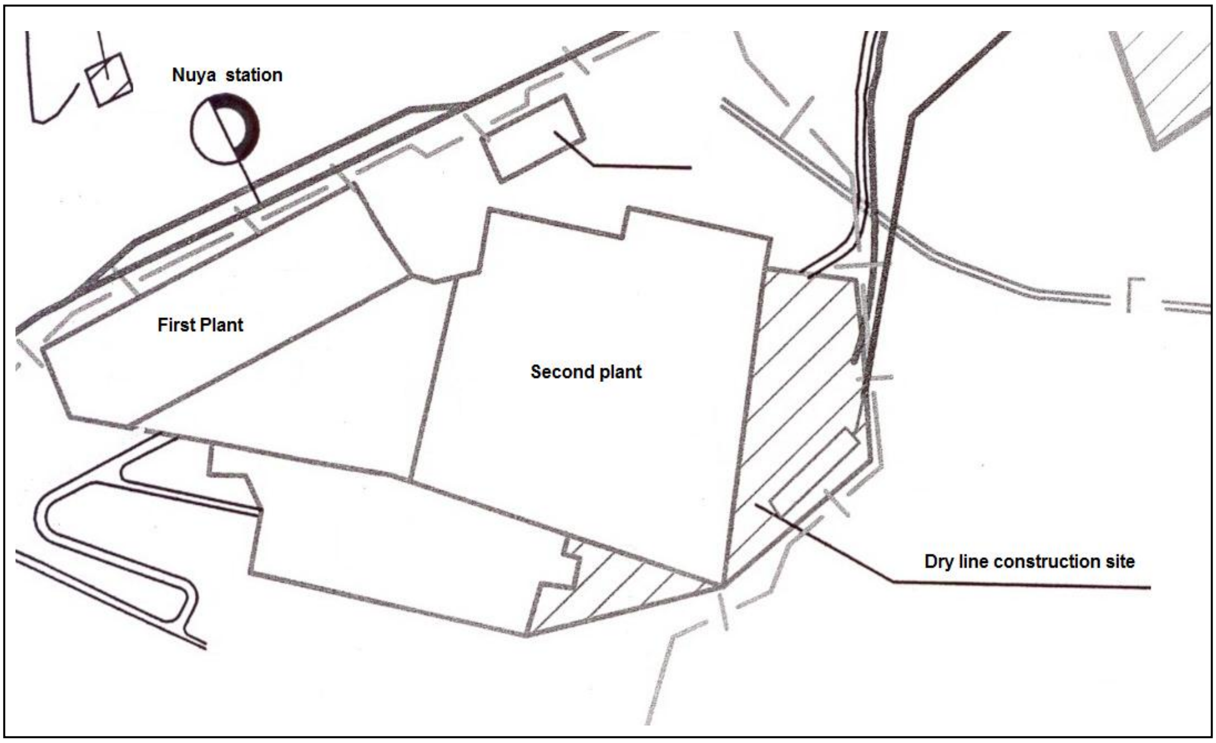
Current process layout

OJSC “Mordovcement” is placed in Komsomolskiy town, Chamzinskiy district, Republic of Mordovia, Russian federation. Plant designed capacity is 3,750 tonnes of cement per year. There are two separate plants placed at OJSC “Mordovcement” production site: Staroalexeevskiy Cement Plant (Old Alexeevskiy Plant) and Alexeevskiy Cement Plant. Staroalexeevskiy Cement Plant is also known as production #1, Alexeevskiy Cement Plant internal abbreviation is production #2. Plants are placed 800 meters apart from each other. Both plants are independent one from another and have their own infrastructure for cement manufacturing, including raw materials preparation facilities, kilns, mills and other equipment to ensure independent operations. There are neighbouring enterprises placed next to the plant, - asbestos-concrete plant and ferroconcrete plant.

Table A.4.2.3: Main technical data for Staroalexeevskiy (first) cement plant

Indicator	Unit	Wet production line
Kiln #1 capacity	tonnes clinker per day	595.2
Kiln #2 capacity	tonnes clinker per day	684
Kiln #3 capacity	tonnes clinker per day	684
Kiln #4 capacity	tonnes clinker per day	684
Kiln runtime factor	-	0.9
Clinker / cement factor	-	0.812
Fuel	-	Natural gas
Fuel consumption (entire plant)	Cubic meters per year	175,257,930
First plant (Staroalexeevskiy) cement production	tonnes of cement per year	930,000
Emission factor	tCO_2/tonne of cement	0.94

Figure A.4.2.2: Staroalexeevskiy (first) and Alexeevskiy (second) cement plants



Raw materials basis is represented by natural mineral deposits and technological materials. Chalk with moisture content of 25.1% is taken from Vanykinskoe natural deposits field. Clay with moisture content of 23.5% is taken from Kochkushi quarry. Bauxites with moisture content of 20.3% are taken from Severoonegskoe natual mineral deposits field. Cinder with moisture content of 19.2% is delivered from Dzerzhinskiy chemical plant. Gypsum added in cement is delivered crushed from Egorchinskiy gypsum plant, Perm area. Raw materials are delivered from the quarry to the pant by rail in dump cars.

The raw materials delivery scheme will be changed during the project implementation. A conveyor line will be constructed from the quarry to the preparation facility of the plant in order to supply the plant with chalk. A crusher will be set in the quarry to prepare raw materials for transportation from the quarry. Belt raw materials re-loader will be set in the quarry to assist with raw materials transportation via the conveyor line. Converyor line to be constructed will supply with chalk both plants, Staroalexeevskiy (production #1) and Alexeevskiy (production #2).

Table A.4.2.4: Raw materials used for cement production

Raw material	Place of origin	Moisture content, %
Chalk	Vanykinskoe natural mineral deposit field, Mordovcement	23-29
Clay	Kochkushkoe natural mineral deposit field, Mordovcement	18-30
Pyrite cinder	“Sverdlova” plant, Dzrezhinsk city, Nizhegorodskaya area	-
Slag	OJSC “Ammofos” Cherepovets city, Vologodskaya area	28
Gypsum	Ergochinskiy gypsum plant, Perm area	-

Natural gas is used as fuel.

Both plants utilize wet clinker manufacturing method.

Staroalexeevskiy cement plant (first production)

Table A.4.2.5: Raw materials quantities required for cement production at Staroalexeevskiy cement plant (first production), including semi-dry method

Raw material	Moisture content, %	Quantity required, tonnes/year
Chalk	0	2154649
Clay	0	199274
Pyrite cinder	0	43747
Chalk	24	2834982
Clay	23,6	259990
Pyrite cinder	20	54800
Opoka[3] (overburden)	33	61194
Slag	15	48235
Gypsum	-	110387

First production (Staroalexeevskiy cement plant) was put into operation in 1956-1959. The chain of operation is as follows: Raw materials are delivered and stored, then crushed in one specially designed crusher called “Gidrofol”, where raw materials are crushed by themselves without action of any other crushing materials. After self crushing, raw materials are introduced into the raw mills, where water is added to form slurry; slurry is stored and corrected in the vertical and in the horizontal raw mixture

[3] Overburden rock found on top of chalk mineral deposits

basins. The plant has four kilns; kiln #1 and kiln #2 with 3.6 metres in diameter and 150 metres long with 25 tonnes of clinker per hour productivity. Kiln #3 and kiln #4 with 4 metres in diameter and 150 metres long with 28.5 tonnes of clinker per hour productivity. Clinker is crushed into cement powder in six cement mills with 26 tonnes per hour productivity each. Additives are dried in drum driers, five in total. Ready cement is stored in 10 silos 2500 tonnes of capacity each.

Alexeevskiy cement plant (second production)

Table A.4.2.6: Main technical data for Alexeevskiy cement plant (second production)

Indicator	Unit	Wet production line
Kiln #5 capacity	tonnes clinker per day	1632
Kiln #6 capacity	tonnes clinker per day	1632
Kiln #7 capacity	tonnes clinker per day	1632
Kiln #8 capacity	tonnes clinker per day	1632
Kiln runtime factor	-	0.89
Clinker / cement factor	-	0.867
Fuel	-	Natural gas
Fuel consumption (entire plant)	Cubic meters per year	378675139
First plant (Staroalexeevskiy) cement production	tonnes of cement per year	2,820,000
Emission factor	tCO_2/tonne of cement	0.94

Table A.4.2.7: Raw materials required for cement production at Alexeevskiy cement plant (second production)

Raw material	Moisture content, %	Quantity required, tonnes/year
Chalk	0	2,934,940
Clay	0	271,440
Pyrite cinder	0	59,590
Chalk	24	3,861,651
Clay	23.6	354,144
Pyrite cinder	20	74,646
Opoka (overburden)	33	82,985
Slag	15	65,412
Gypsum	-	150,330

Second production (Alexeevskiy cement plant) was put into operation in 1969-1973. Raw materials are delivered, stored, and crushed in “Gidrofol” mill, then milled in four raw mills with 140 tonnes per hour capacity. Slurry is stored and being corrected in slurry basins. There are four wet kilns at the second plant kilns #5, 6, and 7 with 5 meters in diameter and 185 meters long with production capacity of 68 tonnes of clinker per hour; kiln #8 with 5.6 meters in diameter and 185 meters long with production capacity of 68 tonnes of clinker per hour. Clinker is crushed into cement powder in eight cement mills with 50 tonnes per hour productivity each. Additives are dried in drum driers, two in total. Ready cement is stored in 16 cement silos, 4500 tonnes of capacity each.

Situation after the project implementation

The proposed project consists of three subprojects, explained below. It is not planned to dismantle or reduce cement production at the wet kilns at both plants although market circumstances could lead to lower demand.

Subproject 1: Construction of semi-dry kiln system

In the scope of this project it is planned to construct the new semi-dry technological line with 2300 tonnes of clinker per day production. The line is being constructed at Staroalexeevskiy (first plant) production site. Production capacity of the semi-dry line is 760,000 tonnes of cement per year.

Calculations for the natural gas consumption by the semi-dry kiln are made assuming that the kiln is producing at its maximum designed capacity. For the most accurate calculations actual gas consumption at the kiln is used. Since the kiln most of the time was running in the test mode, run factor of this kiln is only 0.5109, which represents only half of all available time for the kiln operation. Therefore, accounting for the run factor mentioned, natural gas consumption at designed capacity is equal to 73,140,000 cubic meters.

Table A.4.2.8: Main technical data for Semi-Dry line at Staroalexeevskiy (first) cement plant

Indicator	Unit	Semi-Dry production line
Semi-dry kiln capacity (kiln #9)	tonnes clinker per day	2,300
Kiln run factor	-	0.5109
Clinker /Cement factor	-	0.812
Fuel	-	Natural gas
Fuel consumption (semi-dry kiln with run factor 0.5109)	Cubic meters per year	37,370,222
Semi-Dry line cement production	tonnes of cement per year	760,000
Semi-Dry line electricity consumption (consumption at designed capacity)	MWh per year	59,778 MWh per year

Special details of the semi-dry raw-mixture preparation method is that it is the same as for the wet process, when clinker sintering method is the same as for the dry method with press-filter usage and crusher with drying section usage for the raw mixture dehydration. Semi-dry technological line was commissioned on 28 September 2007. As a result of Semi-dry line commissioning, the cement production capacity at plant#1 increased by 760,000 tonnes of cement per year.

Raw mixture preparation is done at the existing preparation facilities. One raw mill needs to be constructed with additional slurry basin of 8000 cubic meters capacity. Ready raw mixture is retrieved from the new slurry basin and passed into the press-filter. There are five press-filters in total, one of them is reserved as spare. Raw mixture is dehydrated in the press-filters from 40% moisture content to 20% moisture content. Slices made of raw mixture are formed by pushing out certain amount of water inside the press-filter. These slices called cake. Cake is taken away from the press-filter by a belt conveyor and delivered to the silo. Out of the silo cake is transported into the drying crusher with 150 tonnes per hour productivity where it is crushed and dried. Raw meal, formed this way, is captured in deposit cyclones and passed into the cyclone heat exchanger, which consists of one line and three stages of cyclones for calciner. PYROCLON-R calciner is equipped with burner, which draws up to 60% of the fuel required for calcining. The raw meal is gradually warmed up to the decarbonisation temperature inside the heat exchanger, passed into the calciner, decarbonised and introduced into the rotary kiln with four meters in diameter and 47 meters long. 40% of the fuel is supplied into the hot end of the kiln. Gases leaving heat exchanger and rotary kiln are redirected into the drying crusher for cake drying purposes during its crushing (temperature of gases is 545 degrees Celsius). Clinker, formed inside the rotary kiln during raw meal sintering, is introduced into the iron-grid cooler for cooling down by the air flow, generated in five fans. The clinker has temperature about 1000 degrees Celsius at the moment of sliding off the kiln. Air, circulated through the hot clinker, is warming up and used for combustion inside the rotary kiln. After the cooler, clinker is passed to the storage. Milling of clinker is done at the existing cement mill facilities.

Subproject 2: Dry technological chain construction

Table A.4.2.9: Main technical data for the dry line at Alexeevskiy (second) cement plant

Indicator	Unit	Dry production line
Dry kiln capacity (kiln #10)	tonnes clinker per day	6,000
Kiln runtime factor	-	0.85
Clinker /Cement factor	-	0.867
Fuel	-	Natural gas
Fuel consumption (entire plant)	Cubic meters per year	165,000,000
Dry line cement production	tonnes of cement per year	2,350,500
Dry line clinker production	tonnes of clinker per year	1,860,000
Dry line electricity consumption (consumption at designed capacity)	MWh per year	332,626

Table A.4.2.10: Raw materials required for cement production at the dry line, Alexeevskiy cement plant (second production)

Raw material	Moisture content, %	Quantity required, tonnes/year
Chalk	0	2,574,240
Clay	0	238,080
Pyrite cinder	0	52,266
Chalk	24	3,387,060
Clay	23,6	310,620
Pyrite cinder	20	65,472
Opoka (overburden)	33	88,060
Slag	15	410,882
Gypsum	-	152,783

Chalk is transported from the quarry by a conveyor line, which will supply both plants with required chalk. For the dry line of clinker production it is required that chalk should be crushed to 80 millimetres in diameter. Old production capacities (under wet method) may accept pieces of chalk up to 500 millimetres in diameter. Therefore two queues of chalk transportation are designed at the conveyor. One queue is for the dry method and the other one is for old wet production. Crusher in the quarry is required only for the dry method. Chalk is stored at heated storage along with cinder. Clay is delivered from Vanykinskiy quarry by trucks into the receiving bunker, passed form the bunker into the crusher. Chalk, clay and cinder are accurately dosed onto a belt conveyor and introduced into the roller mill, equipped with drying section. Drying of raw materials is done using exhaust gases with temperature of 500 degrees Celsius that come from the combined heat power plant. Ground raw meal is stored in silos and then directed to the two chain system of cyclone heat exchangers, where it is warmed up by kiln exhaust gases and decarbonised in the calciner. Calciner consumes 60% of the fuel. Air, supporting combustion inside the calciner, is taken from the grid cooler and has temperature of 700 degrees Celsius. Clinker is sintered inside the rotary kiln with 5.2 meters in diameter and 65 meters long. Natural gas with net calorific value of 8000 kcal/nm^3 is used as fuel. It is required 725 kcal of heat per one kilogram of clinker sintered. Out of the kiln clinker is introduced into the iron-grid cooler, where it cools down and being redirected into the clinker storage. Clinker is ground in two cement mills. Additives such as opoka and slag are ground in the separate mill. Additives and cement are mixed inside the multi-sectional silos. Ready cement is stored in two blocks of cement silos. Each block has 2 silos with 18 meters in diameter and one multi-chamber silo with 20 meters in diameter. Multi-chamber silo is designated for different types of cement production by mixing separately prepared components that placed at the different chambers inside the silo. Cement shipping may be done in bulk by rail or by trucks, or cement may be transported in package. Dry technological line is scheduled to be commissioned on 1 October 2010.

Secondary fuel usage during clinker sintering

To minimize fuel consumption it is planned to implement secondary fuel usage within the project in order to replace some quantities of gas. It is planned to organize receiving, storage and shredding of automobile tires. Tires in the form of “chips” will be supplied to the semi-dry line. By the series of belt transporters tires will be delivered into the loading system of the PYROCLON-R calciner. Tires consumption is planned at two tonnes per hour. It is planned that up to 25% of required gas for combustion in the calciner will be replaced by the automotive tires.

Table A.4.2.11: Automotive tires (secondary fuel) chemical composition:

Component	Content	Units
Ash	7.5	%
Carbon	81.0	%
Hydrogen	6.7	%
Oxygen	3	%
Nitrogen	0.3	%
Chloride	0.1	%
Sulphur	1.7	%

Table A.4.2.12: Secondary fuel plant operation parameters:

Parameter	Value		Units
	Semi-dry line	Dry line	
Automotive tires consumption	1.7-2.0	8.3	tonnes/hour
Working days throughout the year	330	330	days/year
Daily quantity required	40.8-48	199.2	tonnes
Tires chips mixture density	0.4-0.5	0.4-0.5	tonnes/cubic metre

Secondary fuel (rubber chips) emission factor calculation

Based on the chemical composition analysis presented in the table A.4.2.11 we may find carbon content fracture of the composition. As carbon dioxide formula is CO_2, we can see that only carbon is able to produce chemical compound with oxygen during burning process to produce carbon dioxide (CO_2). Therefore the task is to find how many tonnes of carbon dioxide (CO_2) will be originated during burning of one tonne of carbon (chemical reaction of carbon with oxygen compound).

Molecular weight of carbon (C) -12

Molecular weight of oxygen (O) -16

Molecular weight of carbon dioxide (CO_2) – 44 (12+2*16)

In order to find out how many tonnes of carbon dioxide (CO_2) will be originated during burning of one tonne of carbon, the following proportion have to be solved:

C – 12
CO_2 – 44

Solving the proportion we will get:

$$CO_2 = \frac{44 \times C}{12} \qquad (1)$$

Considering that one tonne of rubber chips being combusted, we will get that this one tonne will contain 810 kilogram of carbon (81%, see table A.4.2.11), assigning the actual value of carbon content as 810 kilogram or 0.81 tonne, we will get actual value of carbon dioxide originated per one tonne of rubber chips combusted:

$$CO_2 = \frac{44 \times 0.81 * tonnes}{12} \qquad (2)$$

CO_2=2.97 tonnes

Therefore emission factor for the alternate (secondary) fuel is 2.97 tonnes CO_2 per tonne of alternate fuel.

Subproject 3: Combined heat power plant construction

Combined heat power plant (CHPP) will be placed between the two plants and its construction is intended to supply cement plants with heat and electricity. Operational mode of the plant is round-the-clock and round-the-year, therefore CHPP operational mode is the same as operational mode of cement plants with corresponding electricity and heat load.

CHPP supplies heat loads of cement plant:

- Dry line of cement manufacturing by the exhaust gases after the gas turbine units;
- Steam for technology and facility heating;
- Hot water supplement;

CHPP capacity is:

- 72 MW electrical power;
- 61 GCal/hour heat capacity;

Table A.4.2.13: Heat supplement by CHPP

Heat supplement by CHPP	Unit	Amount
Facilities warming and hot water generation	Gcal/year	39,528
Cement manufacturing technological line (dry method)	Gcal/year	480,476

Natural gas has been chosen as fuel for CHPP gas turbine units and for steam boiler, there is no back up fuel planned. Back up fuel for reserved steam boiler is petroleum residue. Steam generated in boiler is used in the steam turbine unit.

Table A.4.2.14: Natural gas properties

Fraction	Unit	Volume
Methane	Volume, %	98.97
Ethane	Volume, %	0.23
Propane	Volume, %	0.02
Nitrogen	Volume, %	0.76
Carbon dioxide	Volume, %	0.02
Net calorific value	Kcal/m^3 KJ/m^3	8,000 33,472
Density (0ºC; 0,10132 MPa)	Kg/m^3	0.73

Equipment to be used in CHPP:

- Two gas turbines General Electric LM2500+G4DLE, power output 30 MW;
- Steam turbine is Siemens SST-PAC 300, power output up to 50 MW;
- Steam boiler, (steam parameters - 4 MPa, 440ºC);
- Reserve boiler Viessmann Vitomax 200HS;

Only natural gas can be burnt inside the gas turbine units.

Table A.4.2.15: Gas turbine characteristics

Fraction	Unit	Quantity
Power	MW	30
Combustible products consumption	Kg/second	84
Exhaust gases temperature	ºC	501

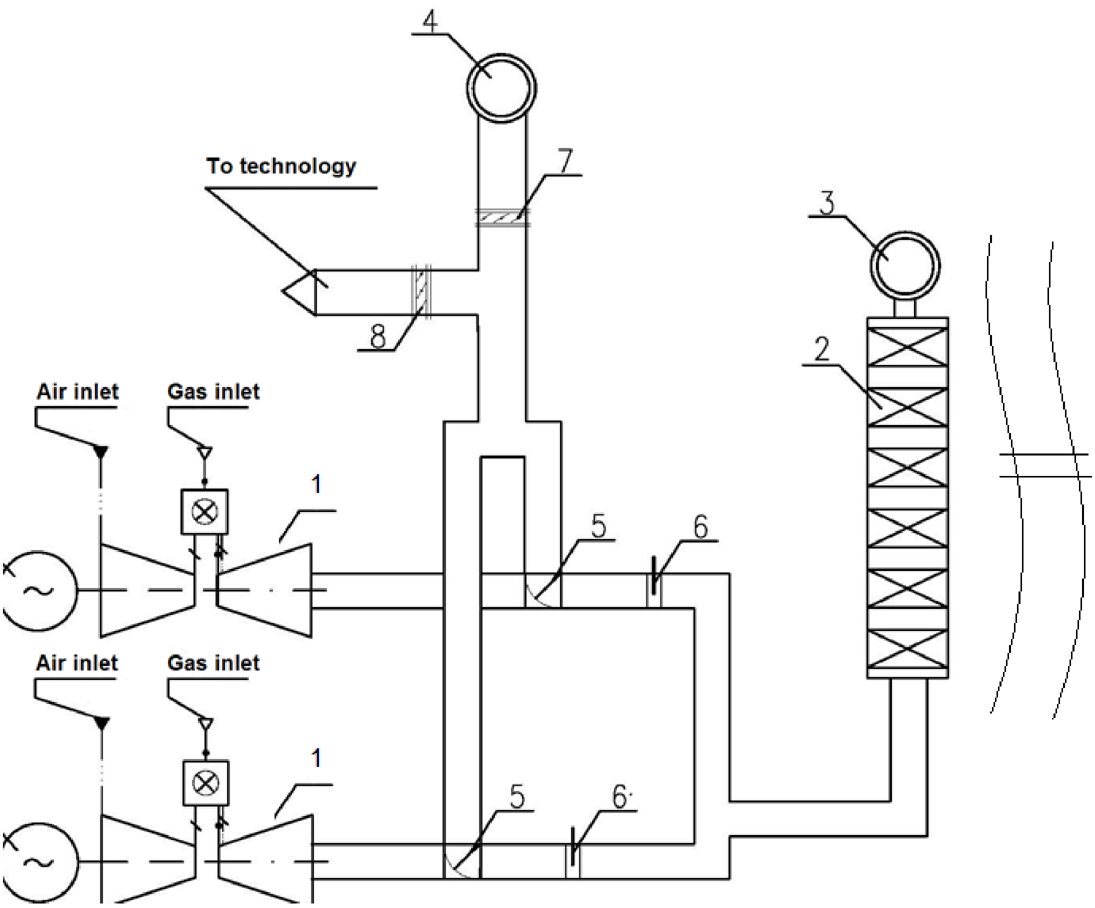
Gas turbine exhaust gases are used for two consumers:

- Technological chain of cement production (dry line);
- Steam boiler for steam generation (4 MPa, 440ºC)

Table A.4.2.16: Electricity requirements at the plant

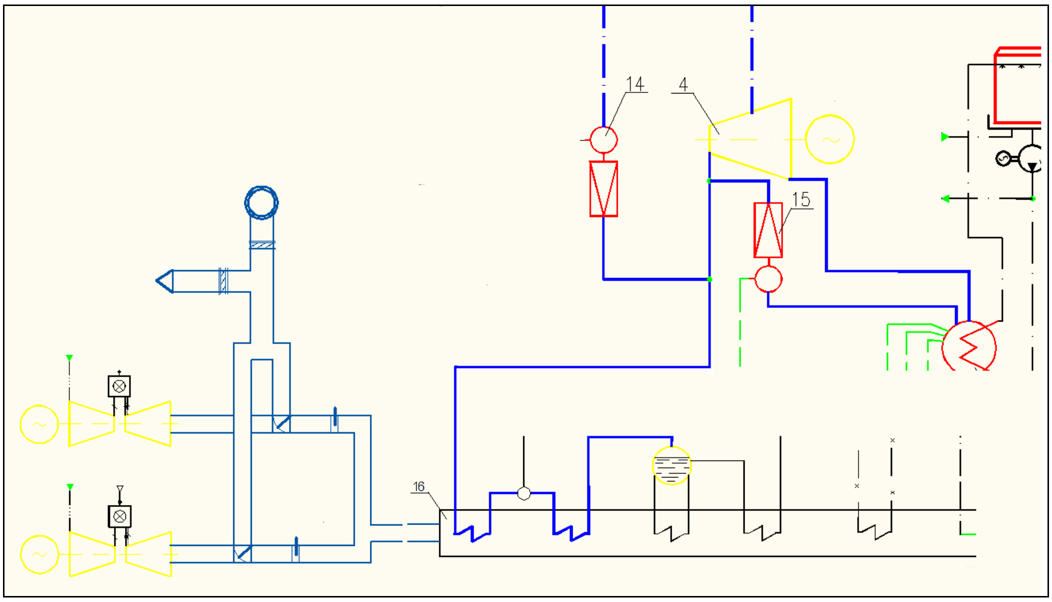
Fraction	Unit	Quantity
Dry line	MW	44.44
Semi-dry line	MW	6.82
Staroalexeevskiy plant	MW	17.5
Alexeevskiy plant	MW	32
Power of CHPP left after fulfilling needs of the dry line	MW	26

Figure A.4.2.3: Combined heat power plant scheme (part 1)



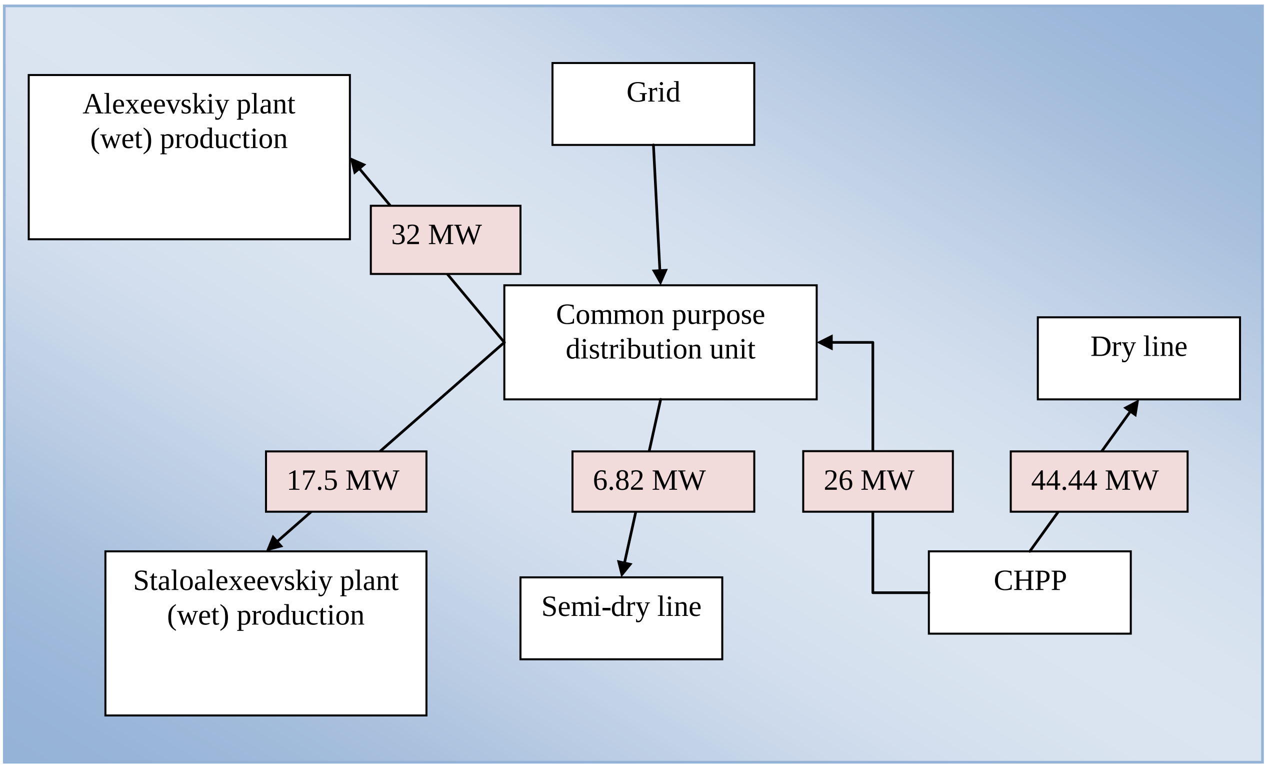
1- Gas turbine; 2- Boiler; 3- Exhaust gas post; 4- Dump post; 5- Redirecting device; 6- Valve; 7- Bypass line valve into the dump post; 8- bypass line valve to technology.

Figure A.4.2.3: Combined heat power plant scheme (part 2)



4- Steam Turbine SST-PAC 300; 14 -Cooling unit ; 15- Cooling unit; 16- boiler;

Figure A.4.2.4: Electricity distribution at the plant



The purpose of boiler is to produce steam and heat up circulating water due to heat utilizing during gas combustion inside of the gas turbine. Part of electricity generated by the steam turbine is used to serve CHPP own needs. Gas serves as steam source in case of emergency shut down of the main boiler.

Combined heat power plant is going to be commissioned on 1 February 2010.

Table A.4.2.17: Dry manufacturing line construction schedule

N	Title	2006	2007	2008	2009	2010
1	Board of directors meeting					
2	Clay crushing					
3	Chalk storage					
4	Chalk dosing					
5	Pyrite cinder dosing and loading					
6	De-duster system setup					
7	Dosing and transporting chain A and chain B					
8	Heat exchanger chain A					
9	Heat exchanger chain B					
10	Rotary kiln setup					
11	Clinker cooling					
12	Clinker transporting					
13	Clinker silo and open storage					
14	Additives storage, packaging					

Table A.4.2.18: Semi-dry manufacturing line construction schedule

N	Title	2004	2005	2006	2007
1	Board of directors meeting				
2	Furnace building				
3	Exhaust gases electric de-duster building				
4	Clinker tower				
5	Heat exchanger				

6	Press filters building with cake dosing gallery				
7	Heat exchanger tower				
8	Drying crusher				
9	Rotary kiln				
10	Silos				
11	Gas pipeline				
12	Iron grid cooler				

Table A.4.2.19: CHPP construction schedule

N	Title	2008	2009	2010
1	Main building			
2	Gas pipeline			
3	Gas preparation facility			
4	Water-cooling tower			
5	Gas-turbine unit			
6	Boiler			
7	Steam turbine			
8	Cooling system			
9	Auxiliary equipment			

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

More energy-efficient dry process of cement production and semi-dry process of cement production are introduced. Emissions reductions of carbon dioxide will occur, particularly, due to reduction of fossil fuel consumption in the kiln. New dry and semi-dry technologies are much more environmentally friendly compared to the traditional wet method. Combined heat power plant electricity generation efficiency is higher than grid generated electricity. CHPP electricity will replace electricity that would otherwise have to be generated by the existing power plants and/or other new energy units to be constructed by the third parties.

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

Table A.4.3.1.1: Estimated amount of emission reductions before the crediting period

	Years
Period before 2008, for which emission reductions are estimated	1
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2007	17,156

Table A.4.3.1.2: Estimated amount of emission reductions over the crediting period

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	68,627
2009	68,627
2010	160,505
2011	436,139
2012	436,139
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1,170,036
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	234,007

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 19 March 2010 No 2010JI06.

SECTION B. Baseline

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

A baseline for JI project has to be set in accordance with appendix B of the annex to decision 9/CMP.1 (hereinafter referred to as "JI guidelines" version 04), and, in particular, the "Guidance on criteria for baseline setting and monitoring" version 02 developed by the Joint Implementation Supervisory Committee (JISC) (hereinafter referred to as "Guidance").

Baseline is the scenario that reasonably represents the anthropogenic emissions by sources or net anthropogenic removals by sinks of GHGs that would occur in the absence of the project and shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol, and/or anthropogenic removals by sinks, within the project boundary.

A baseline shall be established on a project-specific basis and/or using a multi-project emission factor, taking into account the project boundary.

JI specific approach is used to identify the baseline.

Project not implemented as JI is included as one of the alternatives.

Step 1: Theoretical approach to identify the baseline

The baseline for JI project is scenario that reasonably represents anthropogenic emissions by sources (or anthropogenic removals by sinks) of GHGs that would occur in the absence of the proposed project.

As no approved CDM baseline and monitoring methodology can be applied directly, in accordance with paragraph 24 of the Guidance, plausible future scenarios on the basis of conservative assumptions were identified and the most plausible one selected (step 1). The proposed project, not being developed as a JI project, has been included as one of the alternatives. These alternatives are assessed whether or not to be credible and reasonable and the most plausible alternative is identified as the baseline (step 2).

The approach chosen is to assess all three subprojects as one JI project, combining semi-dry, dry lines and CHPP.

The plant is operating since 1956. All kilns since then are operational. This implies the fact that there was a lack of financing during Soviet Union collapse, irregular and incomplete maintenance. The plant has clear and transparent schedule of kilns maintenance and financing required for maintenance. It is realistic to make an assumption that with the proper maintenance and repair program being implemented, wet kilns will operate until 2020 and beyond.

Step 2: Application of the approach to the project

Step 2a: Identification and listing of plausible alternative baseline scenarios.

Alternate fuel would also be used in the baseline scenario at wet kilns at OJSC Mordovcement premises.

OJSC "Mordovcement" is producing cement using wet process since it was founded. Wet process was the predominant technology for the Soviet Union. The main reason to use wet processes was the simplicity of raw material handling in order to control cement quality. Gas fuel consumption was not considered as a high priority at that time.

Maximum technical cement production capacity of the existing first cement production (plant #1) is 930,000 tonnes of cement per year for four wet lines when for existing second production (plant #2) it is 2,820,000 tonnes per year. After the project implementation, cement production at first cement plant will amount 1,690,000 (930,000 tonnes of cement per year for four wet lines and 760,000 tonnes per year for the semi-dry line) and for the second cement plant will amount 5,170,500 tonnes per year (2,820,000 tonnes per year for existing four wet lines and 2,350,500 for the dry line being constructed). Incremental production will be approximately 3,110,500 million tonnes of cement per year.

There are several options of cement production technically possible at OJSC "Mordovcement". These are discussed below.

Production capacity options:

a. Keeping the existing wet cement production lines, continue consume electricity from the grid. Third party producers will satisfy cement demand instead (approximately 3,110,500 million tonnes of cement per year);
b. Keeping existing cement production lines and constructing a new cement production line (technical production capacity approximately 3,110,500 million tonnes of cement per year);
c. Dismantling existing cement production lines and constructing a new cement production line with a larger capacity (technical production capacity approximately 5,170,500 million tonnes of cement per year).

Technological options of new cement production line

d. Applying wet process;
e. Applying semi-dry process;
f. Applying dry process.

Combined six options mentioned above result in seven possible alternative baseline scenarios:

Alternative 1: Keeping existing lines, continue consume electricity from the grid. Third party producers will satisfy cement demand instead, electricity for wet old lines is consumed from the grid;
Alternative 2: Keeping existing lines and constructing a new line applying wet process;
Alternative 3: Keeping existing lines and constructing new facilities not implementing it as JI project;
Alternative 4: Constructing a new line applying wet process and dismantling the existing lines;
Alternative 5: Constructing a new line applying semi-dry process and dismantling the existing lines;
Alternative 6: Constructing a new line applying dry process and dismantling the existing lines.

Six alternatives are described below in detail.

1) Keeping existing lines, continue consume electricity from the grid. Third party producers will satisfy cement demand instead, electricity for wet old lines is consumed from the grid;

Annual cement production is approximately 3,750,000 million tonnes. Incremental production (approximately 3,110,500 million tonnes of cement per year) would have been covered by other (new and/or existing) cement manufacturers. Electricity is consumed from the grid by old wet lines.

2) Keeping existing lines and constructing a new line utilizing wet process of cement manufacture

A new wet kiln and new auxiliary equipment for the new line would be built to operate together with the existing lines. Total technical cement production capacity will be approximately 6,900,500 tonnes per year (existing kilns: 3,750,000 tonnes, new kilns: 3,110,500 million tonnes).

3) Keeping existing lines and constructing new facilities not implementing it as JI project;

This alternative is similar to alternative 2 above, but new cement production lines will use the semi-dry, and dry method plus CHPP would be constructed. And above of that, JI revenue will not be gained.

4) Constructing a new line applying wet process and dismantling the existing lines;

OJSC "Mordovcement" will construct new cement production lines that apply wet method. Existing lines are dismantled.

5) Constructing new line applying semi-dry process and dismantling existing lines

This alternative is similar to alternative 5 above, but the new cement production line will apply the semi-dry method.

6) Constructing new line applying dry process and dismantling the existing lines

Similar to alternative 5 above, but new cement production line will apply dry method.

Step 2b: Identification of the most plausible alternative scenario

Assessment of alternative 1: Keeping existing lines, continue consume electricity from the grid. Third party producers will satisfy cement demand instead, electricity for wet old lines is consumed from the grid;
Wet process is the predominant cement production technology in Russia and OJSC "Mordovcement" can continue using wet process and consuming electricity from the grid. There are no legal or other requirements which would force OJSC "Mordovcement" to discontinue using wet production process or stop electricity consumption from the grid. Existing lines can continue operation at least until 2020. No additional investment is required. Thus, alternative 1 is reasonable and feasible.

Assessment of alternative 2: Keeping existing lines and constructing new line applying wet process

Under alternative 2, a new wet line would have been built and used together with the existing wet lines. Wet process has already been used on-site, it is well known, and its construction and operation will not face technical and staff training difficulties. However, wet kilns are an out-dated technology with high specific energy consumption per tonne of clinker produced. Given the fact that energy prices are constantly being increased, reinforced application of this technology will lead to high (and increasing) cement production costs. This alternative cannot be considered as reasonable and feasible. Moreover, this alternative is not conservative in terms of GHG emissions.

Assessment of alternative 3: Keeping existing lines and constructing new facilities not implementing it as JI project;

Semi-dry, dry lines and CHPP would be constructed; existing wet lines would be kept. This scenario requires significant investments and is not feasible without JI revenue (demonstrated below) and therefore cannot be identified as the most plausible scenario.

Assessment of alternative 4: Constructing new line applying wet process and dismantling the existing lines

This option is the similar to alternative 2, but more investments are required for its implementation. Therefore alternative 5 is less reasonable than alternative 2.

Assessment of alternative 5: Constructing new line applying semi-dry process and dismantling the existing lines

This option is similar to alternative 3, but it is not reasonable to shut down existing facilities when demand is growing and those facilities can generate revenue, even utilizing more energy intensive method of clinker manufacturing. This option requires capital investments. It is not the most plausible.

Assessment of alternative 6: Constructing new line applying dry process and dismantling the existing lines

This option is similar to alternative 4, but it is not reasonable to shut down existing facilities when demand is growing and those facilities can generate revenue, even utilizing more energy intensive method of clinker manufacturing. This option requires capital investments. It is not the most plausible.

Conclusion

Only alternatives 1 and 3 are realistic and credible. However, alternative 3 is not economically/financially feasible. This is proven in Section B.2 below, by applying an investment analysis in accordance with the approved CDM "Tool for the demonstration and assessment of additionality" (version 05.2). The tool is used in its totality.

Scenario that represents the baseline:

- In the project absence (not constructing semi-dry, dry lines and CHPP) cement would have been produced by the other, third party cement manufacturers, located within the radius of 1000 km from the plant location or at the existing wet kilns located at Mordovcement plant and electricity is consumed by old wet lines from the grid.

Alternative 1 is the only remaining realistic and credible alternative and therefore identified as the most plausible baseline scenario. Therefore the baseline scenario is the alternative 1.

Key data used to establish the baseline in tabular form is presented below.

Table B 1.1. Key parameters used to identify the baseline

Data/Parameter	$EF_{calcin,y}$
Data unit	tCO_2/t clinker
Description	Default calcination factor in year *y*
Time of determination/monitoring	Fixed ex-ante during determination
Source of data (to be) use	Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker
Value of data applied (for ex ante calculations/determinations)	0.525
Justification f the choice of data or description of measurement methods and procedures (to be) applied	This default emission factor is close to the IPCC default factor and is adjusted for Mg carbonates
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$NCV_{fuel\_i,y}$ ("fuel_i" is natural gas)
Data unit	KJ/m^3
Description	Net calorific value of natural gas in year *y*
Time of determination/monitoring	Monitored during the crediting period
Source of data (to be) use	Plant records
Value of data applied (for ex ante calculations/determinations)	33,472
Justification f the choice of data or description of measurement methods and procedures (to be) applied	Natural gas net calorific value is taken from the Certificate of natural gas supplier. Natural gas supplier issues it on monthly basis.
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	EF_{fuel_i} ("fuel_i" is natural gas)

Data unit	tCO_2/GJ
Description	Emission factor of natural gas
Time of determination/monitoring	Fixed ex-ante during determination. Updates of IPCC default factor will be monitored during the crediting period
Source of data (to be) use	2006 IPCC Guidelines on National GHG Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html, Volume 2, Chapter 2 page 16, table 2.2
Value of data applied (for ex ante calculations/determinations)	0.0561
Justification f the choice of data or description of measurement methods and procedures (to be) applied	IPCC default emission factor is used
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{el\_j,y}$
Data unit	tCO_2/MWh
Description	Standardized CO_2 emission factor of the regional energy system (RES) *j* (multi-project baseline)
Time of determination/monitoring	Fixed ex-ante during determination
Source of data (to be) use	The study "Development of grid GHG emission factors for power systems of Russia" commissioned by "Carbon Trade and Finance" in 2008 (further in the text – Study) Version 02
Value of data applied (for ex ante calculations/determinations)	0.511 – for RES "Centre"; 0.548 – for RES "North-West"; 0.506 – for RES "Mid Volga"; 0.541 – for RES "Urals"; 0.500 – for RES "South"; 0.894 – for RES "Siberia";
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The Study was verified by Bureau Veritas Certification in 2008
OA/QC procedures (to be) applied	-
Any comment	For the calculation of emissions related to electricity consumption in the project and baseline scenarios for replacement part of cement production, the combined margin emission factor for RES "Mid Volga" was applied. For the calculation of emissions related to electricity consumption in the baseline scenarios for incremental part of cement production, the corresponding grid emission factors (for RES "Centre", RES "Mid Volga", RES "North-West" and RES "South") were applied. Please see Annex 2.

Data/Parameter	$BEF_{incr,y}$
Data unit	tCO_2/t cement
Description	Baseline emission factor for incremental cement production
Time of determination/monitoring	Monitored during the crediting period
Source of data (to be) use	OJSC “NIICEMENT” annual statistical report “Russian Cement Industry in 2007”. This report contains the data of annual cement and clinker production and annual fuel and electricity consumption at Russian cement plants.
Value of data applied (for ex ante calculations/determinations)	0.819
Justification f the choice of data or description of measurement methods and procedures (to be) applied	The underlying principle of the Combined Margin (as first introduced in the “Tool to calculate the emission factor for an electricity system” Version 02) is used. IPCC default values are used for CO_2 emission factor of fossil fuels. The default grid emission factors for the regional power systems of Russia are used. Please see Annex 2 for more detail description including the assumptions, formulae, parameters, data sources and key factors
OA/QC procedures (to be) applied	-
Any comment	-

Baseline emissions of the incremental production are calculated on the basis of displaced cement production by third party producers. An approach needs to be developed how such a counterfactual situation can be constructed while remaining transparent and conservative.

Cement industry is a transparent market where standardized types of cement products exist. Within a certain region or country cement can be transported from the producer to the consumer.

A similar situation exists in an electricity system where electricity can be transported from the producer to the consumer without significant transmission constraints. Given the similarity, the following approach takes into account the underlying principles of the “Tool to calculate the emission factor for an electricity system” (version 02) (hereinafter referred to as “CDM Tool”), adopted by the CDM Executive Board, which deals with capacity additions to the electricity grid.

However, it has to be considered that cement, inter alia due to transportation costs, is not delivered over huge distances. In Russia the average distance of cement deliveries is approximately 500 km.[4] Therefore, it is assumed that new cement capacities can have a potential effect on the production of other cement capacities within a radius of the transportation distance; radius of the circle is approximately 1000 km, two times of the transportation distance. In general, an impact is the more likely, the nearer the plant.

If the JI project is not implemented, incremental production would be covered by other cement producers and result in corresponding emissions, i.e.:

1. Other cement plants that exist within a radius of approximately 1,000 km (operating margin or OM);

[4] See OJSC “NIICEMENT” annual statistical report “Russian Cement Industry in 2007”.

2. New cement capacity additions (to be) built within a radius of 1,000 km (build margin or BM).[5]

Operating margin (OM) emission factor

It is not feasible to define exactly which of the existing cement plants would produce the incremental amount of cement. Most transparent approach is to calculate weighted average of specific CO_2 emissions of the nearest cement plants within 1000 km radius. The result will give the emission factor expressed in tCO_2/t cement.

The OM emission factor is calculated by taking into account the following emissions:

1. Emissions from fuel consumption;
2. Emissions from calcination;
3. Emissions from electricity consumption.

$$OM_y = \frac{\sum EF_{el\_j,y} x EL_{OM\_k,y} + 0.525 x CLNK_{OM,y} + \sum_i EF_{fuel\_i} x NCV_{fuel\_i,incr} x FUEL_{OM,i,y}}{CEM_{OM,y}} \quad (1)$$

Where:

$EL_{OM\_k,y}$	Total electricity consumption at the cement plant *k* in the OM in year *y* (MWh)[6];
$EF_{el\_j,y}$	Grid emission factor of a regional energy system *j* in year *y* used for cement plant *k* located in this area (tCO_2/MWh)[7];
0.525	Calcination emission factor (tCO_2/t clinker)[8];
$CLNK_{OM,y}$	Total clinker production at the cement plants in the OM in year *y* (tonnes);
EF_{fuel_i}	Carbon emission factor of kiln fuel *i* (tCO_2/GJ);
$NCV_{fuel\_i,incr}$	Net calorific value of kiln fuel *i* (GJ/tonne or 1000 m^3);
$FUEL_{OM,i,y}$	Total fuel consumption of kiln fuel *i* at the cement plants in the OM in year *y* (tonnes or 1000 m^3);
$CEM_{OM,y}$	Total cement production at the cement plants in the OM in year *y* (tonnes).

The OM_y emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post.

Build margin (BM) emission factor

In absence of the project, a competitor could decide to build a new cement plant or extend an existing cement production capacity to meet the market demand. It is not feasible to define exactly which new

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[5] The BM defines the new capacity additions that might have been constructed in project absence. This is estimated based on information about the most recently built plants/capacity additions.

[6] The data of annual cement and clinker production and annual fuel and electricity consumption at Russian cement plants are taken from the OJSC "NIICEMENT" annual statistical report "Russian Cement Industry in 2007".

[7] The data of grid emission factors for the nearest 14 cement plants within a radius of 1,000 km from the project is taken from the study "Development of grid GHG emission factors for power systems of Russia" commissioned by "Carbon Trade and Finance" in 2008. Amounts of grid emission factors are presented in Table Anx. 2.4 below.

[8] WBCSD, CO_2 Accounting and Reporting Standard for the Cement Industry (2005)

cement plant/capacity addition would be built and produce the incremental amount of cement. Four options can be applied to calculate the BM emissions:

a) The five most recent capacity additions within the last 10 years within a radius of 1,000 km are taken into account. This approach is applicable if relevant capacity additions can be observed;
b) Alternatively, five new capacity additions planned for the near future within a radius of 1,000 km can be taken into account, if their implementation is realistic/probable. If more capacity additions are planned proximity is decisive;
c) Provided objective data exist, it can be assumed, for reasons of conservativeness, that an installation would be built based on Best Available Technology (BAT) of cement production;
d) If no recent capacity additions have occurred within a radius of 1,000 km and it is unclear which new installations will be built or when, it is reasonable and most realistic to assume the BM emission factor to be zero ex-ante, but monitor it during the crediting period ex-post. In this context, the five most recent capacity additions built within the last 10 years within a radius of 1,000 km (or all, if less than 5 exist) are taken into account, in accordance with the formula below.

$$BM_y = \frac{\sum EF_{el\_j,y} x EL_{BM\_k,y} + 0.525 x CLNK_{BM,y} + \sum_i EF_{fuel\_i} x NCV_{fuel\_i,incr} x FUEL_{BM,i,y}}{CEM_{BM,y}} \quad (2)$$

Where:

$EL_{BM,y}$	Total electricity consumption at the cement plant *k* in the BM in year *y* (MWh);
$CLNK_{BM,y}$	Total clinker production at the cement plants in the BM in year *y* (tonnes);
$FUEL_{BM,i,y}$	Total fuel consumption of kiln fuel *i* at the cement plants in the BM in year *y* (tonnes or 1000 m^3);
$CEM_{BM,y}$	Total cement production at the new cement plants in the BM in year *y* (tonnes).

The BM_y emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post in case of option a), it is fixed ex-ante in case of options b) and c), and it is monitored and calculated ex-post in case of option d).

Combined margin (CM) emission factor

The CM emission factor is calculated by weighing the OM emission factor and the BM emission factor on a 50 % / 50 % basis, as recommended by the CDM Tool.

$$CM_y = \frac{OM_y + BM_y}{2} \qquad (3)$$

Where:

CM_y CM emission factor for incremental cement production (tCO_2/t cement)

The CM emission factor is used for estimating/calculating the baseline emissions of the incremental production, unless the BM emission factor is zero, as described in option d) above. In particular case, only the OM emission factor is taken into account.

In principle, the CM emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post.

If the data required to calculate the OM/BM/CM emission factors for year y is usually only available later than six months after the end of year y, alternatively the emission factors of the previous year (y-1) may be used. If the data is usually only available more than 18 months after the end of year y, the emission factors of the year preceding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout the crediting period.

This methodological approach can be freely reproduced and used for JI projects if proper reference to the source is made.

Application of methodological approach

Background data for the calculation of the OM emission factor

Information on the nearest twenty cement plants within approximately1000 km radius from the project site is presented in Table B.1.2. below:

Table B.1.2: Background information on the nearest twenty cement plants

No.	Plant	Production method	Fuel	Cement production in 2007 (thousand tonnes)
1	Oskolcement	wet	gas	3,320,3
2	Lipetskcement	dry	gas	1,483,0
3	Voskresenskcement	wet	gas	1,680,8
4	Shchurovsky cement	wet	gas	1,237,7
5	Mikhailov cement	wet	gas	1,331,0
6	Sterlotamakskoye AO "Soda"	wet/dry	gas	988,8
7	Zhigulevskiye stroymaterialy	wet	gas	1,288,8
8	Volskcement	wet	gas	2,434,8
9	Ulyanovskcement	wet	gas	1,905,8
10	Sebryakovcement	wet	gas	3,194,0
11	Maltsovskiy Portlandcement	wer	gas	3,480,0
12	Pikalevskiy cement	wet	gas	2,025,5
13	Gornozavodskcement	wet	gas	1,870,0
14	Novotroickiy cementniy zavod	wet	gas	797,0
15	Podolsk-cement	wet	gas	150,0
16	Belgorodskiy cement	wet	gas	2 200,1
17	Podgorenskiy cementnik	wet	gas	430,0
18	Nevyanskiy cementnik	dry	gas	1 090,1
19	Katavskiy cement	dry	gas	1 208,4
20	Magnitogorskiy COZ	wet	gas	321,6
Total cement production in 2007				32,437,7

Source: OJSC "NIICEMENT" annual statistical report "Russian Cement Industry in 2007"

An investigation was conducted to assess the average kiln efficiencies of these cement plants and the average electricity consumption. Data was processed accordingly to obtain the OM emission factor in 2007, which is equal to0.819 tCO_2/t cement.

The OM_y emission factor is estimated ex-ante and monitored and calculated ex-post.

Electricity consumption from the grid is the common way of energy supply for heavy industrial manufacturers in most of the cases. Since the very beginning OJSC "Mordovcement" consumed electricity generated in the grid.

Leakages assessment

Leakage is the net change of anthropogenic emissions by sources which occurs outside of the project boundary, and that can be measured and is directly attributable to the JI project.

Semi-dry and dry lines of cement manufacturing are more energy efficient technologies compare to the wet method of clinker production, meaning that less fossil fuel such as natural gas needs to be consumed and essentially burnt. Less fuel consumption leads to the less leakage associated with natural gas extraction, processing and transportation, given the same value for the leakage coefficient.

Value, defined for natural gas processing, transporting and distribution is equal[9] 921 tonnes per 10^{15}Joule.

Table B.1.2. Leakages assessment

Process type	Specific gas fuel consumption	Leakages associated with fuel consumption
Wet process	6.26 GJ/tclinker	5.76 $kgCH_4$/tclinker
Semi-dry process	3.54 GJ/tclinker	3.26 $kgCH_4$/tclinker
Dry process	2.97 GJ/tclinker	2.73 $kgCH_4$/tclinker

As it can be seen from the analysis made, leakages associated with new semi-dry and dry lines are much lower than leakages connected with the wet process. In order to preserve conservativeness and not to elevate emission reductions from leakages, leakages are excluded from further consideration.

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:

According to paragraph 2 of Annex 1 of the JISC's Guidance (version 02), unless an approved CDM baseline and monitoring methodology is used, inter alia, the following options may be applied:

- Provision of traceable and transparent information showing that the baseline was identified on the basis of conservative assumptions, that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources or enhancements of net anthropogenic removals by sinks of GHGs;

- Provision of traceable and transparent information that an accredited independent entity has already positively determined that a comparable project (to be) implemented under comparable circumstances (same GHG mitigation measure, same country, similar technology, similar scale)

[9] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, page. 1.129 Table 1-61http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref10.pdf

would result in a reduction of anthropogenic emissions by sources or an enhancement of net anthropogenic removals by sinks that is additional to any that would otherwise occur and a justification why this determination is relevant for the project at hand.

- Application of the most recent version of the "Tool for the demonstration and assessment of additionality" approved by the CDM Executive Board (allowing for a grace period of two months when the PDD is submitted for publication on the UNFCCC JI website), or any other method for proving additionality approved by the CDM Executive Board.

In this PDD, the most recent version of the "Tool for the demonstration and assessment of additionality" (version 05.2) (hereinafter referred to as "Additionality Tool") is applied to prove that emission reductions by the proposed JI project are additional to any that would otherwise occur.

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 1: Keeping existing lines. Third party producers will satisfy remaining cement demand;
Alternative 2: Keeping existing lines and constructing a new line utilizing wet process of cement manufacture;
Alternative 3: Keeping existing lines and constructing new facilities not implementing it as JI project;
Alternative 4: Constructing a new line applying wet process and dismantling the existing lines;
Alternative 5: Constructing new line applying semi-dry process and dismantling existing lines;
Alternative 6: Constructing new line applying dry process and dismantling the existing lines;

Alternatives 1and 3 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.

Alternative 1 was assessed in the section B.1. and was excluded from further consideration based on the assessment made.

Step 2: Investment analysis

The main goal of 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 sale of ERUs associated with the JI project.

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

Sub-step 2a: Determine appropriate analysis method

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 fuel and electricity savings and additional sales revenues due to the incremental production capacity installed. Thus, this analysis method is not applicable.

As it is stated in the Tool (Sub-step 2a, 1), either investment comparison analysis (Option II) or the benchmark analysis should be undertaken. An investment comparison analysis (Option II) compares suitable financial indicators for realistic and credible investment alternatives. Benchmark analysis (Option III) is applied in this project.

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

Additionality Tool is applied – using “government bonds rates increased by a suitable risk premium”. If the proposed project (not being implemented as JI project) has less favourable indicator, i.e. a lower IRR, than the benchmark, then the project cannot be considered as financially attractive.

The results of the analysis made below are different with the values stated in the business plan on the project realization. This difference is explained by the two different approaches used to estimate project feasibility. All methodologies known that are used by financial analysts propose optimistic assumptions on resources cost, demand for the product, and from all of the values of the IRR indicator calculated methodologies recommend to choose the highest value for the indicator (IRR). Additionality tool proposes different approach when prices are fixed, conservative assumptions are made, inflation is excluded. Therefore there is the transparent explanation why results for the IRR values stated in the business plan are different with the values obtained from the financial analysis made in accordance with additionality tool.

The originally developed business plan by the plant has undergone correction, therefore the corrected business plan was provided by the plant. Corresponding differences were submitted to the verifier on the confidentiality basis.

Table B.2.0. Financial indicators used to set benchmark

#	Factor	Rate	Description	Source
1	Risk-free rate	4.24%	German long-term interest rate in euro as a secondary market yields of government bonds with a remaining maturity close to ten years, July 2004. This rate is taken as Germany is the largest Euro economy.	European Central Bank[10]
2	Russian interest rate	7.5%	YTM of the Russia-30 Eurobonds in July 2004. Russia-30 is the largest Eurobonds issue by Russia.	Fidaily[11]
3	Country risk premium	3.26%	Non-specific risk associated with investments in Russia. Equals to Russian interest rate less Risk-free rate.	-
4	Euro inflation	2.04%	5-year average inflation in eurozone	Eurostat[12]
5	Real risk-free rate	2.1%	*Real interest rate=(1+Nominal Interest Rate)/(1+Inflation)-1*	-
6	Company related risk premium	3.6%	Company-specific risk premium associated with company stability, reputation, overall estimation.	
7	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 ВК 477.
	Total expected return	17.02%	This rate takes into account real (inflation adjusted) risk-free rate increased by a general expected market return, country risk and specific project risk.	

[10] 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.

[11] http://www.cbonds.info/ru/rus/emissions/index.php

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

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. Investment decision: 9 July 2004, commissioning date: 28 September 2007;
2. The project requires investments of approximately EUR 312 million during six years;
3. There are no kilns will be dismantled after commissioning of the new kilns;
4. All relevant indicators are taken from economical department at the plant;
5. The project lifetime is 20 years (lifetime of dry kiln), but semi-dry line operational time is extended to the operational time of the dry kiln to keep consistency of performance as one JI project, by the same reasons CHPP operational time is matched with the dry line operational time, because dry line cannot operate without CHPP. This assumption is realistic, because time extended is only a few years, and above of that it is conservative, because semi-dry line and CHPP extended operation period brings additional profit to the project performance;
6. Calculations are made at constant prices as of July 2004[13];
7. The exchange rate (EUR/RUR) is defined 1/35.9 as of 9 July 2004
8. Production is assumed at the maximum technical capacity;
9. Cement production is 3,110,500 tonnes of cement per year;
10. CHPP electricity generation is 579,888 MWh per year;
11. Fuel and electricity consumption are taken into account;
12. Natural gas is the main fuel;

All essential technical-economical parameters and assumptions (such as capital costs, fuel prices, lifetime and other) are received from OJSC "Mordovcement".

The project's financial indicators are presented in Table B.2.1 below.

Table B.2.1. Financial indicators of the project

Scenario	IRR (%)
Base case	14.26%

Cash flow analysis shows an IRR of 14.26%, which is below the benchmark of 17.02% (benchmark set in the table B 2.0). Hence, the project cannot be considered as financially attractive.

Sub-step 2d: Sensitivity analysis

Sensitivity analysis should be made to show whether conclusion regarding the financial/economic attractiveness is robust to reasonable variations and critical assumptions.

The following three key factors were considered in the sensitivity analysis: electricity cost, gas and cement prices. In line with the Additionality Tool, sensitivity analysis should be undertaken within the interval of ±10% for the key indicators.

[13] 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.

Scenario 1 considers 10% investment cost growth.

Scenario 2 is based on the assumption of 10% investment cost decrease.

Scenario 3 assumes 10% gas price increase and *Scenario 4* is opposite to Scenario 3.

Scenario 5 implies 10% electricity tariff growth and Scenario 6 uses 10% electricity tariff drop.

Scenario 7 and *Scenario 8* are based on upward and downward 10% cement price trend.

A summary of the results is presented in Table B.2.2 and in Figures B.2.1 below.

Table B.2.2: Sensitivity analysis (summary)

Scenario	IRR (%)
Scenario 1	12.82%
Scenario 2	15.95%
Scenario 3	13.96%
Scenario 4	14.56%
Scenario 5	14.39%
Scenario 6	14.13%
Scenario 7	16.48%
Scenario 8	11.92%

Hence, the sensitivity analysis consistently proves (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 the Additionality Tool, a barrier analysis is not conducted.

Step 4: Common practice analysis

In Russia majority of kilns at cement plants were constructed before 1988. About 86% of cement is produced using wet method of cement manufacturing. Wet process was the predominant technology in the Soviet Union. No new cement capacity additions can be observed during the last 10 years within the radius of 1,000 km from the project site (see also Annex 2).

Hence, the proposed JI project does not reflect the common practice.

Conclusion

Application of the CDM Additionality Tool has demonstrated that 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:

There are three different sources of GHG emissions while producing cement:

- Emissions from calcination (decarbonisation) process;
- Fuel combustion;
- GHG emissions in the power grid as a result of electricity consumption.

The project boundary shall encompass all anthropogenic emissions by sources of GHGs which are:

- Under the control of the project participants;
- Emissions from the existing kilns are not included in the project scenario and included in the baseline in case if replacement capacity occur;
- Reasonably attributable to the project; and
- Significant.

An overview of all emission sources within the project boundary is given in Table B.3.1 below.

Table B.3.1: Sources of emissions

№	Source	Gas[14]	Included/ excluded	Justification/Explanation
1	Fuel consumption at the quarry	CO_2	Excluded	• Fuel consumed by heavy duty trucks that are used for raw materials delivery, and also by diesel locomotives, and reloaded by excavators; • Minor source of emissions (less than 1%); • Belt conveyor will replace rail transport used for chalk. Clay will still be transported by trucks. Clay is not the main raw material used and considered as additive, therefore clay represent minor, compared to chalk, raw material, causing even smaller emission due to fuel consumption at the quarry.
2	Grid electricity consumption at the quarry	CO_2	Included	• Electricity consumed at the quarry mainly by excavators used for the raw materials reloading into the dumpcars and heavy duty trucks; • Belt re-loader and crusher as well as raw materials transportation conveyor will be set at the quarry in order to prepare raw materials and transport them to the plant.
3	Fuel consumption during the process of the raw material transportation	CO_2	Excluded	• The explanation of the fuel consumers is identical to clause 1; • Minor source of emissions (less than 1%); • The project foresees an electricity powered belt conveyor for raw material transportation instead of fuel powered railroad transport in the baseline scenario. Hence, emissions from fuel consumption during transportation are reduced and excluding this source is conservative; • Assessment of emissions connected with diesel consumption has given value of 902 tonnes CO_2. This represents 0.17% of the total emissions and, based on the guidance above, these emissions are excluded from further consideration.

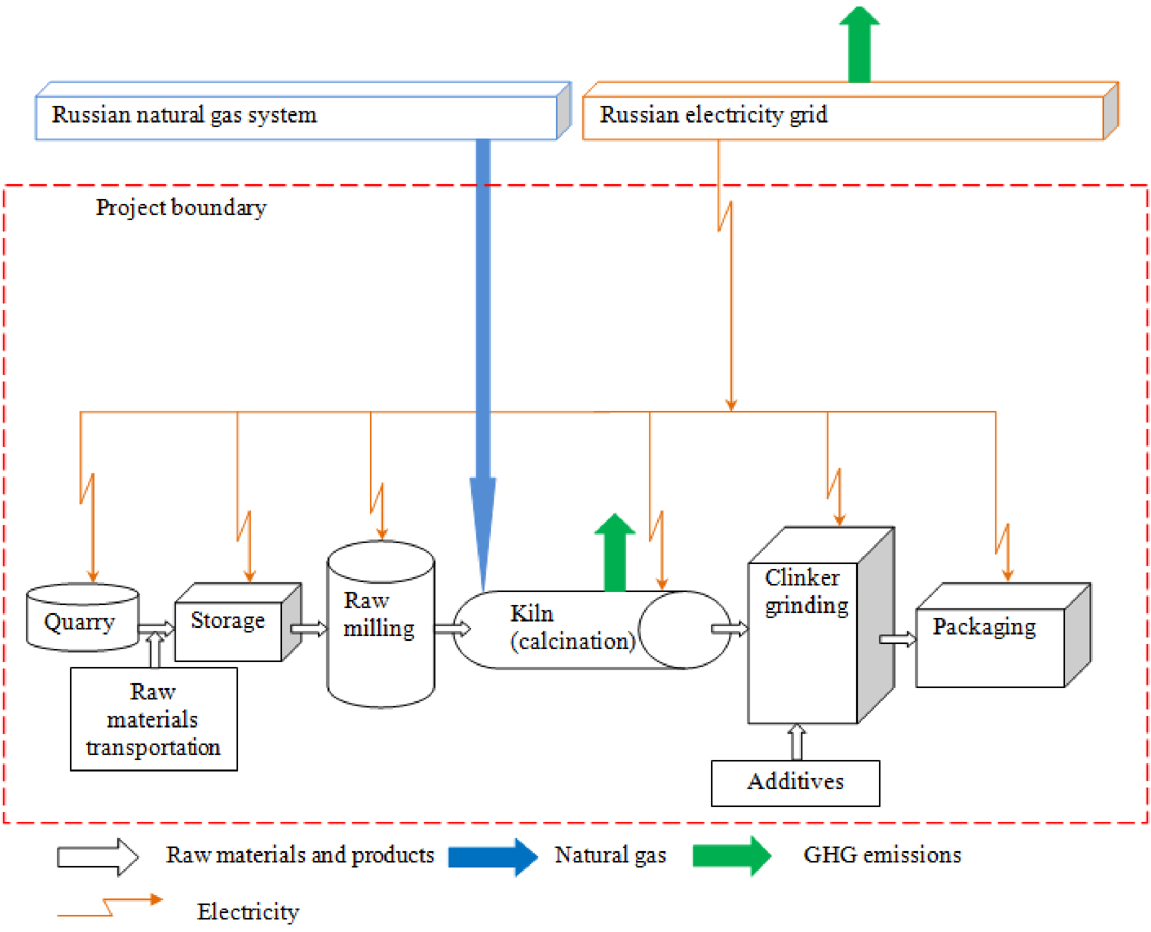
[14] Only CO_2 emissions are taken into account. CH_4 and N_2O emissions are neglected and excluded for simplification. This is in line with relevant CDM approaches (for example, ACM0015 “Consolidated baseline and monitoring methodology for project activities using alternative raw materials that do not contain carbonates for clinker manufacturing in cement kilns --- Version 2, http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html).

№	Source	Gas[14]	Included/ excluded	Justification/Explanation
4	Grid electricity consumption during raw materials transportation	CO_2	Included	• Consumed mainly by the belt conveyor to be constructed; • Increased on-site electricity consumption will be taken into account for reasons of conservativeness (see above); • Emissions are calculated using a standardized Russian regional electricity emission factor.
5	Fuel combustion to dry raw materials	CO_2	Excluded	• Drying of raw materials is done in drying crusher that uses exhaust gases taken from first stage of cyclone heat exchangers with temperature of 530-560ºC for semi-dry line and form CHPP gas turbines for the dry line. No additional fuel consumption is required.
6	Grid electricity consumption for cement production (including all stages of cement production starting from raw meals preparation to cement packaging)	CO_2	Included	• Electricity consumption by crushers, mills, conveyors, electrical drives and other electricity powered equipment used in cement manufacturing process; • Emissions are calculated using a standardized Russian regional electricity emission factor.
7	Emissions due to calcination	CO_2	Included	• Chemical reaction of calcium carbonate dissociation called calcinations, final products of this reaction is calcium oxide and carbon dioxide; • In the project and the baseline scenarios emissions from calcination will be different.
9	Emissions due to gas burning inside kilns and calciner	CO_2	Included	• Cement rotary kiln is powered by the natural gas; the product of natural gas burning inside the rotary kiln is carbon dioxide; • Gas is used as fuel during calcination and clicker sintering.
10	Emissions due to gas burning inside the gas turbines	CO_2	Included	• Electricity generation at CHPP is done by using gas turbines, where natural gas serves as fuel and the final product of gas combustion inside the gas turbines is carbon dioxide; • Gas is used as fuel during burning process inside gas turbines used for electricity generation

№	Source	Gas[14]	Included/ excluded	Justification/Explanation
11	Leakages	CO_2	Excluded	• Leakage is the net change of anthropogenic emissions by sources which occurs outside of the project boundary, and that can be measured and is directly attributable to the JI project. • Based on the assessment made, leakages are excluded from further consideration, Table B.1.2.

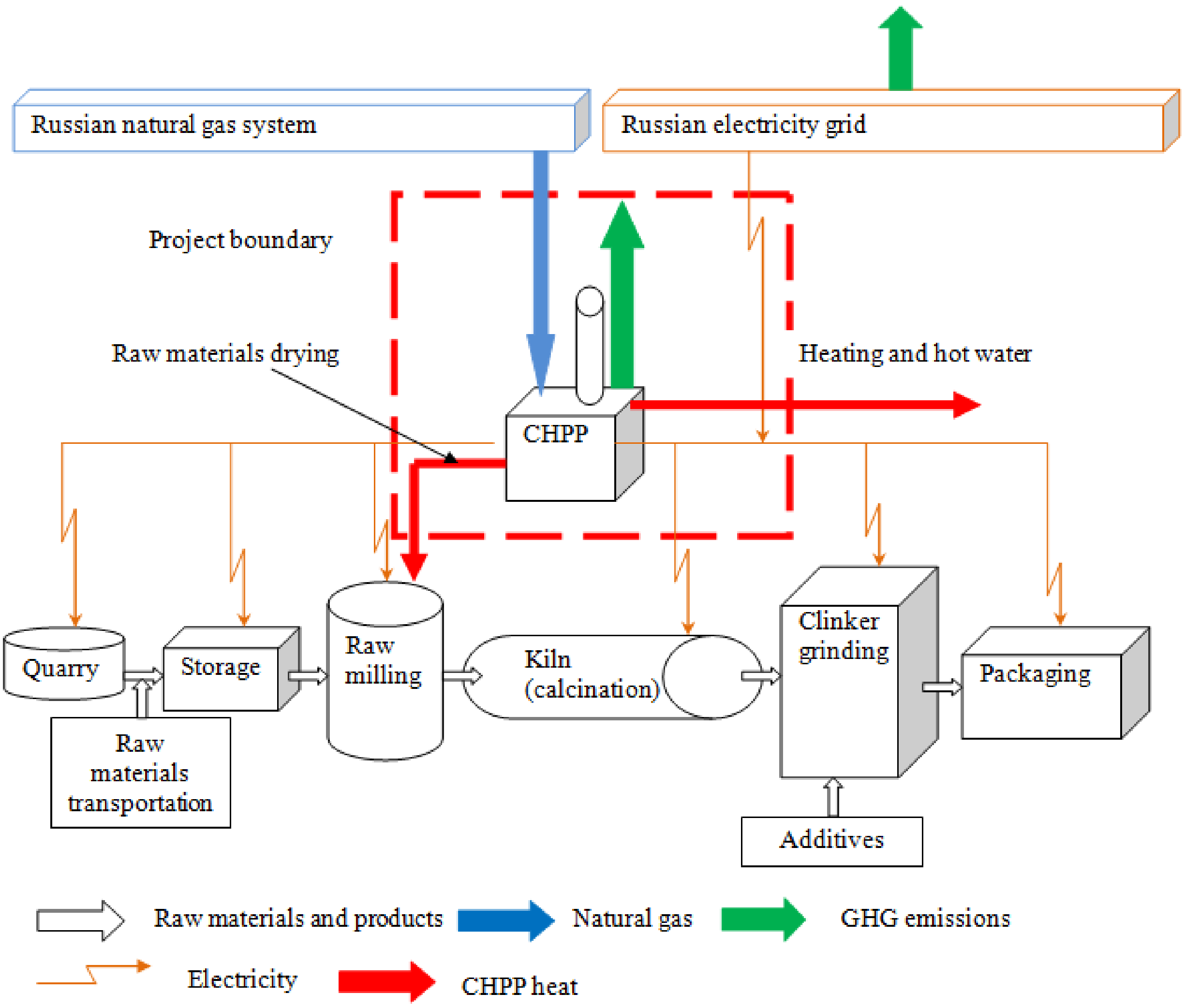
Emission sources within the project boundary are also shown in Figure B.3.2 below.

Figure B.3.1: Sources of emissions and project boundary for the dry and semi-dry lines



Please see Sections D and E for detailed data on the emissions within the project boundary.

Figure B.3.2: Sources of emissions and project boundary for CHPP



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: 20/07/2010

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

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Date of project start: 09/07/2004

C.2. Expected operational lifetime of the project:

The operational lifetime of the project is 20 years or 240 months. This corresponds to the operational lifetime of the dry kiln – the biggest investment cost item.

C.3. Length of the crediting period:

Start of the crediting period: 01/01/2008
Length of crediting period: 5 years or 60 months

Emission reductions generated after the crediting period may be used in accordance with an appropriate mechanism under the UNFCCC.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

In accordance with paragraph 31 of the JISC's Guidance, as part of the PDD of a proposed JI project a monitoring plan has to be established by the project participants in accordance with appendix B of the JI guidelines. In this context two options apply:

a) Project participants may apply approved CDM baseline and monitoring methodologies;
b) Alternatively, a monitoring plan may be established in accordance with appendix B of the JI guidelines, i.e. a JI specific approach may be developed. In this case, inter alia, selected elements or combinations of approved CDM baseline and monitoring methodologies may be applied, if deemed appropriate.

Step 1. Indication and description of the approach chosen regarding monitoring

JI specific approach regarding monitoring is used in this PDD.

As elaborated in Section B.3 above, the project affects emissions related to the kiln fuel, calcination (decarbonisation), and the electricity consumption of the raw milling and the kilns. These emissions will be monitored in the project scenario and the baseline scenario.

Baseline emissions are determined on the following basis:
1. Baseline emissions of electricity consumption are established using the relevant regional Russian standardized grid emission factor, as described in Annex 2;
2. Baseline emissions of the incremental production are estimated/calculated using the operating margin approach, as elaborated in Annex 2.

Assumptions:
- Technical lifetime of existing kilns extends to at least the end of the crediting period;
- No energy efficiency measures would be implemented at existing wet kilns until the end of the crediting period;
- Clinker factor in the project scenario is identical to the clinker factor for the replacement production.

General remarks:
- Throughout the monitoring plan, natural gas is taken as the fuel. Should the plant use other fuels at some stage, the relevant formulae will be updated;
- Social indicators, such as number of people employed, safety records, training records etc., will be available to the verifier, as required;

- Environmental indicators, such as dust, NO_x, or SO_x emissions, will be available to verifier, as required;

According to the information obtained from OJSC "Mordovcement", it is not planned to decrease cement production at any of the wet kilns. This would mean that any cement produced on the new kiln would displace third party producers as explained below (called incremental production). However, the economic situation might change and may force the enterprise to cut production at some wet kilns that are less energy efficient compared to the newly added semi-dry and dry lines. In this case the project would partially replace existing wet cement production. To account for this type of situation, baseline emissions calculations contain formulae which includes both incremental and replacement capacity (see Annex 2 for details). This would make the monitoring system more complex as many parameters of the wet kilns will have to be monitored for the replacement part. To reduce the complexity of the monitoring system, the Monitoring Plan will allow the Project Participant to decide for each monitoring period whether to follow one of the three options:

a) All cement produced on the new kilns would have been produced by the third party producers. This option will be chosen if all existing wet kilns are working on full capacity (> 90%, run factor is more than 0,9) only formulae for incremental production to be used;
b) *Assume* that all cement produced on the new kilns would have been produced by third party producers. This option should be chosen if all or either of the existing wet kilns are working close to full capacity (80%-90%, run factor falls into the interval 0,8-0,9). This option will result in more conservative reduction compared to option c) below; as well as will allow differentiation between actual replacement capacity occurrence and accidental and unintentional production drop, such as delayed repairs and so on. This option allow flexibility in calculations, either formulae accounting for incremental production only to be used (in case if it was determined replacement production absence) or formulae accounting for both incremental and replacement capacity (in case if replacement production occurrence was confirmed);
c) Full monitoring of all parameters, including those on the existing wet kilns in case the wet kilns were not working on full capacity during the monitoring period; all or either of the wet kilns production is less than 80% (run factor is less than 0.8) and replacement production is positively confirmed. Formulae accounting for both incremental and replacement production to be used.

More detailed information on what formulae corresponds to which option is presented in section D.1.1.4

Step 2. Application of the approach chosen

The data monitored and required for calculation of the ERUs will be archived and kept for 2 years after the last transfer of ERUs.

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	$CLNK^{Semi-dry}{}_{PR,y}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	-
P2	$CLNK^{Dry}{}_{PR,y}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	-
P3	$FC^{Semi-dry,kiln}_{fuel\_i,y}$	Plant records	m^3	m	Continuously	100%	Electronic	Fuel consumption by the Semi-dry kiln
P4	$FC^{Dry,kiln}_{fuel\_i,y}$	Plant records	m^3	m	Continuously	100%	Electronic	Fuel consumption by the dry kiln
P5	$FC^{CHPP}_{fuel\_i,y}$	Plant records	m^3	m	Continuously	100%	Electronic	Fuel consumption by the CHPP
P6	$PEL^{Semi-dry}{}_{y}$	Plant records	MWh	c	At end of the monitoring period	100%	Electronic	**-**

P8	$E_{quarry,y}$	Plant records	MWh	m	At end of the monitoring period y	100%	Electronic	Electricity consumption at the quarry
P9	$CEMPROD_{semi-dry}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	Cement production at semi-dry line
P11	$CEMPROD_{total}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	Total cement production at both plants (Staroalexeevskiy and Alexeevskiy)
P12	$E_{preparation\_semi-dry}$	Plant records	MWh	m	At end of the monitoring period	100%	Electronic	Electricity consumption for raw materials preparation at the semi-dry line
P14	$E^{Semi-dry}{}_{production}$	Plant records	MWh	m	At end of the monitoring period	100%	Electronic	Electricity consumption for cement production at the semi-dry line
P15	$PERCENT^{GRID}$	Plant records	%	m	At end of the monitoring period	100%	Electronic	Electricity consumption by the semi-dry line from power grid
P21	$NCV_{fuel\_i,y}$	Plant records	KJ/m^3	m/c	Per shipment/	100%	Electronic	-

					At end of the monitoring period			
P22	$Al\_fuel^{semi-dry}{}_{y}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	Alternate fuel consumption in year *y* at the semi-dry line
P23	$Percent\_C$	Plant records	%	e	At end of the monitoring period	100%	Paper	Carbon content in the alternative fuel
P24	$Al\_fuel^{dry}{}_{y}$	Plant records	tonnes	m/c	At end of the monitoring period	100%	Electronic	Alternate fuel consumption in year *y* at the dry line

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

$$PE^{Total}{}_{y} = PE^{Semi-dry}{}_{,y} + PE^{Dry}{}_{,y} + PE^{CHPP}{}_{,y} \quad (1)$$

$PE^{Total}{}_{y}$ Total project emissions in year *y* (tCO_2);

$PE^{Semi-dry}{}_{,y}$ Project emissions for the Semi-dry method in year *y* (tCO_2);

$PE_{Dry,y}$ Project emissions for the Dry method in year *y* (tCO_2);

$PE^{CHPP}{}_{,y}$ Project emissions for the CHPP in year *y* (tCO_2);

Subproject 1 Semi-dry line

$$PE^{Semi-dry}{}_{,y} = PE^{Semi-dry}{}_{calcin,y} + PE^{Semi-dry}{}_{el,y} + PE^{Semi-dry}{}_{fuel,y} + CO_{2,y}{}^{semi-dry} \quad (2)$$

Where:

$PE^{Semi-dry}{}_{,y}$ Project emissions for the Semi-dry method in year *y* (tCO_2);

$PE^{Semi-dry}{}_{calcin,y}$ Project emissions for the Semi-dry method due to calcination in year *y* (tCO_2);

$PE^{Semi-dry}{}_{fuel,y}$ Project emissions for the Semi-dry method due to combustion of fuel in year *y* (tCO_2);

$PE^{Semi-dry}{}_{el,y}$ Project emissions for the Semi-dry method due to electricity consumption for raw meal preparation (transportation, milling, handling), and grinding of clinker, as well as the new kiln (tCO_2);

$CO_{2,y}{}^{semi-dry}$ CO_2 emissions due alternate fuel usage at the semi-dry line in year *y* (tCO_2);

Project emissions due to calcination

$$PE^{Semi\text{-}dry}{}_{calcin,y} = EF_{calcin,y} \times CLNK^{Semi\text{-}dry}{}_{PR,,y} \quad (3)$$

Where:

$PE^{Semi\text{-}dry}{}_{calcin,y}$ Project emissions for the Semi-dry method due to calcination in year *y* (tCO_2);

$EF_{calcin,y}$ Default emission factor (tCO_2/t clinker)[15];

$CLNK^{Semi-dry}{}_{PR,y}$ Production of clinker in year y (tonnes);

Project emissions due to fuel consumption

$$PE^{Semi-dry}{}_{fuel,y} = PE^{Semi-dry,kiln}_{gas,y} \qquad (4)$$

Where:

$PE^{Semi-dry}{}_{fuel,y}$ Project emissions for the Semi-dry method due to combustion of fuel in year *y* (tCO_2);

$PE^{kiln}_{gas,y}$ Project emissions from combustion of natural gas in the new semi-dry kiln in year *y* (tCO_2);

Emissions of CO_2 due to combustion of fuels in the new semi-dry kiln:

$$PE^{Semi-dry,kiln}_{gas,y} = \sum_i FC^{Semi-dry,kiln}_{fuel\_i,y} \times EF_{fuel\_i} \times NCV_{fuel\_i,y} \qquad (5)$$

Where:

$PE^{Semi-dry,kiln}_{gas,y}$ Project emissions for the Semi-dry method due to combustion of fuel (natural gas) in year *y* (tCO_2);

$FC^{Semi-dry,kiln}_{fuel\_i,y}$ Fuel consumption of type *i* (natural gas) in the new kiln in year *y* (m^3);

$NCV_{fuel\_i,y}$ Net calorific value of fuel of type *i* (natural gas) in year *y* (GJ/m^3);

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[15] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

EF_{fuel_i} Emission factor of fuel of type *i* (natural gas) (tCO_2/GJ), see Table B 1.1 for details;

Project emissions due to electricity consumption

Emissions due to electricity consumption during raw materials transportation to the plant site, raw material preparation, new kiln electricity consumption, and clinker grinding are calculated as follows:

$$PE^{Semi-dry}{}_{el,y} = EF_{el,y}{}^{GRID} \times PERCENT^{GRID} \times PEL^{Semi-dry}{}_{y} \quad (6)$$

Where:

$EF_{el,y}{}^{GRID}$ Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);

$PERCENT^{GRID}$ Percentage of electricity consumed from the grid, %

$PEL^{Semi-dry}{}_{y}$ Total electricity consumption in the project scenario in year *y* (MWh);

$$PEL_y{}^{Semi-dry} = E_{quarry,y} \times \frac{CEMPROD^{semi-dry}{}_y}{CEMPROD_{total}} + E_{preparation\_semi-dry} + E^{Semi-dry}{}_{production} \quad (7)$$

Where:

$E_{quarry,y}$ Electricity consumption at the quarry, total for both cement plants (MWh/year);

$CEMPROD_{semi-dry}$ Cement production at semi-dry line (tonnes of cement/year);

$CEMPROD_{total}$ Total cement production for all kilns at both (sum) production #1 and production #2 (tonnes of cement/year);

$E_{preparation\_semi-dry}$ Electricity consumption for raw materials preparation at the semi-dry line (MWh/year);

$E^{Semi-dry}_{production}$	Electricity consumption for cement production at the semi-dry line (MWh/year);

Subproject 2 Dry line

$$PE^{Dry}{}_{,y} = PE^{Dry}{}_{calc,y} + PE^{Dry}{}_{fuel,y} + CO_{2,y}{}^{dry} \qquad (8)$$

Where:

$PE^{Dry}{}_{,y}$	Project emissions at the dry line in year *y* (tCO_2);
$PE^{Dry}{}_{calc,y}$	Project emissions due to calcination in year *y* (tCO_2);
$PE^{Dry}{}_{fuel,y}$	Project emissions due to combustion of fuel in year *y* (tCO_2);
$CO_{2,y}{}^{dry}$	CO_2 emissions due alternate fuel usage at the dry line in year *y* (tCO_2);

Project emissions due to calcination

$$PE^{Dry}{}_{calcin,y} = EF_{calcin,y} \times CLNK^{Dry}{}_{PR,y} \qquad (9)$$

Where:

$PE^{Dry}{}_{calcin,y}$	Project emissions at the dry line due to calcination in year *y* (tCO_2);
$EF_{calcin,y}$	Default emission factor (tCO_2/t clinker)[16];
$CLNK^{Dry}{}_{PR,y}$	Production of clinker in year y (tonnes);

[16] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

Project emissions due to fuel consumption

$$PE^{Dry}{}_{fuel,y} = PE^{Dry,kiln}_{gas,y} \tag{10}$$

Where:

$PE^{Dry}{}_{fuel,y}$ Project emissions due to fuel consumption in the new dry kiln in year y (tCO_2);
$PE^{Dry,kiln}_{gas,y}$ Project emissions from combustion of natural gas in the new dry kiln in year y (tCO_2);

Emissions of CO_2 due to combustion of fuels in the new dry kiln:

$$PE^{Dry,kiln}_{fuel,y} = \sum_i FC^{Dry,kiln}_{fuel\_i,y} \times EF_{fuel\_i} \times NCV_{fuel\_i,y} \tag{11}$$

Where:

$PE^{Dry,kiln}_{fuel,y}$ Emissions of CO2 due to combustion of fuels in the new dry kiln in year y (tCO_2);
$FC^{Dry,kiln}_{fuel\_i,y}$ Fuel consumption of type i (natural gas) in the new kiln in year y (m^3);
$NCV_{fuel\_i,y}$ Net calorific value of fuel of type i (natural gas) in year y (GJ/(m^3);
EF_{fuel_i} Emission factor of fuel of type i (natural gas) (tCO_2/GJ), see Table B 1.1 for details;

Subproject 3 CHPP

Project emissions due to CHPP operation:

$$PE_{CHPP,y} = PE_{fuel,y}^{CHPP} \tag{12}$$

Where:

$PE_{CHPP,y}$	Project emissions due to CHPP operation in year *y* (tCO_2);
$PE_{fuel,y}^{CHPP}$	Project emissions due to gas fuel consumption in year *y* (tCO_2);

Project emissions due to gas fuel consumption:

$$PE_{fuel,y}^{CHPP} = \sum_i FC_{fuel\_i,y}^{CHPP} \times EF_{fuel\_i} \times NCV_{fuel\_i,y} \tag{13}$$

Where:

$PE_{fuel,y}^{CHPP}$	Project emissions for the CHPP due to fuel consumption in year *y* (tCO_2);
$FC_{fuel\_i,y}^{CHPP}$	Fuel consumption of type *i* (natural gas) at CHPP in year *y* (m^3);
$NCV_{fuel\_i,y}$	Net calorific value of fuel of type *i* (natural gas) in year *y* (GJ/(m^3));
EF_{fuel_i}	Emission factor of fuel of type *i* (natural gas) (tCO_2/GJ), see Table B 1.1 for details;

Alternate fuel emissions assessment

Semi-dry line

Total carbon content in the fuel throughout the year at semi-dry line

$$C^{semi-dry}{}_{y} = Percent\_C \times Al\_fuel^{semi-dry}{}_{y} \qquad (14)$$

Where:

$C^{semi-dry}{}_{y}$	Total carbon content in the alternate fuel in the year *y* (tonnes/year);
$Percent\_C$	Carbon content in the alternate fuel (see table A.4.2.11.) (%);
$Al\_fuel^{semi-dry}{}_{y}$	Alternate fuel consumption in year *y* (tonnes/year);

Carbon dioxide (CO_2) emitted per year

$$CO_{2,y}{}^{semy-dry} = \frac{C^{semi-dry}{}_{y} \times 44}{12} \qquad (15)$$

Where:

$C^{semi-dry}{}_{y}$	Total carbon content in the alternate fuel in the year *y* (tonnes/year);
44	Molecular weight of the carbon dioxide molecule (C+2O=12+2×16);
12	Molecular weight of carbon;

Dry line

$$C^{dry}{}_{y} = Percent\_C \times Al\_fuel^{dry}{}_{y} \qquad (16)$$

Where:

C^{dry}_{y}	Total carbon content in the alternate fuel in the year *y* (tonnes/year);
$Percent\_C$	Carbon content in the alternate fuel (see table A.4.2.11.) (%);
$Al\_fuel^{dry}_{y}$	Alternate fuel consumption in year *y* (tonnes/year);

Carbon dioxide (CO_2) emitted per year

$$CO_{2,y}{}^{dry} = \frac{C^{dry}{}_y \times 44}{12} \qquad (17)$$

Where:

$C^{dry}{}_y$	Total carbon content in the alternate fuel in the year *y* (tonnes/year);
44	Molecular weight of the carbon dioxide molecule (C+2O=12+2×16);
12	Molecular weight of carbon;

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	$EL_{OM,y}$	OJSC “NIICEMENT”	MWh	m/c	Annually	100 %	Electronic	See Annex 2
B2	$CLNK_{OM,y}$	OJSC “NIICEMENT”	tonnes	m/c	Annually	100 %	Electronic	See Annex 2
B3	$FUEL_{OM,i,y}$	OJSC “NIICEMENT”	1000 m^3	m/c	Annually	100 %	Electronic	See Annex 2
B11	BE_{rep}	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic	Replacement cement production at wet kilns
B12	$CEMPROD(wet)^i_{level2}$	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic/Paper	Actual cement production at the kiln *i*
B14	NCV_{fuel}	Plant records	GJ/(m^3)	m/c	At end of the monitoring period	100 %	Electronic	See Annex 2
B15	$CLNK(wet)^i_{level2}$	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic/Paper	Actual clinker production at the kiln *i*
B16	$CEMPROD_{semi-dry,y}$	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic/Paper	Actual cement production at the semi-dry kiln
B17	$CEMPROD_{dry,y}$	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic/Paper	Actual cement production at the dry kiln

B20	FCS^{i}	Plant records	nm³/tonne of cement	c/m	At end of the monitoring period	100%	Electronic/paper	Specific fuel consumption at the *wet* kiln *i*
B21	$CEMPROD(wet)^{i}_{level1}$	Plant records	tonnes	c/m	At end of the monitoring period	100%	Electronic/paper	Designed cement production level at the *wet* kiln number *i*
B22	$CLNK(wet)^{i}_{level1}$	Plant records	tonnes	c/m	At end of the monitoring period	100%	Electronic/paper	Designed clinker production level at the *wet* kiln number *i*
B23	$EL(wet)_{i}^{CHPP}$	Plant records	KWh	m	At end of the monitoring period	100%	Electronic/paper	Amount of electricity supplied by CHPP to the wet lines during monitoring period
B24	$EL(wet)^{i}_{level1}$	Plant records	KWh	m	At end of the monitoring period	100 %	Electronic	Designed electricity consumption to produce cement CEM^{i}_{level1} level at the *wet* kiln number *i*, (MWh) for the monitoring period *Y*

B25	$EL(wet)^{i}_{level2}$	Plant records	KWh	m	At end of the monitoring period	100 %	Electronic	Actual electricity consumed to produce cement CEM^{i}_{level2} level at the *wet* kiln number *i*, (MWh); for the monitoring period *Y*
B26	$CEM_{OM,y}$	Plant records	tonnes	m/c	At end of the monitoring period	100 %	Electronic/Paper	Total cement production at cement plants in the OM in year *y* (tonnes)
B27	EF_{fuel}	Natural gas emission factor	tCO_2/GJ	e	At end of the monitoring period	100%	Electronic	IPCC default emission factor 2006 IPCC Guidelines on National GHG Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html, Volume 2, page 16, table 2.2 $EF_{fuel} = EF_{fuel\_i}$

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

Subprojects 1 and 2 (Semi-dry and dry line of cement manufacturing)

As further described in Annex 2, the baseline emissions have two sources:

- Production by other cement plants (incremental production) and;
- Production at existing wet lines (replacement production);

$$BE_y = BE_{rep,y} + BE_{incr,y} \quad (18)$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2);
$BE_{incr,y}$	Baseline emissions due to incremental production in year *y* (tCO_2) (see also Annex 2);
BE_{rep}	Baseline emissions due to replacement capacity in year *y* (tCO_2);

Baseline emissions due to replacement and incremental production:

In accordance with the approach elaborated in Annex 2, taking into account that there are no capacities additions can be identified within a radius of 1,000 km, the baseline emission factor for incremental cement production is estimated/calculated in the following way:

All production levels are equal to the maximum designed capacities.

$$CEMPROD(new)_y = CEMPROD_{semi-dry,y} + CEMPROD_{dry,y} \quad (19)$$

Where:

$CEMPROD(new)_y$	Cement produced at newly installed capacities (dry and semi-dry) in the year *y* (tonnes of cement);
$CEMPROD_{semi-dry,y}$	Cement production at the semi-dry line in the year *y* (tonnes of cement);

$CEMPROD_{dry,y}$ Cement production at the dry line in the year *y* (tonnes of cement);

$$BEF_{incr,y} = OM_y \quad (20)$$

Where:

$BEF_{incr,y}$ Baseline emission factor for incremental production in year *y* (tCO_2/t cement)

OM_y Operating margin (OM) emission factor of cement production at the cement plants in the OM in year *y* (tCO_2/t cement) (see Annex 2);

OM emission factor is estimated/calculated in the following way:

$$OM_y = \frac{EF_{el,y}^{GRID} \times EL_{OM,y} + EF_{calcin,y} \times CLNK_{OM,y} + \sum_i EF_{fuel\_i} \times NCV_{fuel\_i,incr} \times FUEL_{OM,i,y}}{CEM_{OM,y}} \quad (21)$$

Where:

$EL_{OM,y}$ Total electricity consumption at the cement plants in the OM in year *y* (MWh);

$CLNK_{OM,y}$ Total clinker production at the cement plants in the OM in year *y* (tonnes);

$NCV_{fuel\_i,incr}$ Net calorific value of kiln fuel *i* (GJ/tonne or 1000 m^3);

$FUEL_{OM,i,y}$ Total fuel consumption of kiln fuel *i* at the cement plants in the OM in year *y* (tonnes or 1000 m^3);

$CEM_{OM,y}$ Total cement production at cement plants in the OM in year *y* (tonnes);

EF_{fuel_i} Emission factor for fuel of type *i;*

$EF_{el,y}^{GRID}$ Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);

$EF_{calcin,y}$ Default emission factor (tCO_2/t clinker)[17];

Option A of the monitoring plan - incremental production only

Baseline emissions due to the incremental production:

$$BE_{incr,y} = CEMPROD(new)_y \times OM_y \quad (22)$$

Option B of the monitoring plan - incremental production only or replacement and incremental production

This option to be used when existing wet kilns production level is 80%-90% of their designed capacities, run factor falls into the interval 0,8-0,9. Due to the fact that production level and run factor for the wet kilns is floating around the margin when replacement production is taking place, it is not always clear what type of the situation is taking place. Therefore, this option gives flexibility to choose between incremental production only and replacement and incremental production calculations for the baseline emissions. If wet kilns production is on the lower end (80% and run factor is 0.8) but replacement production is not confirmed (delayed repairs, and so on), formulae 19-22 to be used to calculate the baseline emissions.

If wet kilns production is on the lower end (80% and run factor is 0.8) and replacement production is confirmed, the following formulae to be used to calculate baseline emissions:

Taking into account approach developed in Annex 2, and adjusting the formula for the appropriate specific fuel and electricity consumptions as well as for the appropriate emission factors:

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[17] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

$$BE_y = \sum_i (FCS^i \times CEMPROD(wet)^i_{level1} - FCS^i \times CEMPROD(wet)^i_{level2}) \times NCV_{fuel} \times EF_{fuel} + \sum_i (CLNK(wet)^i_{level1} - CLNK(wet)^i_{level2}) \times EF_{calcin} + \\ + \sum_i (EL(wet)^i_{level1} - EL(wet)^i_{level2}) \times EF_{el}^{GRID} + BEF_{inc} \times (CEMPROD(new) + \sum_i CEMPROD(wet)^i_{level2} - \sum_i CEMPROD(wet)^i_{level1}) \quad (23)$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2);
FCS^i	Specific fuel consumption at the *wet* kiln *i* (nm^3/tonne of cement);
$CEMPROD(wet)^i_{level1}$	Designed cement production level at the *wet* kiln number *i*, (tonnes);
$CEMPROD(wet)^i_{level2}$	Actual cement production level at the *wet* kiln number *i*, (tonnes);
NCV_{fuel}	Net calorific value of the fuel (TJ/nm^3);
EF_{fuel}	Emission factor for the fuel used in the *wet* kilns (tCO_2/TJ);
$CLNK(wet)^i_{level1}$	Designed clinker production level at the *wet* kiln number *i*, (tonnes);
$CLNK(wet)^i_{level2}$	Actual clinker production level at the *wet* kiln number *i*, (tonnes);
EF_{calcin}	Calcination factor (tCO_2/t clinker)[18];
$EL(wet)^i_{level1}$	Designed electricity consumption to produce cement CEM^i_{level1} level at the *wet* kiln number *i*, (MWh);
$EL(wet)^i_{level2}$	Actual electricity consumed to produce cement CEM^i_{level2} level at the *wet* kiln number *i*, (MWh);
$EF_{el,y}^{GRID}$	Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);
$BEF_{incr,y}$	Baseline emission factor for incremental cement production in year *y* (tCO_2/t cement) (see Annex 2);
$CEMPROD(new)_y$	The sum of cement produced at both semi-dry and dry (newly added) capacities in year *y* (tonnes of cement);

[18] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

Baseline emissions due to due to electricity supply by CHPP to the wet lines (grid electricity displacement):

$$BE^{GRID}{}_{el,y} = EF_{el,y}{}^{GRID} \times EL(wet)_i^{CHPP} \qquad (24)$$

Where:

$BE^{GRID}{}_{el,y}$	Baseline emissions due to due to electricity supply by CHPP to the wet lines (tCO_2);
$EF_{el,y}{}^{GRID}$	Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);
$EL(wet)_i^{CHPP}$	Amount of electricity supplied by CHPP to the wet lines during monitoring period *y* (MWh);

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

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

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

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:

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

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

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

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):

$$ER_y = BE_y - PE_y \quad (26)$$

Where:

ER_y	Emission reductions of the proposed JI project 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).

Atmospheric emissions are the only important source of pollution at Mordovcement that has an impact on the local environment. According to the national requirements, atmospheric emissions have to be measured by taking samples. Mordovcement systematically collects data on the pollutants that may have negative impact on the local environment. As of February 2009, the environmental laboratory of the Environmental Department of Mordovcement performs measurements of the following pollutants:

Gaseous pollutants (NO_x and SO_x)

Gaseous pollutants are measured by means of a mobile gas spectrometer. It is used to measure the gaseous emissions every two months by taking samples. Currently, there is a negligible level of SO_x emissions at Mordovcement, but the existing gas spectrometer will measure SO_x emissions, if they appear.

Solid pollutants

The main solid pollutant on-site is inorganic dust. Emissions of dust are measured using the weighing method. Level of dust is measured by weighing a filter installed for a certain time in the exhaust air flow. Samples are taken on a monthly basis.

Monitoring at semi-dry and dry kilns

Monitoring at semi-dry and dry kilns is identical.

OJSC “Mordovcement” has ISO 9001:2000 certificate that includes clause “Monitoring and measurement devices management”. Measuring system of commercial gas counters has special “Passport” sertificate.

In case of the proposed JI project, the new dry kiln will be put into operation. The existing scheme of air pollution measurement will also be used in the project scenario. Gaseous pollutants (NO_x and SO_x, if any) will be measured every two months. Dust measurements will be made by the plant's environmental laboratory using the weighing method on a monthly basis.

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, P2, B15, B22	Medium	Clinker production is calculated as a difference between the cement produced and the additives used in the cement production process. Weighting method will be used to identify amount of cement and additives. Independent company will calibrate the meters. Total clinker production is derived from the daily reports at the Planning and economics department. Planning and economics is responsible for registration and archiving data.
P3, P4, P5, B20	Medium	Natural gas (fuel) consumption will be measured continuously. Existing gas flow meters will be used. An independent company will calibrate the meters. Measurement will be carried out automatically. Results of measurement will be recorded and archived in electronic system of the plant. Technology and production department is responsible for registration and archiving data.
P6, P8, P12, P14, P15, B23, B24, B25	Low	Electricity consumption is measured continuously. An independent company calibrates the meters. Measurement is carried out automatically. Results of measurement are recorded and archived in electronic system of the plant. Technology and production department is responsible for registration and archiving data.
P21, B14	Medium	Natural gas net calorific value is taken from the Certificate of natural gas supplier. Natural gas supplier issues it on the monthly basis. Technology and production department will store these certificates and will calculate the weighted average net calorific value at the end of each year.
P9, P11, B11, B12, B16, B17, B21	Medium	The weighting method is used to identify the amount of cement. An independent company calibrates the meters. Measurement is carried out automatically. Results of measurement are recorded and archived in electronic system of the plant. Planning and economics department is responsible for registration and archiving data.
P22, P24	Medium	The weighting method is used to identify amount of the alternate fuel consumed. The independent company calibrates the meters. Measurement is carried out automatically. Results of measurement are recorded and archived in electronic system of the plant. Technology and production department is responsible for registration and archiving data.
P23	Low	Carbon content in the alternate fuel is fixed ex-ante at the level of 81%
B1, B2, B3, B26	Low	Values are obtained from NII Cement directory. General accurateness and focused attention shell be followed in order to pick correct values.

B7, B12, B16, B17	Medium	Weighting method will be used to identify amount of cement. Independent company will calibrate the meters. Total cement production is derived from the daily reports at the Planning and economics department. Planning and economics is responsible for registration and archiving data.
B8, B15	Medium	Clinker production is calculated as a difference between the cement produced and the additives used in the cement production process. Weighting method will be used to identify amount of cement and additives. Independent company will calibrate the meters. Total clinker production is derived from the daily reports at the Planning and economics department. Planning and economics is responsible for registration and archiving data.
B9	Medium	Electricity consumption is measured continuously. An independent company calibrates the meters. Measurement is carried out automatically. Results of measurement are recorded and archived in electronic system of the plant. Technology and production department is responsible for registration and archiving data.

Internal quality system at OJSC “Mordovcement”

The internal quality system at OJSC “Mordovcement” is functioning in accordance with the national standards and regulations in force.

The plant will be equipped with all required instrumentation and field devices for the process interlocking, measurements and protection. The instrumentation and field devices will include all the instrumentation and field devices and all electrical equipment in the field necessary for accurate analogue and digital measuring required for the control and supervision. Modern Plant Automation and Control Networks will use Siemens automated real time control and measurement system.

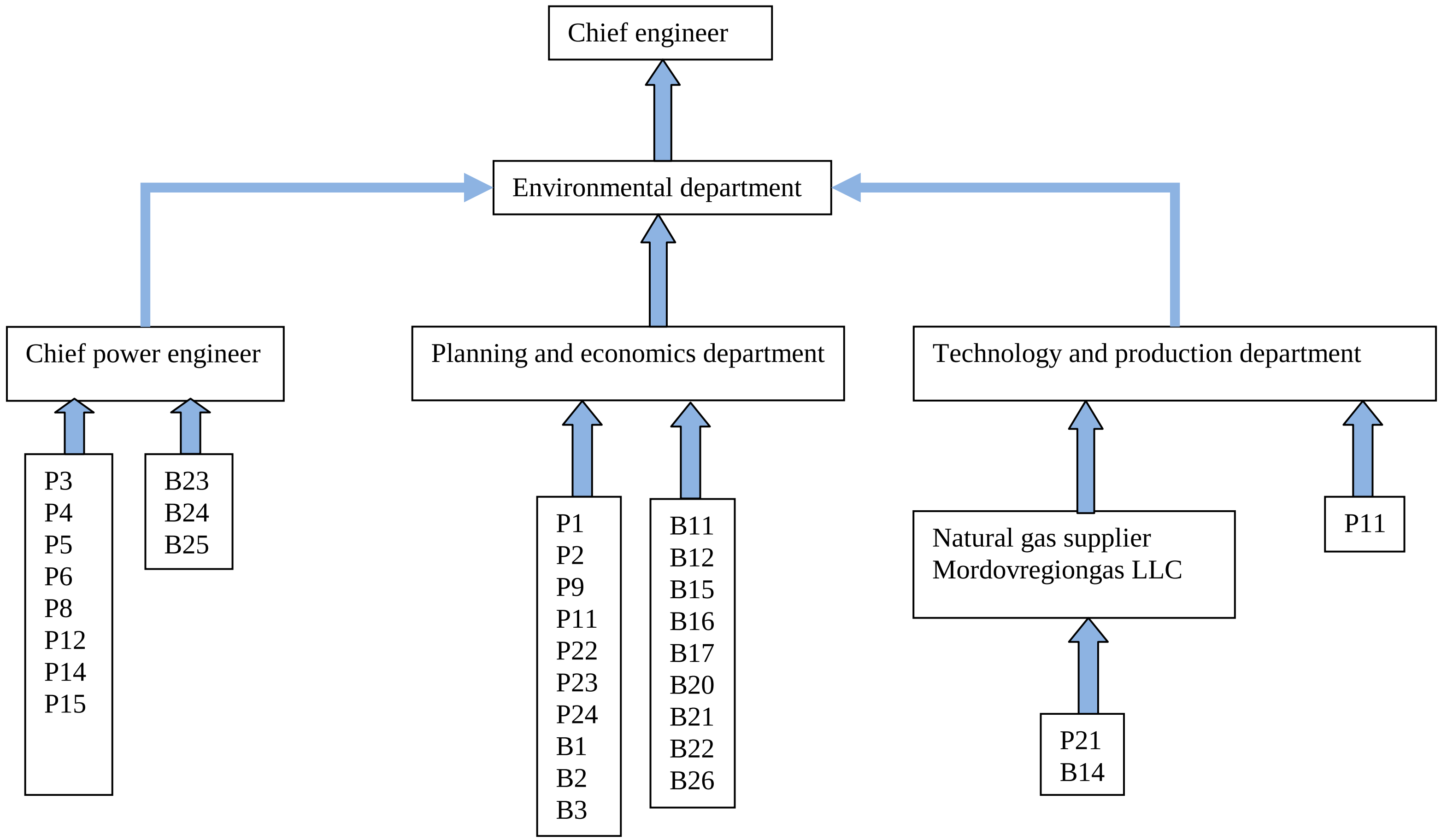
The plant’s chief metrologist department is in charge of the efficient supervision of measuring devices operation and performance. It checks and replaces the devices (adjusted and calibrated) if necessary.

Calibration of the metering devices is made in accordance with the calibration schedule. It is approved every year. Metering devices are calibrated by the independent entity which has the state licence. Currently it is “Standardization and metrology” centre at Saransk City.

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

The scheme of monitoring data collection at OJSC "Mordovcement" is described in Figure D.3.1.

Figure D.3.1: Scheme of monitoring data collection at OJSC "Mordovcement"



Source: OJSC "Mordovcement"

Three units of OJSC "Mordovcement" will be responsible for information collecting in monitoring:

1) *Chief Power engineer department*

Chief Power engineer Department is responsible for electricity consumption at OJSC "Mordovcement". It collects data from the individual electricity meters installed at the production units that consume electricity and data of the commercial electricity meter that belonging to the regional power distribution company, and measures the overall electricity consumption at the plant. Data from individual electricity meters is cross-checked with the data of the commercial meter. For the purposes of monitoring, the energy department will report the level of electricity consumption of the kiln system and the raw milling system, and provide it to the environmental department.

2) *Planning and economics department*

Planning and economics department is responsible for accounting, controlling and planning of materials used and produced. It collects and stores data on purchased, used, produced and sold materials of the plant. These data include volumes of used chalk and clay, corrective additives, clinker and cement.

3) *Environmental Department*

The Environmental Department has the overall responsibility for the implementation of the monitoring plan, i.e. for organizing and storing the data and emission reductions calculations. It will also prepare annual monitoring reports to be presented to the verifier of the emissions reduction took place. Other departments of OJSC "Mordovcement" will submit relevant data to the Environmental Department. In addition to the preparation of the monitoring reports, the department will conduct an internal audit annually to assess project performance and, if necessary, make corrective actions.

In addition to the internal departments of OJSC "Mordovcement", one independent external organization will provide data necessary for the monitoring plan implementation:

1) *Laboratory of gas supplier organization "Mordovregiongas" LLC*

This laboratory will provide data on the net calorific value for the natural gas supplied.

As per usual routine procedures, all the data needs to be stored for three years for the purposes of independent financial audits. For the purpose of monitoring system implementation, the data collected will be stored by the Environmental Department at least two years after the last transfer of ERUs associated with the project.

For a detailed description of each parameter monitored, please refer to Sections D.1 and D.2.

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

- OJSC "Mordovcement" is a project participant.
  OJSC "Mordovcement" Albina Ivanovna Erastova, Deputy Chief engineer in technical supervision and ecology.
  E-mail: viryaskin@mordovcement.ru

- Global Carbon BV is a project participant.
  Global Carbon BV Sergey Papkov, JI Consultant.
  E-mail: Papkov@global-carbon.com

SECTION E. Estimation of greenhouse gas emission reductions

For the purpose of estimating the ERUs below, it is assumed that there is no production reduced at any of the wet kilns, hence 100% of the cement production on the new kilns is incremental capacity. Also it is assumed that kilns are operating at their maximum designed capacity. Option A of the monitoring plan is used.

E.1. Estimated project emissions:

Table E.1.1: Estimated project emissions within the crediting period semi-dry line (subproject 1)

Project emissions	Unit	2008	2009	2010	2011	2012
Kiln fuel	[tCO_2/y]	109,770	109,770	109,770	109,770	109,770
Calcination	[tCO_2/y]	362,250	362,250	362,250	362,250	362,250
Alternate fuel	[tCO_2/y]	52,034	52,034	52,034	52,034	52,034
Electricity	[tCO_2/y]	30,248	30,248	24,051	5,459	5,459
Total	[tCO_2/y]	554,303	554,303	548,105	529,514	529,514
Total 2008 - 2012	[tCO_2]	2,715,738				

Table E.1.2: Estimated project emissions within the crediting period dry line (subproject 2)

Project emissions	Unit	2010	2011	2012
Kiln fuel	[tCO_2/y]	48,854	195,416	195,416
Calcination	[tCO_2/y]	244,125	976,500	976,500
Alternate fuel	[tCO_2/y]	53,986	215,943	215,943
Electricity	[tCO_2/y]	0	0	0
Total	[tCO_2/y]	346,965	1,387,859	1,387,859
Total 2008 - 2012	[tCO_2]	3,122,682		

Table E.1.3: Estimated project emissions within the crediting period CHPP (subproject 3)

Project emissions	Unit	2010	2011	2012
Fuel	[tCO_2/y]	68,539	274,156	274,156
Total 2008 - 2012	[tCO_2]	616,850		

E.2. Estimated leakage:

Leakages are excluded from consideration due conservativeness reasons. Conservative assumptions are made. See section B.1. Table B1.2 for details.
Not applicable.

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

Table E.3.1: Estimated project emissions including leakage within the crediting period semi-dry line (subproject 1)

Project emissions	Unit	2008	2009	2010	2011	2012
Kiln fuel	[tCO_2/y]	109,770	109,770	109,770	109,770	109,770
Calcination	[tCO_2/y]	362,250	362,250	362,250	362,250	362,250
Alternate fuel	[tCO_2/y]	52,034	52,034	52,034	52,034	52,034
Electricity	[tCO_2/y]	30,248	30,248	24,051	5,459	5,459
Total	[tCO_2/y]	554,303	554,303	548,105	529,514	529,514
Total 2008 - 2012	[tCO_2]	2,715,738				

Table E.3.2: Estimated project emissions including leakage within the crediting period dry line (subproject 2)

Project emissions	Unit	2010	2011	2012
Kiln fuel	[tCO_2/y]	48,854	195,416	195,416
Calcination	[tCO_2/y]	244,125	976,500	976,500
Alternate fuel	[tCO_2/y]	53,986	215,943	215,943
Electricity	[tCO_2/y]	0	0	0
Total	[tCO_2/y]	346,965	1,387,859	1,387,859
Total 2008 - 2012	[tCO_2]	3,122,682		

Table E.3.3: Estimated project emissions including leakage within the crediting period CHPP (subproject 3)

Project emissions	Unit	2010	2011	2012
Fuel	[tCO_2/y]	68,539	274,156	274,156
Total 2008 - 2012	[tCO_2]	616,850		

E.4. Estimated baseline emissions:

Table E.4.1: Estimated baseline emissions within the crediting period semi-dry line (subproject 1)

	Unit	2008	2009	2010	2011	2012
Baseline emissions	[tCO_2/y]	622,929	622,929	622,929	622,929	622,929

Table E.4.2: Estimated baseline emissions within the crediting period dry line (subproject 2)

	Unit	2010	2011	2012
Baseline emissions	[tCO_2/y]	481,643	1,926,573	1,926,573

Table E.4.3: Estimated baseline emissions (electricity displacement from the grid) within the crediting period CHPP (subproject 3)

	Unit	2010	2011	2012
Baseline emissions	[tCO_2/y]	19,541	78,165	78,165

E.5. Difference between E.4. and E.3. representing the emissions reduction of the project:

Table E.5.1: Difference representing emissions reduction within the crediting period semi-dry line (subproject 1)

Emissions reduction	Unit	2008	2009	2010	2011	2012
Total	[tCO_2/y]	68,627	68,627	74,824	93,415	93,415
Total 2008 - 2012	[tCO_2]	398,908				

Table E.5.2: Difference representing emissions reduction within the crediting period dry line (subproject 2)

Emissions reduction	Unit	2010	2011	2012
Total	[tCO_2/y]	134,679	538,714	538,714
Total 2008 - 2012	[tCO_2]	1,212,107		

Table E.5.3: Difference representing emissions reduction within the crediting period CHPP (subproject 3)

Emissions reduction	Unit	2010	2011	2012
Total	[tCO_2/y]	-48,998	-195,991	-195,991
Total 2008 - 2012	[tCO_2]	-440,980		

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

Table E.6.1: Project, baseline, and emission reductions within the crediting period semi-dry line (subproject 1)

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 2008	554,303	0	622,929	68,627
Year 2009	554,303	0	622,929	68,627
Year 2010	548,105	0	622,929	74,824
Year 2011	529,514	0	622,929	93,415
Year 2012	529,514	0	622,929	93,415
Total (tonnes of CO_2 equivalent)	2,715,738	0	3,114,647	398,908

Table E.6.2: Project, baseline, and emissions reduction within the crediting period dry line (subproject 2)

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 2010	346,965	0	481,643	134,679
Year 2011	1,387,859	0	1,926,573	538,714
Year 2012	1,387,859	0	1,926,573	538,714
Total (tonnes of CO_2 equivalent)	3,122,682	0	4,334,789	1,212,107

Table E.6.3: Total project, baseline, and emissions reduction within the crediting period CHPP (subproject 3)

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 2010	68,539	0	19,541	-48,998
Year 2011	274,156	0	78,165	-195,991
Year 2012	274,156	0	78,165	-195,991
Total (tonnes of CO_2 equivalent)	616,850	0	175,871	-440,980

Table E.6.4: Total project, baseline, and emissions reduction within the crediting period for three projects (semi-dry line, dry line, CHPP)

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 2008	554,303	0	622,929	68,627
Year 2009	554,303	0	622,929	68,627
Year 2010	963,609	0	1,124,114	160,505
Year 2011	2,191,528	0	2,627,667	436,139
Year 2012	2,191,528	0	2,627,667	436,139
Total (tonnes of CO_2 equivalent)	6,455,270	0	7,625,306	1,170,036

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:

Cement production has a certain impact on the local environment. In Russia emission levels in industry are regulated by operating licenses issued by the regional offices of Ministry of Natural Resources and Environment of Russian Federation on an individual basis for every enterprise that has significant impact on the environment. 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 were made by the Law on Amendments to the Construction Code effective of January 1st, 2007. This Law reduced the scope of activities subject to SEE, transferring them to so called State expertise (SE) done in line with the Article 49 of the Construction Code of RF. In line with the Construction code the Design Document should contain Section “Environmental Protection”. Compliance with the environmental regulations (so called technical regulations in Russian on Environmental Safety) should be checked during the process of SE. In the absence of the above mentioned regulations compliance is checked in a very general manner.

Main causes of environmental impacts during cement manufacturing are:
- pollutants release into the atmosphere ;
- manufacturing wastes;
- manufacturing waters dumping;

OJSC “Mordovcement” is granted positive conclusion dated 11.01.2007 from the regional office of Glavgosexpertiza, in Republic of Mordovia for the semi-dry line construction.
Environmental assessment for the dry line is done in the special section of the project documentation called OVOS in 2006 by the project institute OJSC “Giprocement”. Environmental assessment for CHPP is done in the special section of the project documentation called OVOS in 2006 by the project institute “Uralvnipienergoprom”.

List of the relevant documents required for the project realization:

- State expertise positive conclusion #13-1-5-0439-08 dated 28 April 2008 on Dry technological line for cement manufacturing;
- State expertise positive conclusion #13-1-5-0438-08 dated 19 August 2008 on Combined Heat Power Plant (CHPP) construction;
- State expertise positive conclusion #148.01.06.01.02.05 dated 03.08.2005 on Semi-dry technological line for cement manufacturing;
- Construction permit #151 dated 06.05.2005 for Semi-dry technological line for cement manufacturing construction;
- Construction permit #RU 13522000 - 06 dated 16 March 2008 for dry technological line for cement manufacturing and combined heat power plant (CHPP) construction;
- Pollutants release permit #232/07 dated 28 August 2007 #287;
- Pollutants release permit #232/08 dated 10 September 2008 #529;

Projects comply with following regulations:

- Federal law “On environment protection”, 2002;
- Federal law “On atmospheric air protection” 1998;
- Federal law “On industrial and consumer wastes ”, 2000;

There are several environment contamination sources at OJSC "Mordovcement":

- Non-organic dust
- Nitrogen and sulphur dioxides
- Carbon dioxide

NO_x are formed due to the inevitable oxidation reaction of the atmospheric nitrogen at high temperatures in cement kiln. It is expected that emissions will meet requirements of the Russian legislation and will be within the range of the Best Available Technology levels defined by the IPCC[19] .

SO_2 emissions in cement production originate mainly from the raw materials and also from coal with sulphur content.

Project is tending to minimize pollutions into the atmosphere by gaseous emissions. Certain measures are taken to implement this:

- Minimize number of base equipment units to be installed
- Modern and efficient electrical filters installation

Project is realized on the territory of the Russian Federation, which is big enough to consider transboundary effects absence. Project affects only few kilometres of the territory surrounding the plant. Project documentation successfully undergone the environmental expertise; according to it, the project does not have any transboundary impacts.

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:

There are three sources of emission in the project:

1) Exhaust gases release into the atmosphere, after cleaning, from the drying crusher, which uses gases coming from the rotary kiln. Pollutants include non-organic dust, nitrogen oxides, carbon oxides;
2) Release into the atmosphere of aspiration air from the clinker cooler. Pollutants consist of non-organic dust;
3) Pollutants forming during clicker collection. Pollutants include non-organic dust;

Analysis made by the assessing organization showed that contamination values will remain within prescribed maximum permissible concentrations as pointed out in 2008 pollutants criteria for the plant.

Pollutions from sources one and two are measured quarterly. Gaseous pollutants are sampled once a year.

Water is taken from communal-fire pipeline and industrial pipeline. Industrial water is used for equipment cooling, exhaust gases moistening, equipment wash. Water used for equipment cooling is not getting

[19] IPCC, Reference Document on Best Available Techniques in the Cement and Limestone Manufacturing Industries (December 2001), http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter7.pdf, page 9

contaminated and is being recycled. Rest of the water is used for slurry preparation and further used in technological processes of the semi-dry line. Sewerage is designed for communal wastes and it will be connected to the existing plant's network.

SECTION G. Stakeholders' comments

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

Proposed JI projects are not required to go through a local stakeholder consultation process. Despite this, public hearings were organised by OJSC "Mordovcement" in Chamzinka rural settlement on 18 February 2008 and confirmed by the corresponding "Record on public hearings took place in Chamzinla rural settlement dated 18 February 2008". All supporting information had been provided for the interested parties. No negative responses encountered. Public hearings were supported by the publication in the local newspaper "Znamya" in the issue dated 22 February 2008.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	OJSC "Mordovcement"
Street/P.O.Box:	
Building:	
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Represented by:	
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Annex 2

BASELINE INFORMATION

Project design

Current situation

Currently, there are two plants located at the premises of OJSC Mordovcement. Staroalexeevskiy Cement Plant (Old Alexeevskiy Plant) and Alexeevskiy Cement Plant. Staroalexeevskiy Cement Plant is also known as production #1, Alexeevskiy Cement Plant internal abbreviation is production #2. Plant designed capacity is 3,750,000 tonnes of cement per year for both plants accounted together. Plants are placed 800 meters apart from each other. Both plants are independent one from another and have their own infrastructure for cement manufacturing, including raw materials preparation facilities, kilns, mills and other equipment to ensure independent operations. There are eight wet kilns operating, each plant has four wet kilns.

Proposed new kiln and electricity generation process layout

- One new semi-dry process kiln with capacity of 2,300 tonnes of clinker per day will be installed, while keeping all the rest four wet kilns operational. The new process layout would result in an increase in the production of clinker and cement. Technical production capacity of the new semi-dry installation is 690,000 tonnes of clinker or 760,000 tonnes of cement per year.

- One new dry process kiln with capacity of 6,000 tonnes of clinker/day will be installed, while keeping all the rest four wet kilns operational. The new process layout would result in an increase in the production of clinker and cement. Technical production capacity of the new dry line installation is 1,860,000 tonnes of clinker or 2,350,500 tonnes of cement per year.

- One combined cycle heat power plant (two gas turbines and one steam turbine) with 72 MW power output and 61 Gcal/hour heat output will be installed. Grid electricity consumption will be kept. Heat from gas turbines will be used for facilities warming during winter time and hot water generating throughout the year – 39,528 Gcal/year. Also gas turbines heat will be used for the raw materials drying at the dry line of cement production – 480,476 Gcal/year.

Baseline

A baseline is the scenario that reasonably represents the anthropogenic emissions by sources or net anthropogenic removals by sinks of GHGs that would occur in the absence of the project; (paragraph 20 (a) of the Guidance) and shall be established in accordance with appendix B of the JI guidelines (paragraph 23), shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol, and/or anthropogenic removals by sinks, within the project boundary (paragraph 20 (b) of the Guidance).

Scenario that represents the baseline:

- In the project absence (not constructing semi-dry, dry lines and CHPP) cement would have been produced by the other, third party cement manufacturers, located within the radius of 1000 km from the plant location or at the existing wet kilns located at Mordovcement plant and electricity is consumed from the grid by old wet lines.

For the cement industry four approved CDM baseline and monitoring methodologies exist: ACM0003 (Version 07.3), ACM0015 (Version 03) (consolidating AM0033 and AM0040 and AM0024). None of these methodologies can be applied directly to the project which foresees a process switch combined with an increase in production, but these methodologies have been carefully studied to identify the main principles underlying the approach to baseline setting, additionality and monitoring.

Furthermore, the approach regarding baseline setting applied for the JI project "Switch from wet-to-dry process at Podilsky Cement, Ukraine" (JI Track 2 reference number: 0001), for which the determination has been deemed final, is taken into account with respect to production at the maximum technical capacity.

On this basis, a JI specific approach regarding baseline setting and monitoring has been developed in accordance with appendix B of the JI Guidelines and the JISC's Guidance.

Approach to identify the baseline

The baseline for a JI project is the scenario that reasonably represents the anthropogenic emissions by sources (or anthropogenic removals by sinks) of GHGs that would occur in the absence of the proposed project.

As shown in Section B.1 above, the most plausible baseline scenario is that the existing cement production lines would be kept and third Party producers would satisfy cement demand instead at the same time electricity would have been consumed from the grid.

In this case, the baseline consists of one part:

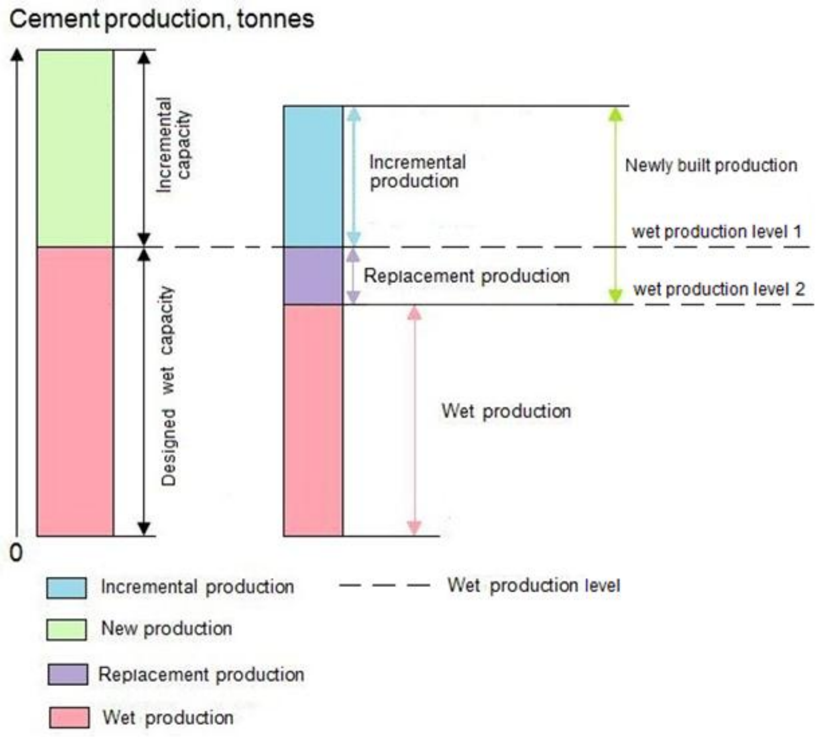
- In the project absence (not constructing semi-dry, dry lines and CHPP) cement would have been produced by the other, third party cement manufacturers, located within the radius of 1000 km from the plant location or at the existing wet kilns located at Mordovcement plant and electricity is consumed by old wet lines from the grid;

Cement production

1. *Theoretical approach*

Cement production capacity consist of two parts – replacement capacity and incremental capacity. These capacities are identified on the picture Anx. 2.1

Picture Anx 2.1.Replacement and incremental capacity correlation;



Definitions of capacity:

- Incremental production – part of cement production that exceeds designed capacities of existing wet lines and assumed as volume of cement supplied by other cement manufacturers to the final cement consumers;
- New capacity – sum of capacities in cement production of dry and semi-dry lines;
- Replacement capacity – cement, produced at semi-dry or dry lines that in the baseline scenario would have been produced on wet lines;
- Wet production – cement produced at wet kilns;

The first column in picture Anx 2.1. represents situation when wet kilns are operating at full capacity (wet production level 1).
The second column in picture Anx 2.1. represents situation when wet kilns are operating not at full capacity (wet production level 2).

As it can be seen from the definition above, replacement and incremental capacities are fractions of newly installed capacities of semi-dry and dry lines taken into account together. These fractions are changing directly proportionally to changes in wet production.

To express the baseline emissions associated with replacement capacity, we need to develop a formula accounting for such capacity in the baseline. Assumption made is that wet kilns cannot increase production because they are operating at their maximum (designed) capacity, therefore first wet production level (level 1 is equal designed wet capacity) is always more or equal (if no replacement capacity present) to the second wet production level (level 2 is wet production level corresponding to cement wet production reduced below wet designed capacity). As we can see from figure A.2.1, replacement capacity equals the difference between wet production level 1 (wet designed capacity) and wet production level 2 (actual wet production). From the same figure, we may find that to get incremental capacity, we need to add new (dry and /or semi-dry) and wet production level 2 and subtract wet production level 1. Finalizing and considering emission factors for each capacity type, we have formula that accounts for both incremental and replacement capacity emissions in the baseline scenario:

$$BE = EF_{Rep} \times \left(Wet_1 - Wet_2\right) + EF_{Inc} \times (New + Wet_2 - Wet_1) \qquad (1)$$

Where:

- BE Baseline emissions in year y, tCO_2;
- EF_{Rep} Emission factor calculated for replacement capacity, tCO_2/Tonne of cement;
- Wet_1 Wet designed capacity, Tonnes of cement/year;
- Wet_2 Actual wet production, Tonnes of cement/year;
- EF_{Inc} Emission factor calculated for incremental capacity, tCO_2/Tonne of cement;
- New Actual production at the new lines (dry and semi-dry), Tonnes of cement/year;

Level 1 refers to “designed” when level 2 is referred to “actual” whether it concerns cement production, clicker production or electricity consumption . To determine if replacement capacity is actually took place, it is necessary to compare cement production value against designed capacity. Actual production at wet kilns, as well as any other cement kiln is varying during operation of the kiln. Variation in the kiln operating time may be caused by repairs, forced standby, technological upgrades and so on. Kiln operating time throughout the year is expressed by the run factor, which represents the ratio of standby time over the operating time for the kiln in the period concerned. Normally, run factor for cement kiln is floating around 0.82-0.95; this is the normal range for the cement industry. Therefore, actual replacement capacity will not occur unless run factor of the kiln will go off the normal range. Due to complexity of wet kilns run factor forecasting it is decided to use three options in the monitoring plan (see section D and text below).

Applying corresponding calculation for the capacities, appropriate emission factors and specific consumptions, we get the formula for replacement production calculations.

Cement production expression to account for replacement capacity in the baseline emissions:

$$\begin{aligned} BE_y = & \sum_i (FCS^i \times CEMPROD(wet)^i{}_{level1} - FCS^i \times CEMPROD(wet)^i{}_{level2}) \times NCV_{fuel} \times EF_{fuel} + \\ & + \sum_i (CLNK(wet)^i{}_{level1} - CLNK(wet)^i{}_{level2}) \times EF_{calcin} + \sum_i (EL(wet)^i{}_{level1} - EL(wet)^i{}_{level2}) \times EF_{el}{}^{GRID} + \\ & + BEF_{inc} \times (CEMPROD(new) + \sum_i CEMPROD(wet)^i{}_{level2} - \sum_i CEMPROD(wet)^i{}_{level1}) \qquad (2) \end{aligned}$$

Where:

BE_y Baseline emissions in year y (tCO_2)

FCS^{i} Specific fuel consumption at the *wet* kiln *i* (nm^3/tonne of cement);
$CEMPROD(wet)^{i}_{level1}$ Designed cement production level at the *wet* kiln number *i*, (tonnes);
$CEMPROD(wet)^{i}_{level2}$ Actual cement production level at the *wet* kiln number *i*, (tonnes);
NCV_{fuel} Net calorific value of the fuel (TJ/nm^3);
EF_{fuel} Emission factor for the fuel used in the *wet* kilns (tCO_2/TJ);
$CLNK(wet)^{i}_{level1}$ Designed clinker production level at the *wet* kiln number *i*, (tonnes);
$CLNK(wet)^{i}_{level2}$ Actual clinker production level at the *wet* kiln number *i*, (tonnes);
EF_{calcin} Calcination factor (tCO_2/t clinker)[20];
$EL(wet)^{i}_{level1}$ Designed electricity consumption to produce cement CEM^{i}_{level1} level at the *wet* kiln number *i*, (MWh);
$EL(wet)^{i}_{level2}$ Actual electricity consumed to produce cement CEM^{i}_{level2} level at the *wet* kiln number *i*, (MWh);
$EF_{el,y}^{GRID}$ Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);
$BEF_{incr,y}$ Baseline emission factor for incremental cement production in year *y* (tCO_2/t cement) (see Annex 2);
$CEMPROD(new)_{y}$ The sum of cement produced at both semi-dry and dry (newly added) capacities in year *y* (tonnes of cement);

According to the information obtained from OJSC “Mordovcement”, it is not planned to decrease cement production at any of the wet kilns. This would mean that any cement produced on the new kiln would displace third party producers, as explained above (called incremental production). However, the economic situation might change and may force the enterprise to cut production at some wet kilns that are less energy efficient compared to the newly added semi-dry and dry lines. In this case the project would partially replace existing wet cement production. To account for this type of situation, baseline emissions calculations contain formulae which includes both incremental and replacement capacity. This would make the monitoring system more complex as many parameters of the wet kilns will have to be monitored for the replacement part. To reduce the complexity of the monitoring system, the Monitoring Plan will allow the Project Participant to decide for each monitoring period whether to follow one of the options given:

A) All cement produced on the new kilns would have been produced by third party producers. This option will be chosen if all existing wet kilns are working on full capacity (> 90%, run factor is more than 0,9) only formulae for incremental production to be used;
B) *Assume* that all cement produced on the new kilns would have been produced by third party producers. This option should be chosen if all or either of the existing wet kilns are working close to full capacity (80%-90%, run factor falls into the interval 0,8-0,9). This option will result in more conservative reduction compared to option c) below; as well as will allow differentiation between actual replacement capacity occurrence and accidental and unintentional production drop, such as delayed repairs and so on. This option allows flexibility in calculations, either formulae accounting for incremental production only to be used (in case if it was determined

[20] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

replacement production absence) or formulae accounting for both incremental and replacement capacity (in case if replacement production occurrence was confirmed);

C) Full monitoring of all parameters, including those on the existing wet kilns in case the wet kilns were not working on full capacity during the monitoring period; all or either of the wet kilns production is less than 80% (run factor is less than 0.8) and replacement production is positively confirmed. Formulae accounting for both incremental and replacement production to be used.

2. Theoretical approach application

Subprojects 1 and 2 (Semi-dry and dry line of cement manufacturing)

Baseline emissions have two sources:

- Production by other cement plants (incremental production) and;
- Production at existing wet lines (replacement production);

$$BE_y = BE_{rep,y} + BE_{incr,y} \quad (3)$$

Where:

BE_y Baseline emissions in year *y* (tCO_2);

$BE_{incr,y}$ Baseline emissions due to incremental production in year *y* (tCO_2) (see also Annex 2);

BE_{rep} Baseline emissions due to replacement capacity in year *y* (tCO_2);

Baseline emissions due to replacement and incremental production:

Taking into account that there are no capacities additions can be identified within a radius of 1,000 km, the baseline emission factor for incremental cement production is estimated/calculated in the following way:

All production levels are equal to the maximum designed capacities.

$$CEMPROD(new)_y = CEMPROD_{semi-dry,y} + CEMPROD_{dry,y} \quad (4)$$

Where:

$CEMPROD(new)_y$ Cement produced at newly installed capacities (dry and semi-dry) in the year *y* (tonnes of cement);

$CEMPROD_{semi-dry,y}$ Cement production at the semi-dry line in the year *y* (tonnes of cement);

$CEMPROD_{dry,y}$ Cement production at the dry line in the year *y* (tonnes of cement);

$$BEF_{incr,y} = OM_y \quad (5)$$

Where:

$BEF_{incr,y}$ Baseline emission factor for incremental production in year *y* (tCO_2/t cement)

OM_y Operating margin (OM) emission factor of cement production at the cement plants in the OM in year *y* (tCO_2/t cement) (see Annex 2);

OM emission factor is estimated/calculated in the following way:

$$OM_y = \frac{EF_{el,y} \times EL_{OM,y} + EF_{calcin,y} \times CLNK_{OM,y} + \sum_i EF_{fuel\_i} \times NCV_{fuel\_i,incr} \times FUEL_{OM,i,y}}{CEM_{OM,y}} \quad (6)$$

Where:

$EL_{OM,y}$ Total electricity consumption at the cement plants in the OM in year *y* (MWh);

$CLNK_{OM,y}$ Total clinker production at the cement plants in the OM in year *y* (tonnes);

$NCV_{fuel\_i,incr}$ Net calorific value of kiln fuel *i* (GJ/tonne or 1000 m^3);

$FUEL_{OM,i,y}$ Total fuel consumption of kiln fuel *i* at the cement plants in the OM in year *y* (tonnes or 1000 m^3);

$CEM_{OM,y}$ Total cement production at cement plants in the OM in year *y* (tonnes);

EF_{fuel_i} Emission factor for fuel of type *i*;

$EF_{el,y}^{GRID}$ Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante;

$EF_{calcin,y}$ Default emission factor (tCO_2/t clinker)[21];

Option A of the monitoring plan - incremental production only

Baseline emissions due to the incremental production:

$$BE_{incr,y} = CEMPROD(new)_y \times OM_y \quad (7)$$

Option B of the monitoring plan - incremental production only or replacement and incremental production

This option to be used when existing wet kilns production level is 80%-90% of their designed capacities, run factor falls into the interval 0,8-0,9. Due to the fact that production level and run factor for the wet kilns is floating around the margin when replacement production is taking place, it is not always clear what type of the situation is taking place. Therefore, this option gives flexibility to choose between incremental production only and replacement and incremental production calculations for the baseline emissions. If wet kilns production is on the lower end (80% and run factor is 0.8) but replacement production is not confirmed (delayed repairs, and so on), formulae 19-22 to be used to calculate the baseline emissions.

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[21] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

If wet kilns production is on the lower end (80% and run factor is 0.8) and replacement production is confirmed, the following formulae to be used to calculate baseline emissions:

Adjusting the formula for the appropriate specific fuel and electricity consumptions as well as for the appropriate emission factors:

$$BE_y = \sum_i (FCS^i \times CEMPROD(wet)^i{}_{level1} - FCS^i \times CEMPROD(wet)^i{}_{level2}) \times NCV_{fuel} \times EF_{fuel} +$$
$$+ \sum_i (CLNK(wet)^i{}_{level1} - CLNK(wet)^i{}_{level2}) \times EF_{calcin} + \sum_i (EL(wet)^i{}_{level1} - EL(wet)^i{}_{level2}) \times EF_{el}{}^{GRID} +$$
$$+ BEF_{inc} \times (CEMPROD(new) + \sum_i CEMPROD(wet)^i{}_{level2} - \sum_i CEMPROD(wet)^i{}_{level1}) \quad (8)$$

Where:

BE_y Baseline emissions in year *y* (tCO_2)
FCS^i Specific fuel consumption at the *wet* kiln *i* (nm^3/tonne of cement);
$CEMPROD(wet)^i{}_{level1}$ Designed cement production level at the *wet* kiln number *i*, (tonnes);
$CEMPROD(wet)^i{}_{level2}$ Actual cement production level at the *wet* kiln number *i*, (tonnes);
NCV_{fuel} Net calorific value of the fuel (TJ/nm^3);
EF_{fuel} Emission factor for the fuel used in the *wet* kilns (tCO_2/TJ);
$CLNK(wet)^i{}_{level1}$ Designed clinker production level at the *wet* kiln number *i*, (tonnes);
$CLNK(wet)^i{}_{level2}$ Actual clinker production level at the *wet* kiln number *i*, (tonnes);
EF_{calcin} Calcination factor (tCO_2/t clinker)[22];
$EL(wet)^i{}_{level1}$ Designed electricity consumption to produce cement $CEM^i{}_{level1}$ level at the *wet* kiln number *i*, (MWh);
$EL(wet)^i{}_{level2}$ Actual electricity consumed to produce cement $CEM^i{}_{level2}$ level at the *wet* kiln number *i*, (MWh);
$EF_{el,y}{}^{GRID}$ Standardized CO_2 emission factor of the relevant regional electricity grid in year *y* (tCO_2/MWh), fixed ex-ante (see Annex 2);
$BEF_{incr,y}$ Baseline emission factor for incremental cement production in year *y* (tCO_2/t cement) (see Annex 2);
$CEMPROD(new)_y$ The sum of cement produced at both semi-dry and dry (newly added) capacities in year *y* (tonnes of cement);

Subproject 3 CHPP

Baseline emissions for CHPP have one source:

- Electricity generation in the grid;

[22] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

$$BE^{CHPP}{}_{y} = BE^{CHPP}{}_{electricity,y} \quad (9)$$

Where:

$BE^{CHPP}{}_{y}$	Baseline emissions for the CHPP in year y (tCO_2);
$BE^{CHPP}{}_{electricity,y}$	Electricity that would have been consumed from the grid in case of CHPP absence;

$$BE^{CHPP}{}_{electricity,y} = EF_{el,y} \times EL^{CHPP}{}_{y} \quad (10)$$

Where:

$EL^{CHPP}{}_{y}$	Part of electricity displaced by CHPP in the relevant grid (RES “Mid Volga”) due to consumption of this part of electricity by the wet lines in year y (MWh);
$EF_{el,y}$	Standardized CO_2 emission factor of the relevant regional electricity grid in year y (tCO_2/MWh), fixed ex-ante (see Annex 2);

Baseline emissions of the incremental production are calculated on the basis of displaced cement production by third party producers. An approach needs to be developed how such a counterfactual situation can be constructed while remaining transparent and conservative.

Cement industry is a transparent market where standardized types of cement products exist. Within a certain region or country cement can be transported from the producer to the consumer.

A similar situation exists in an electricity system where electricity can be transported from the producer to the consumer without significant transmission constraints. Given the similarity, the following approach takes into account the underlying principles of the “Tool to calculate the emission factor for an electricity system” (version 02) (hereinafter referred to as “CDM Tool”), adopted by the CDM Executive Board, which deals with capacity additions to the electricity grid.

However, it has to be considered that cement, inter alia due to transportation costs, is not delivered over huge distances. In Russia the average distance of cement deliveries is approximately 500 km.[23] Therefore, it is assumed that new cement capacities can have a potential effect on the production of other cement capacities within a radius of the transportation distance; radius of the circle is approximately 1000 km, two times of the transportation distance. In general, an impact is the more likely, the nearer the plant.

If the JI project is not implemented, incremental production would be covered by other cement producers and result in corresponding emissions, i.e.:

3. Other cement plants that exist within a radius of approximately 1,000 km (operating margin or OM);
4. New cement capacity additions (to be) built within a radius of 1,000 km (build margin or BM).[24]

[23] See OJSC “NIICEMENT” annual statistical report “Russian Cement Industry in 2007”.

[24] The BM defines the new capacity additions that might have been constructed in project absence. This is estimated based on information about the most recently built plants/capacity additions.

Operating margin (OM) emission factor

It is not feasible to define exactly which of the existing cement plants would produce the incremental amount of cement. Most transparent approach is to calculate weighted average of specific CO_2 emissions of the nearest cement plants within 1000 km radius. The result will give the emission factor expressed in tCO_2/t cement.

The OM emission factor is calculated by taking into account the following emissions:

4. Emissions from fuel consumption;
5. Emissions from calcination;
6. Emissions from electricity consumption.

$$OM_y = \frac{\sum EF_{el\_j,y} x EL_{OM\_k,y} + 0.525 x CLNK_{OM,y} + \sum_i EF_{fuel\_i} x NCV_{fuel\_i,incr} x FUEL_{OM,i,y}}{CEM_{OM,y}} \quad (11)$$

Where:

$EL_{OM\_k,y}$	Total electricity consumption at the cement plant *k* in the OM in year *y* (MWh)[25];
$EF_{el\_j,y}$	Grid emission factor of a regional energy system *j* in year *y* used for cement plant *k* located in this area (tCO_2/MWh)[26];
0.525	Calcination emission factor (tCO_2/t clinker)[27];
$CLNK_{OM,y}$	Total clinker production at the cement plants in the OM in year *y* (tonnes);
EF_{fuel_i}	Carbon emission factor of kiln fuel *i* (tCO_2/GJ);
$NCV_{fuel\_i,incr}$	Net calorific value of kiln fuel *i* (GJ/tonne or 1000 m^3);
$FUEL_{OM,i,y}$	Total fuel consumption of kiln fuel *i* at the cement plants in the OM in year *y* (tonnes or 1000 m^3);
$CEM_{OM,y}$	Total cement production at the cement plants in the OM in year *y* (tonnes).

The OM_y emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post.

Build margin (BM) emission factor

In absence of the project, a competitor could decide to build a new cement plant or extend an existing cement production capacity to meet the market demand. It is not feasible to define exactly which new

[25] The data of annual cement and clinker production and annual fuel and electricity consumption at Russian cement plants are taken from the OJSC “NIICEMENT” annual statistical report “Russian Cement Industry in 2007”.

[26] The data of grid emission factors for the nearest 14 cement plants within a radius of 1,000 km from the project is taken from the study “Development of grid GHG emission factors for power systems of Russia” commissioned by “Carbon Trade and Finance” in 2008. Amounts of grid emission factors are presented in Table Anx. 2.4 below.

[27] Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO_2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker

cement plant/capacity addition would be built and produce the incremental amount of cement. Four options can be applied to calculate the BM emissions:

e) The five most recent capacity additions within the last 10 years within a radius of 1,000 km are taken into account. This approach is applicable if relevant capacity additions can be observed;
f) Alternatively, five new capacity additions planned for the near future within a radius of 1,000 km can be taken into account, if their implementation is realistic/probable. If more capacity additions are planned proximity is decisive;
g) Provided objective data exist, it can be assumed, for reasons of conservativeness, that an installation would be built based on Best Available Technology (BAT) of cement production;
h) If no recent capacity additions have occurred within a radius of 1,000 km and it is unclear which new installations will be built or when, it is reasonable and most realistic to assume the BM emission factor to be zero ex-ante, but monitor it during the crediting period ex-post. In this context, the five most recent capacity additions built within the last 10 years within a radius of 1,000 km (or all, if less than 5 exist) are taken into account, in accordance with the formula below.

$$BM_y = \frac{\sum EF_{el\_j,y} x EL_{BM\_k,y} + 0.525 x CLNK_{BM,y} + \sum_i EF_{fuel\_i} x NCV_{fuel\_i incr} x FUEL_{BM,i,y}}{CEM_{BM,y}} \quad (12)$$

Where:

$EL_{BM,y}$	Total electricity consumption at the cement plant *k* in the BM in year *y* (MWh);
$CLNK_{BM,y}$	Total clinker production at the cement plants in the BM in year *y* (tonnes);
$FUEL_{BM,i,y}$	Total fuel consumption of kiln fuel *i* at the cement plants in the BM in year *y* (tonnes or 1000 m^3);
$CEM_{BM,y}$	Total cement production at the new cement plants in the BM in year *y* (tonnes).

The BM_y emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post in case of option a), it is fixed ex-ante in case of options b) and c), and it is monitored and calculated ex-post in case of option d).

Combined margin (CM) emission factor

The CM emission factor is calculated by weighing the OM emission factor and the BM emission factor on a 50 % / 50 % basis, as recommended by the CDM Tool.

$$CM_y = \frac{OM_y + BM_y}{2} \quad (13)$$

Where:

CM_y CM emission factor for incremental cement production (tCO_2/t cement)

The CM emission factor is used for estimating/calculating the baseline emissions of the incremental production, unless the BM emission factor is zero, as described in option d) above. In particular case, only the OM emission factor is taken into account.

In principle, the CM emission factor can either be calculated and fixed ex-ante for the whole crediting period, or estimated ex-ante and monitored and calculated ex-post.

If the data required to calculate the OM/BM/CM emission factors for year y is usually only available later than six months after the end of year y, alternatively the emission factors of the previous year (y-1) may be used. If the data is usually only available more than 18 months after the end of year y, the emission factors of the year preceding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout the crediting period.

This methodological approach can be freely reproduced and used for JI projects if proper reference to the source is made.

Application of methodological approach

Background data for the calculation of the OM emission factor

Information on the nearest twenty cement plants within approximately1000 km radius from the project site is presented in Table Anx.2.3 below:

Table Anx.2.2: Background information on the nearest twenty cement plants

No.	Plant	Production method	Fuel	Cement production in 2007 (thousand tonnes)
1	Oskolcement	wet	gas	3,320,3
2	Lipetskcement	dry	gas	1,483,0
3	Voskresenskcement	wet	gas	1,680,8
4	Shchurovsky cement	wet	gas	1,237,7
5	Mikhailov cement	wet	gas	1,331,0
6	Sterlotamakskoye AO "Soda"	wet/dry	gas	988,8
7	Zhigulevskiye stroymaterialy	wet	gas	1,288,8
8	Volskcement	wet	gas	2,434,8
9	Ulyanovskcement	wet	gas	1,905,8
10	Sebryakovcement	wet	gas	3,194,0
11	Maltsovskiy Portlandcement	wer	gas	3,480,0
12	Pikalevskiy cement	wet	gas	2,025,5
13	Gornozavodskcement	wet	gas	1,870,0
14	Novotroickiy cementniy zavod	wet	gas	797,0
15	Podolsk-cement	wet	gas	150,0
16	Belgorodskiy cement	wet	gas	2 200,1
17	Podgorenskiy cementnik	wet	gas	430,0
18	Nevyanskiy cementnik	dry	gas	1 090,1
19	Katavskiy cement	dry	gas	1 208,4
20	Magnitogorskiy COZ	wet	gas	321,6
Total cement production in 2007				32,437,7

Source: OJSC "NIICEMENT" annual statistical report "Russian Cement Industry in 2007"

An investigation was conducted to assess the average kiln efficiencies of these cement plants and the average electricity consumption. Data was processed accordingly to obtain the OM emission factor in 2007, which is equal to0.819 tCO2/t cement.

The OM_y emission factor is estimated ex-ante and monitored and calculated ex-post.

Background data for the calculation of the BM emission factor

Only three new kilns were constructed in Russia from 1992:

- in the Central part of Russia: one kiln at Mordovcement (2008, semi-dry);

- in the Ural region: two kilns at JSC "Soda" (2007, dry) and at Magnitogorsky cement plant (2007, wet).

New kilns at JSC "Soda" and at Magnitogorsky cement plant are located out of the relevant geographical area within the transportation distance for OJSC "Mordovcement" of 542 km, where JSC "Soda" is located 680 kilometres away and Magnitogorsky cement plant is located 870 kilometres away. Mordovcement is the current JI project, and as such don't need to be considered. Therefore no new cement capacity additions without JI status can be observed during the last 10 years within relevant geographical area. Some new cement capacity additions were planned in the relevant region, but, in particular also due to the economic crisis, it is unclear whether they will be implemented at all or at least in the near future.

Therefore, it is reasonable and most realistic to assume the BM emission factor to be zero ex-ante, but monitor it during the crediting period ex-post. In this context, the five most recent capacity additions built within the last 10 years within radius of 1,000 km (or all, if less than 5 exist) are taken into account.

OM or CM emission factor

The OM emission factor is estimated ex-ante and monitored and calculated ex-post.

For the reasons mentioned above, the BM emission factor is set to be zero ex-ante, but monitored during the crediting period ex-post. If no relevant capacity additions can be identified, the OM emission factor is applied, otherwise the CM emission factor is used on a 50:50 basis.

The data vintage y-2 is used throughout the crediting period.

The baseline emission factor for the incremental cement production ($BEF_{incr,y}$) is therefore estimated ex-ante at a value of 0.819 tCO2/t, the level of the ex-ante OM emission factor. During the crediting period it is either the relevant ex-post OM or CM emission factor, in accordance with the definitions above.

Technical transmission and distribution electricity losses

Total quantity of project electricity consumption for semi-dry and dry lines is 392,404 MWh per year (for 2011).

In the baseline there is one component of cement production is taken into account due to currently absent replacement capacity:

- Incremental (3,110,500 tonnes of cement per year).

For estimation of electricity consumption for incremental part of cement production the individual specific factor of electricity consumption is used for each plant. This factor was defined as an average value of the nearest twenty cement plants located within the radius of 1,000 km from the project. It is equal 115.3 KWh/t cement (please see Table Anx.2.4).

Table Anx.2.3: Specific factor of electricity consumption at the nearest twenty cement plants in 2007

N	Cement plants	Cement production	Specific factor of electricity consumption
		thous.tonn	kWh/t cement
1	Oskolcement	3,320,3	100.6
2	Lipetskcement	1,483,0	124.0
3	Voskresenskcement	1,680,8	121.3
4	Shchurovsky cement	1,237,7	130.0
5	Mikhailov cement	1,331,0	116.0
6	Sterlotamakskoye AO "Soda"	988,8	95.4
7	Zhigulevskiye stroymaterialy	1,288,8	125.0
8	Volskcement	2,434,8	116.0
9	Ulyanovskcement	1,905,8	107.5
10	Sebryakovcement	3,194,0	101.9
11	Maltsovskiy Portlandcement	3,480,0	108.5
12	Pikalevskiy cement	2,025,5	128.0
13	Gornozavodskcement	1,870,0	120.0
14	Novotroickiy cementniy zavod	797,0	120.0
15	Podolsk-cement	150,0	90,5
16	Belgorodskiy cement	2 200,1	84,5
17	Podgorenskiy cementnik	430,0	111,5
18	Nevyanskiy cementnik	1 090,1	156,0
19	Katavskiy cement	1 208,4	155,0
20	Magnitogorskiy COZ	321,6	114,9
Average			**115.3**

The project electricity consumption is less than baseline electricity consumption and the project technical transmission and distribution losses are less than the baseline technical transmission and distribution losses.

Therefore the technical transmission and distribution losses were not taken into account in emissions calculations. It is conservative.

Table Anx. 2.4. Key parameters used to identify the baseline

Data/Parameter	$EF_{calcin,y}$
Data unit	tCO_2/t clinker
Description	Default calcination factor in year *y*
Time of determination/monitoring	Fixed ex-ante during determination
Source of data (to be) use	Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD) 2005, CO2 Accounting and Reporting Standard for the Cement Industry, www.wbcsd.org, http://www.wbcsd.org/DocRoot/hnvVGp31rApruOH35k2O/ghg-

	account.pdf , page 102, parameter CO2 emission factor for calcination from a tonne of clinker
Value of data applied (for ex ante calculations/determinations)	0.525
Justification f the choice of data or description of measurement methods and procedures (to be) applied	This default emission factor is close to the IPCC default factor and is adjusted for Mg carbonates
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$NCV_{fuel\_i,y}$ ("fuel_i" is natural gas)
Data unit	KJ/m^3
Description	Net calorific value of natural gas in year *y*
Time of determination/monitoring	During the crediting period
Source of data (to be) use	Plant records
Value of data applied (for ex ante calculations/determinations)	33,472
Justification f the choice of data or description of measurement methods and procedures (to be) applied	Natural gas net calorific value is taken from the Certificate of natural gas supplier. Natural gas supplier issues it on monthly basis.
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	EF_{fuel_i} ("fuel_i" is natural gas)
Data unit	tCO_2/GJ
Description	Emission factor of natural gas
Time of determination/monitoring	During the crediting period
Source of data (to be) use	2006 IPCC Guidelines on National GHG Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html, Volume 2, Chapter 2, page 16, table 2.2
Value of data applied (for ex ante calculations/determinations)	0.0561
Justification f the choice of data or description of measurement methods and procedures (to be) applied	IPCC default emission factor is used because the local data is not available
OA/QC procedures (to be) applied	-
Any comment	-

Data/Parameter	$EF_{el,y}^{GRID}$
Data unit	tCO_2/MWh
Description	Standardized CO_2 emission factor of the regional energy system (RES) *j* (multi-project baseline)
Time of determination/monitoring	Ex-ante
Source of data (to be) use	The study "Development of grid GHG emission factors for power systems of Russia" commissioned by "Carbon Trade and Finance" in 2008 (further in the text – Study) Version 02
Value of data applied (for ex ante calculations/determinations)	0.511 – for RES "Centre"; 0.548 – for RES "North-West"; 0.506 – for RES "Mid Volga"; 0.541 – for RES "Urals"; 0.500 – for RES "South"; 0.894 – for RES "Siberia";
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The Study was verified by Bureau Veritas Certification in 2008
OA/QC procedures (to be) applied	-
Any comment	For the calculation of emissions related to electricity consumption in the project and baseline scenarios for replacement part of cement production, the combined margin emission factor for RES "Centre" was applied. For the calculation of emissions related to electricity consumption in the baseline scenarios for incremental part of cement production, the corresponding grid emission factors (for RES "Centre", RES "Mid Volga", RES "North-West" and RES "South") were applied. Please see Annex 2.

Data/Parameter	$BEF_{incr,y}$
Data unit	tCO_2/t cement
Description	Baseline emission factor for incremental cement production
Time of determination/monitoring	During the crediting period
Source of data (to be) use	OJSC "NIICEMENT" annual statistical report "Russian Cement Industry in 2006". This report contains the data of annual cement and clinker production and annual fuel and electricity consumption at Russian cement plants.
Value of data applied (for ex ante calculations/determinations)	0.819
Justification f the choice of data or description of measurement methods and procedures (to be) applied	The underlying principle of the Combined Margin (as first introduced in the "Tool to calculate the emission factor for an electricity system" Version 02) is used. IPCC default values are used for CO_2 emission factor of fossil fuels. The default grid emission factors for the regional power systems of Russia are used. Please see Annex 2 for more detail

	description including the assumptions, formulae, parameters, data sources and key factors
OA/QC procedures (to be) applied	-
Any comment	-

Standardized grid emission factors

Standardized CO_2 emission factors, used to calculate emissions related to electricity consumption in the project and baseline scenarios in this PDD.

Standardized CO_2 emission factors were elaborated for the power systems of Russia in the study “Development of grid GHG emission factors for power systems of Russia” Version 02 (further in the text – Study) commissioned by “Carbon Trade and Finance” in 2008.

On the basis of the approved CDM “Tool to calculate the emission factor for an electricity system” (version 02), operating, build and combined margin emission factors were calculated for the 7 regional Russian electricity systems (RESs). Within these RESs no major transmission constraints exist, while they operate at the same time relatively “independently” from each other (i.e. the electricity exchange between the regional systems is rather insignificant).

This Study recommends using the operating margin emission factor for the baseline GHG emission calculation if JI project reduces the electricity consumption. After project electricity consumption will be decreased in comparison with baseline, as shown above. Therefore the operating margin emission factors were used for emissions calculation.

Operating margin emission factors were used for emissions calculation both in the project and baseline. It is conservative.

For the calculation of emissions related to electricity consumption in the project and the operating margin, emission factor for RES “Mid Volga” was applied as grid emission factor and fixed ex-ante:

$EF_{el\_j,y}$ = 0.506 tCO_2/MWh.

For calculation of emissions related to electricity consumption in the baseline scenario for incremental part of cement production, corresponding operating margin emission factors (for RES “Centre”, RES “Mid Volga”, RES “North-West”, RES “Urals” and RES “South”) were applied as grid emission factors.

The grid emission factor of RES “Centre” (0.511 tCO_2/MWh) was used for emission calculation at:

- Oskolcement;
- Lipetskcement;
- Voskresenskcment;
- Shchurovsky cement;
- Mikhailov cement;
- Maltsovskiy Portlandcement;
- Podolsk-cement;
- Belgorodskiy cement;
- Podgorenskiy cementnik;

The grid emission factor of RES “Mid Volga” (0.506 tCO_2/MWh) was used for emission calculation at:

- Zhigulevskiye stroymaterialy;
- Volskcement;
- Ulyanovskcement;

The grid emission factor of RES “South” (0.500 tCO_2/MWh) was used for emission calculation at:

- Sebryakovcement;

The grid emission factor of RES “North-West” (0.548 tCO2/MWh) was used for emission calculation at:

- Pikalevskiy cement;

The grid emission factor of RES “Urals” (0.541 tCO_2/MWh) was used for emission calculation at:

- Gornozavodskcement;
- Novotroickiy cementniy zavod;
- Nevyanskiy cementnik;
- Katavskiy cement;
- Magnitogorskiy COZ;
- Sterlotamakskoye AO "Soda";

The whole Study is available on request.

Annex 3

MONITORING PLAN

Left blank on purpose.
See section D for the monitoring plan.
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