JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 0.1 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Slag usage and switch from wet to semi-dry process at Volyn-Cement, Ukraine.

Sectoral scope 4: Manufacturing industries[1]

PDD version 4.0 dated 18 February 2010.

A.2. Description of the project:

Cement production is a highly energy intensive process that generates significant emissions of greenhouse gases, in particular CO_2. There are three main sources of CO_2 emissions in the cement production process. The first source is fossil fuel combustion and the second source is the chemical decomposition of the limestone into calcium oxide and carbon dioxide. The third source, being smaller as to compare with the first two, is the grid emissions due to electricity consumption of plants motor drives (e.g. kiln rotation, pumping, fans) and other power consumers.

The project aims to significantly decrease the emissions of the first two sources (fossil fuel combustion and calcination) at Volyn-Cement Cement factory in Ukraine. The Volyn-Cement factory is one of the biggest cement plants in Ukraine having approximate capacity of 2 mln tonnes of cement a year. It uses a wet process and runs seven kilns.

Kilns installed	Process type	Kiln clinker capacity, t/h each
#1, 2, 3 and 7	Wet	22
#4, 5 and 6	Wet	53

Table 1. Existing production capacity

Firstly, it is foreseen to increase the addition of non-carbonated raw material in the raw meal fed to the kilns. Currently, about 4% of unground blast furnace slag is being added. According to the plan, from 2010 on the share of slag will be increased to some 15% which is regarded as the project target. This reduces the emission due to the calcination process. Further in this PDD this part of the project is referred to as subproject 1.

Secondly, the project will decrease the emissions of fossil fuel combustion by changing the technology of cement production from a wet production process to a semi-dry production process (subproject 2).

It is foreseen that all four smaller kilns will be demolished and one of 53 t/h (out of three) will be mothballed. A new semi-dry kiln having capacity of 250 t/h will be installed and operate together with two existing wet kilns of 53 t/h.

Kilns in operation	Process type	Kiln clinker capacity, t/h each
#8	Semi-dry	250
#4, 5	Wet	53

Table 2. Production capacity after project implementation

It is planned that the new semidry kiln #8 will be commissioned and starts operation in 2012.

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[1] http://cdm.unfccc.int/DOE/scopelst.pdf

Wet cement production technology is the conventional technology of cement production in Ukraine with a very limited number of dry and semi-dry technology examples[2]. During raw material preparation stage limestone, clay and additives are crushed and mixed in the raw mill. In the case of wet cement technology water is added to the raw mill together with the raw materials in order to produce slurry. The slurry is further homogenized and fed to the rotary kiln. At the point of the kiln inlet, at the drying zone, water is evaporated from the slurry, and raw materials are moved further into the kiln to be calcined and burnt into clinker. Evaporation of the wet slurry consumes significant amounts of energy. At present the average fuel energy consumption at Volyn-Cement over the years 2004, 2005, and 2006 is from 5.953 to 6,033 GJ per tonne of clinker produced (from 1422 to 1441 kcal/kg of clinker).

Semi-dry production process was selected for the reason of high raw materials moisture reaching 24%. The process foresees crushing and blending of the raw materials in a special crusher-dryer to produce the raw meal which is then fed to pre-heater tower where it is dried with kiln exhaust gases. Then the dry raw meal is fed into the calciner where at high temperature the decarbonisation process takes place. The pre-calcined materials are then fed into the rotary kiln where the formation of clinker is occurring. It allow to reduce the kiln fuel consumption by 35-40%, reduce the capital cost of production assets as to compare to the wet process, but increases the complexity of operation and maintenance and consumption of electricity.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (Host party)	JSC Volyn-Cement	No
Germany	Dyckerhoff AG	No
Netherlands	Global Carbon BV	No

Table 3. Project Participants.

Role of the Project Participants:

- JSC Volyn-Cement is the legal entity operation and owning the cement plant. Volyn-cement will be implementing the proposed JI project;
- Dyckerhoff AG is the mother company owning JSC Volyn-Cement. Dyckerhoff will provide the financial means for the JI project and will provide the specific technologies;

[2] Adaptation of IPCC Guidelines and Software to Ukraine's Cement Sector, Kyiv 2004;

Ukrcement – Ukrainian association of cement industry – UkrCemFor 2007 conference materials

- Global Carbon BV is responsible for the preparation of the investment as a JI project including PDD preparation, obtaining Party approvals, monitoring and transfer of ERUs;
- The fourth legal entity (not a Project Participant) is Dyckerhoff Ukraine which is the management company of Volyn-Cement.

A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

Ukraine

Figure1: Ukraine, the project location and neighbouring countries

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

Rivnenskaya oblast (region)

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

Town of Zdolbuniv is located about 10 km south-east from Rivne, one of regional centres of Western Ukraine, which is located 300 km westward from Kyiv, the country capital.

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

Zdolbuniv is an important railway cross point. Cement factory is located close to main railroad station. The site co-ordinates are: 50°33´ N, 26°16.16´ E. Own chalk quarry is located three km from the plant site. The region is reach in mineral resources like limestone, chalk, clay and stone.

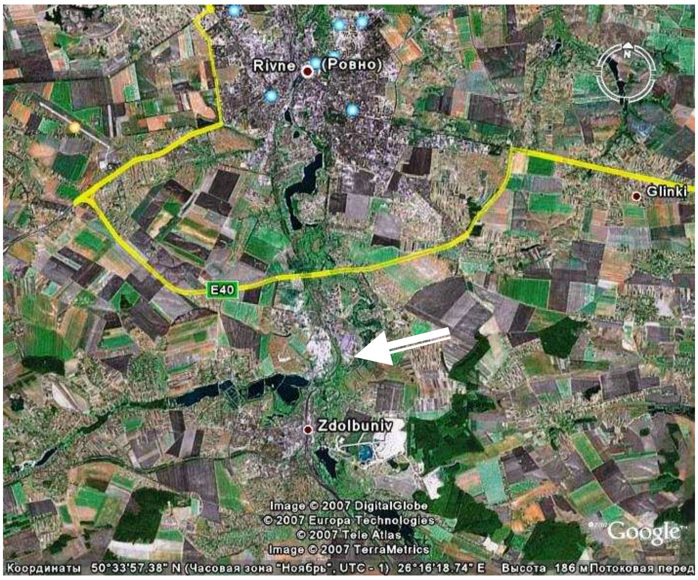

Figure 2: The town of Zdolbuniv near Rivne[3].

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

General description of cement production
The cement production cycle can be divided into four steps:

1. Raw materials extraction
The main chemical compounds necessary for cement production are contained in limestone or chalk ($CaCO_3$) and clay or loam (SiO_2, Fe_2O_3 and Al_2O_3). Limestone (or chalk) and clay (or loam) are extracted from natural deposits, crushed and transported to the cement production site.

2. Processing of raw materials
Crushed limestone and clay are mixed in a proportion of approximately 4:1. In the case of wet production technology water is added to form slurry, which is later evaporated in the drying section of the rotary kiln. In the dry process raw materials are mixed, milled and homogenized without adding water. The waste heat from the dry kiln can be used to dry the raw materials on the preparation stage.

3. Clinker burning (pyroprocessing)
The raw meal is passed to a rotary kiln. Under the influence of high temperatures, limestone (calcium carbonate) is calcined into lime (calcium oxide) and carbon dioxide:

[3] Google Earth

$$CaCO_3 + heat \Rightarrow CaO + CO_2$$

This chemical reaction is one of the two main sources of carbon dioxide during cement production. The other main source of CO_2 is fuel burning in order to heat the kiln. After the calcination, the calcium oxide reacts with the other chemical compounds present at the temperatures between 1400 – 1450^{o}C. This reaction is called sintering. The final product of these reactions is called clinker. Clinker that comes out of the kiln is cooled and heat returned to the process by clinker coolers.

4. Making cement from clinker
The last stage of cement production is fine crushing of clinker in cement mills to the state of powder. Mineral components (e.g. slag, fly ash, or gypsum) are added to the clinker and milled together in order to produce different types of cement.

Current process layout
The current situation at Volyn-Cement is presented in the figure below. Currently totally seven wet rotary kilns are in operation, three out of them are 53 tonnes of clinker/hour and four 22 tonnes/h. All kilns use natural gas as fuel. Similarly to many of Ukrainian cement plants, the use of coal instead of gas is scheduled from July 2009 onwards.

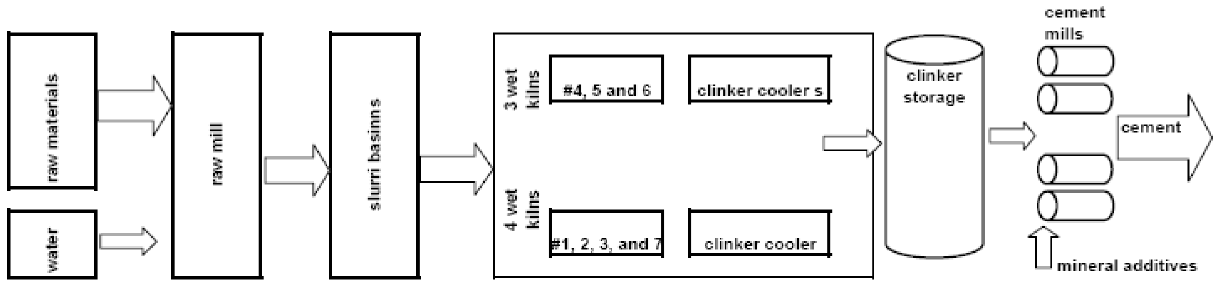

Figure 3: Existing wet cement production process at Volyn-Cement.

Raw materials are individually crushed. They are mixed and milled to a slurry with the addition of water in the raw mills. After homogenisation in slurry basins, the kiln feed slurry is fed into rotary wet kilns. The first process in the kiln is the evaporation of water. Thereafter, with the mineralogical/chemical reactions of calcination and sintering, clinker is formed. The clinker is then passed to the cooler, and further to cement grinding.

Wet rotary kilns can be operated 320 days per year. The total production capacity of the existing installation can be 1.835 million tonnes of clinker per year. With existing clinker factor of 0.85 t clinker/t cement the existing capacity can produce 2.16 million tonnes of cement annually (see annex 2).

Situation after project implementation
In the case of proposed JI project all the existing four small wet kilns will be demolished and one out of existing three bigger wet kilns will be mothballed. The production facility will be equipped with one modern semi-dry kiln system. The raw material preparation in the semi-dry cement production process will also be changed compared to the case of wet technology. The new production scheme in case of the proposed JI project is presented in the figure below. The existing five wet kilns will be replaced by a four-stage calciner kiln system with a modern efficient grate cooler. Also, to further reduce power consumption of the plant, the existing small inefficient clinker ball mills of 40 t/hour will be replaced by modern vertical rotary mills with build in particle classifier. The new mills are of 160 t/h unitary capacity and have significantly lower electricity consumption (see annex 2).

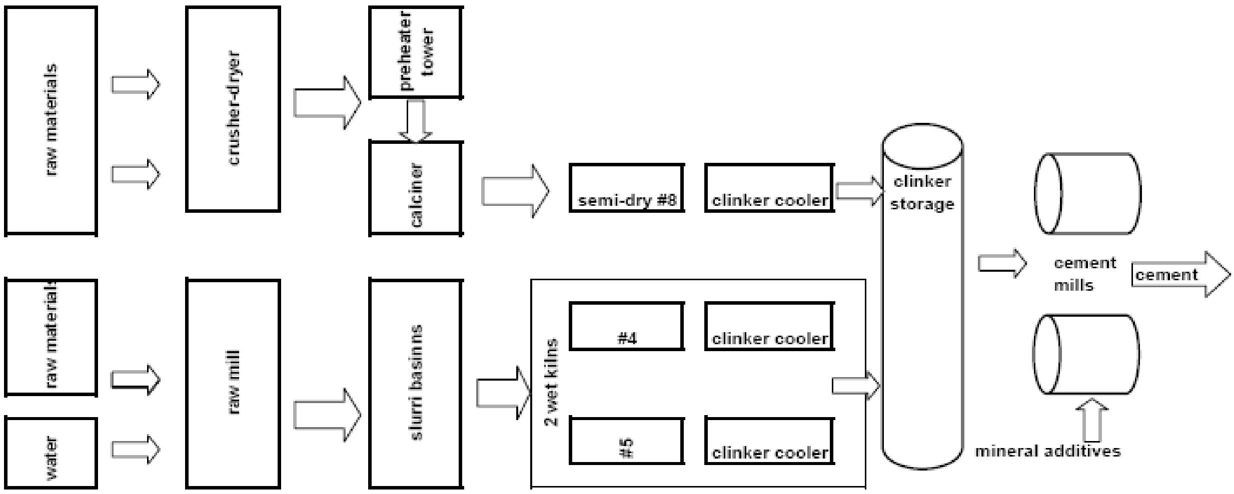

Figure 4: Semi-dry cement production process in the project scenario.

The raw materials extracted are supplied to the plant by a belt conveyor and are stored in piles under the roof. Then they are ground together in a special crusher-dryer mill in defined and well-controlled proportions to form the raw meal. The semi-dry kiln exhaust gases can be used to pre-dry the raw meal in the crusher-dryer. The raw meal is homogenised and mixed with corrective additives (e.g. iron ore) to give chemical consistency and is then is fed into the pre-heater/calciner prior to the rotary kiln. Kiln exhaust gases are used to preheat and dry the raw meal, therefore the fuel consumption will be significantly reduced. The pre-heater and calciner system will further reduce fuel consumption. The raw meal, which is fed to the calciner system, is heated to a temperature of around 800^{o}C by the exhaust heat from the kiln. The temperature in the calciner is controlled at the level of about 950^{o}C to ensure that the calcination reaction takes place. As a result, the raw meal that reaches the kiln is virtually 100% calcined. After sintering process, which takes place in the kiln, the clinker formed is fed to the cooler and further to the clinker storage. The clinker taken from the storage is then ground together with mineral additives (e.g. gypsum) to form Portland cement.

To allow commissioning of the raw meal system, a heat generator will be installed to allow the raw mill produce the first raw meal before the kiln start. Conventionally, this heat generator is not required thereafter and has not been included in the project monitoring plan. In the event of its operation being required thereafter, it will be added to the (monitoring) plan.

The process change, both in the raw material preparation scheme and the use of calciner system, would allow a reduction in energy consumption of the semi-dry kiln to approximately 3.65 GJ per tonne of clinker. The average fuel consumption of the existing wet rotary kilns is about 6.03 GJ per tonne of clinker. This considerable decrease in fuel consumption by the kiln system leads to a significant reduction of CO_2 emissions.

The production capacity of the new kiln will be approximately 6,000 tonnes of clinker per day. It is expected that the dry kiln will work 320 days a year with a 6% allowance for emergency stops. Therefore, the yearly capacity of the new semi-dry installation will be approximately 1.75 million tonnes of clinker. Together with two remaining wet kilns, producing some 0.741 million tonnes of clinker, the total capacity of Volyn-Cement after project implementation will be approximately 2.49 million tonnes of clinker or approximately 3 million tonnes of cement.

The four smaller wet kilns will be demolished. In the event of an emergency or disaster with the new semi-dry line, the third old wet kiln can be restarted. The wet kiln will be kept in reserve for a period of at least five years, which is felt to be the appropriate time period to fully test the new semi-dry line. It is planned to use coal as the primary fuel for the foreseeable future, however should security of supply of coal become an issue, either natural gas or other suitable fuels will be used.

Fuels in the cement sector
In the former Soviet Union natural gas has been subsidised, allowing cement factories to continue using natural gas whereas in Western Europe coal has been the main source of fuel[4]due to the higher cost of natural gas. Over past 3 years all the cement plants in the country have been facing an increasing price of natural gas. During 2005-2007 a doubling of gas prices occurred for the industrial consumers and it is very unlikely that gas prices will not only return to previous level, but even stay at the current level[5].

Currently (December 2007) the cost price of natural gas is about 50% higher than the cost price of coal. As the fuel cost is an important factor in the production cost of cement, the Board of Dyckerhoff decided in 2007 to install a coal milling and handling system at Volyn-Cement to enable the factory to switch to coal in the middle of 2009. The coal mill shall be fully commissioned in 2009.

The trend of the price of natural gas is upwards and will, in time, approach a level similar to those of Western and Central Europe. It is therefore unrealistic to assume that Volyn-Cement will continue using natural gas as main kiln fuel after the commissioning of the coal mill (for reference: the conventional fuel in cement factories in Western Europe, USA, China and India is coal). Due to these factors only coal can be regarded as credible type of fuel in both, baseline and project scenarios.

Maintenance of new installation
Maintenance planning is carried out on the basis of annual schedules of equipment maintenance that are made on the basis of national maintenance standards. Routine maintenance work is done by the qualified personnel of Volyn-Cement. In the case maintenance procedures cannot be done internally, an external company is contracted to do the maintenance work.

The plant provides the external contractor with design documentation, estimates and technical documentation, necessary materials and spare parts. The plant is obliged to provide a contractor with compressed air from plant network, oxygen, water, electric power, hoisting machines during preparatory and maintenance work. In case the contractor is using his own energy recourses the plant pays for them according to contractor estimates and prices.

After the final acceptance of the new installation Volyn-Cement is fully responsible for its employees' safety, for proper and safe operation of all power circuits and communications. The contractor is obliged to carry out the maintenance works closely according to design estimates and technical documentation, provided by the plant (maintenance schedule, financial estimates, and drawings). The contracting organization must remove all defects at its own expense in case if maintenance was not fulfilled in compliance with a standard.

Training for the project
The project involves new technology to Ukraine and therefore an extensive training programme will be put in place. Dyckerhoff AG has vast experience in modern conventional kilns and will provide training and assistance to Volyn-Cement during the design, construction and commissioning phases of the project. The chosen supplier of the equipment will also be contracted by Dyckerhoff AG to provide extensive training and on-site assistance.

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[4] "Best Available Techniques" for the cement industry, CEMBUREAU, 1999

[5] http://en.wikipedia.org/wiki/Russia-Ukraine_gas_dispute

Risks of the project
The risks of the project are summarised in the following table:

Risks	**Mitigation**
1. Financial risk	
The proposed JI project requires large-scale financing for the long term. The national financial market would not be able to provide such kind of financing because of scarce resources. Besides, Ukrainian financial market is oriented for a short-term (up to three years) project financing. On the international market large-scale financing for a project in Ukraine is limited and expensive due to the country-specific risks.	Dyckerhoff AG is willing to provide long-term financing for the project in case investment criteria are met.
2. Technological risk	
Wet cement production technology is common practice in Ukraine as well as in the neighbouring countries. There is lack of knowledge and experience in switching from wet to semi-dry technology in Ukraine.	Dyckerhoff AG is operating dry and semi-dry cement kilns, and has practical experience in switching from wet to semi-dry technology. It will assist Volyn-Cement in overcoming the technological risk.
3. Market risk	
Volyn-Cement is producing cement for the national market in Ukraine with little export share. Cement production levels are directly related with the market demand. Economic recession might lead to the less production levels than expected.	Conservative market forecasts were taken to estimate production levels during the crediting period.
4. JI approval risk	
There is a risk of no approval of the (JI) project by Ukrainian government as the regular approval procedure may experience changes due to transfer of responsibilities from Ministry of Environment to National Environmental Investment Agency.	Volyn-Cement has held consultations with the authorities on the regional level and also received Letter of Endorsement from Ministry of Environment of Ukraine.

Table 4: Summary of project risks

Apart of the significant reduction of emission of GHG-gasses, the project will also decrease the emissions of dust. The effect of the project on the emissions is described in section F.

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

The project will allow to significantly reduce the emissions of CO_2 due to less raw material to be calcined in the kiln (effect of slag addition to the raw mill) and reduction of kiln fuel consumption (effect of introduction of semi-dry kiln with better efficiency). Reduction of emissions due to better electrical efficiency of clinker milling is also expected.

Although switching from wet to semi-dry process has some significant advantages, the project faces two important barriers:

Financial and economic barrier
The cement industry is a capital intensive industry and the proposed project requires a significant amount of financing. For Volyn-Cement it would be difficult to obtain financing of 190 million Euro on the domestic financial market, since the sources for project financing are very limited, and the interest rates are high. On the international market obtaining financing for this project would also be difficult due to the low credit rating of Ukraine and the high perceived risks of the country's market.

Lack of experience and technology in Ukraine
Wet production of cement is the common technology in Ukraine and other countries of the former Soviet Union. In Ukraine, there is no experience in applying semi-dry production technology.

Dyckerhoff AG has the necessary experience in constructing and operating semi-dry process plants. Additional revenue from the transfer of ERUs is the key factor to bring in foreign experience and technology and to alleviate this barrier.

Given both barriers and the impact of Joint Implementation, the proposed JI project is additional to what would otherwise occur. A more detailed description on baseline setting and additionality can be found in section B.

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

	Years
Length of the crediting period	3
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent.
Year 2008	0
Year 2009	0
Year 2010	46,095
Year 2011	46,095
Year 2012	314,773
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	406,962
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	135,654

Table 5: Estimated emission reduction over the crediting period

Estimated emission reductions (tonnes of CO2 equivalent) in 2013	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2014	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2015	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2016	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2017	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2018	326,345

Estimated emission reductions (tonnes of CO2 equivalent) in 2019	326,345
Estimated emission reductions (tonnes of CO2 equivalent) in 2020	326,345
Total emission reductions (tonnes of CO2 equivalent) during 2013-2020	2,610,762

Table 6: Emission reductions over the period of 2013-2020

A.5. Project approval by the Parties involved:

The Project Idea Note had been submitted for review of the Ministry of Environment of Ukraine. Positive Letter of Endorsement # 12036/11/10-07 was issued 08 of November 2007.

After the project had gone through the determination process, the PDD and the Determination Report were presented to the National Environmental Investments Agency of Ukraine and a Letter of Approval #49/23/7 was obtained 23 of January 2008. Following it, Letters of Approval of Germany and the Netherlands were obtained 23 of June 2009 and 13 May 2009 respectively.

SECTION B. Baseline

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

Any baseline for a JI project should be set in accordance with the "Guidance on criteria for baseline setting and monitoring"[6]. In accordance with this Guidance, the project participants may use approved CDM methodologies (article 20 (a) of the Guidance) or can establish a baseline in accordance with appendix B of the JI guidelines using selected elements or combinations approved CDM baseline and monitoring methodologies (….) as appropriate (article 20 (b) of the Guidance).

For the cement industry four approved methodologies exist being ACM0003, ACM0005, ACM0015 (consolidating AM0033 and AM0040) and AM0024. None of these methodologies can be applied directly to the project which foresees process switch combined with the increase of production and increased slag usage as raw material, but these methodologies have been carefully studied to identify the main principles underlying the approach to baseline setting, additionality and monitoring.

Furthermore the approach for baseline setting in the JI project JI0001 "Switch from wet-to-dry process at Podilsky Cement, Ukraine", for which the determination has been made final, has been applied over the existing capacity.

Finally, for proving the additionality of the project the most recent "Tool for the demonstration and assessment of additionality (version 04)" has been applied. Please refer to section B.2.

While identifying the baseline and project emissions, the general principles of appendix B of the JI guidelines (in particular: project-specific approach, taking conservative assumption, and taking into account relevant policies) have been adhered to.

Approach to select the baseline scenario

The baseline is the scenario that reasonably represents the anthropogenic emission by source of greenhouse gases that would occur in absence of the proposed project[7]. As no CDM methodology can be directly applied first a list of plausible future scenarios are identified and listed (article 21 (b) of the Guidance). The proposed project, not developed as a JI project, has been included as an alternative as well. These alternatives are assessed whether or not these alternatives are credible and plausible. The consistency between the baseline scenario determination and additionality determination has been checked.

The approach described above has been used to identify the baseline scenario for Volyn-Cement.

Identification of alternative baseline scenarios

At Volyn-Cement several options for the production of the plant are technically feasible and are discussed below.

Slag usage:

a. Using 0% slag
b. Using 4% unground slag
c. Using 15% ground slag

[6] http://ji.unfccc.int/Ref/Guida.html

[7] JI guidelines, appendix B

Production capacity:

d. Keeping existing cement production capacity. A third party producer will produce the increased cement demand instead;
e. Increase cement production capacity to maintain market share.

Technology of new kilns

f. Using a wet process
g. Using a semi-dry process
h. Using a dry process

Option h is technically not feasible as the moisture content of the raw materials is too high (up to 24%) for a dry process. Hence this option has not been taken into consideration.

Combining the remaining seven options generates nine alternative baseline scenarios:

1. Slag usage of 0% without new kilns
2. Slag usage of 4% without new kilns (current situation)
3. Slag usage of 15% without new kilns
4. Slag usage of 0% with new wet kilns
5. Slag usage of 4% with new wet kilns
6. Slag usage of 15% with new wet kilns
7. Slag usage of 0% with new semi-dry kilns
8. Slag usage of 4% with new semi-dry kilns
9. Slag usage of 15% with new semi-dry kilns (proposed project activity)

The nine alternatives are described below in more detail.

1) Production of clinker without slag addition and using a wet process

Volyn-Cement started producing cement by applying a wet process since the very beginning. The wet process was the predominant technology that was implemented in the Soviet Union. The main reason to use a wet process was the ease in raw material handling and to control the quality of the cement. Second important reason was the natural moisture of raw materials which reaches 24%. Energy efficiency was not considered to be high priority at that time.

The seven existing kilns can be operated at least till 2012.The clinker production, given all the existing kilns will be operated as they do now, will be approximately 1.835 million ton a year. Blast furnace slag (BFS or slag) would not be added to raw material mix.

As the market demand is growing under this alternative Volyn-cement would lose market share. In order words, other cement producers will produce the incremental production instead.

2) Production of clinker adding 4% of slag to the raw mix and using a wet process

Similarly to Alternative 1 above, the clinker production using all existing kilns will be approximately 1.67 million ton a year. All the seven existing wet kilns can be operated at least till 2012. Slag would be added to raw material mix at current level of approximately 4%.

As the market demand is growing under this alternative Volyn-cement would lose market share. In other words, other cement producers will produce the incremental production instead. This alternative would constitute a continuation of situation that existed at Volyn-Cement before 2009.

3) Production of clinker adding 15% of slag to the raw mix and using a wet process

Similarly to Alternatives 1 and 2 above, the clinker production will use all existing wet kilns. All the seven existing wet kilns can be operated at least till 2012. Slag would be added to raw material mix in bigger volumes of approximately 15%. The incentive for this alternative is the reduction of fuel consumption at the existing kilns due to lower calcinations of raw materials in the kiln.

As the market demand is growing under this alternative Volyn-Cement would lose market share. In order words, other cement producers will produce the incremental production instead.

4) Construction of a new wet kiln, no slag addition

In this scenario a new wet kiln(-s) would be built to be operated together with existing wet kilns. Total clinker production would increase by 800-900 ktonnes clinker/annum in order to allow Volyn-Cement to keep the market share. The main incentive to use new kiln with semi-dry process is it’s sensitively better fuel efficiency. Slag would not be added to the raw material mix.

5) Construction of a new wet kiln, 4% of slag addition

Similarly to Alternative 4 above, a new wet kiln(-s) would be built. Slag of 4% would be added to the raw materials.

6) Construction of a new wet kiln, 15% of slag addition

Similarly to Alternatives 4 and 5 above, a new wet kiln(-s) would be built. Slag of 15% would be added to the raw materials.

7) Construction of a new semi-dry kiln, no slag addition

In this scenario a new semi-dry dry kiln would be built at the same site to partially replace existing wet kilns, which will be mothballed or demolished. The new semi-dry kiln would have capacity of approximately 6000 t/day and would operate together with 2 out of three existing wet kilns of capacity 53 t/h. The third kiln and four smaller wet ones will be mothballed.

The new configuration will be able to meet the expected market demand and will be in line with Ukrainian rules and regulations. Total clinker production would increase by 800-900 ktonnes clinker/annum in order to allow Volyn-Cement to keep the market share. Slag would not be added to the raw material mix.

8) Construction of a new semi-dry kiln, 4% slag addition

Similarly to alternative 7 above a new semi-dry kiln(-s) would be built to be operated together with existing wet kilns. Total clinker production would increase by 800-900 ktonnes clinker/annum in order to allow Volyn-Cement to keep the market share. Slag of 4% would be added to the raw material mix.

9) Construction of a new semi-dry kiln, 15% slag addition

Similarly to alternatives 7 and 8 a new semi-dry kiln(-s) would be built to be operated together with existing wet kilns. Total clinker production would increase by 800-900 ktonnes clinker/annum in order to allow Volyn-Cement to keep the market share. Slag addition would me increased to 15% to the raw material mix.

This Alternative represents the proposed JI project in which Volyn-Cement would increase the addition of slag to 15% and construct a new semi-dry kiln of 6000 tonne of clinker a day to operate together with part of existing wet capacity. It does not take any JI incentive (transferring ERUs) into account. The required investment would be approximately 190 million Euro. This alternative would become fully possible with the increase of slag addition in 2010 and commissioning of the dry kiln expected in early 2010.

Assessment of the alternative scenarios
Volyn-Cement is producing cement for the Ukrainian market. Within this market Volyn-Cement should work within the following constraints:

- The cement market is a competitive market;
- The factory should meet the quality requirements of its clients;
- The factory should be able to meet the growing demand for cement on the Ukrainian market;
- And the factory should be profitable at the same time.

Volyn-Cement started producing cement by applying a wet process since the very beginning. The wet process was the predominant technology that was implemented in the Soviet Union. The main reason to use a wet process was the ease in raw material handling and to control the quality of the cement. Second important reason was the natural moisture of raw materials which reaches 24%. Energy efficiency was not considered to be high priority at that time.

The seven existing kilns can be operated at least till 2012 (see section C.2).The clinker production, given all the existing kilns will be operated as they do now, will be approximately 1.835 million ton a year. Blast furnace slag (BFS or slag) would not be added to the raw material mix.

Assessment of alternative 1: Production of clinker without slag addition and using a wet process
The wet process is the predominant cement making technology in Ukraine and Volyn-Cement can continue to use the wet process. Slag addition is also not common to most of plants. There are no legal or other requirements which would enforce Volyn-Cement to discontinue using wet production process. The existing kilns can continue operation till at least 2012. No additional investment is required. Thus, the Alternative 1 is reasonable and feasible one.

Assessment of alternative 2: Production of clinker adding 4% of slag to the raw mix and using a wet process
Similarly to Alternative 1, Volyn-Cement could continue producing clinker at the existing facilities and continue using slag as a part of raw mix in 4% proportion. This alternative constitute in continuation of existing situation at Volyn-Cement, it is a reasonable and feasible alternative.

Assessment of alternative 3: Production of clinker adding 15% of slag to the raw mix and using a wet process.
Wet process can be continued, while significant increase of slag proportion faces difficulties. The most important is the weak financial performance of slag addition due to rise of blast furnace slag cost. Please, refer to section B2 where the proof of non-profitability of slag increase is provided. Hence, the alternative 3 is not a reasonable alternative.

Assessment of alternative 4: Construction of a new wet kiln, no slag addition.
In this Alternative a new wet kiln(-s) would be built to be operated together with existing wet kilns. Total clinker production would increase by 800-900 ktonnes clinker/annum in order to allow Volyn-Cement to keep the market share. Slag would not be added to the raw material mix. Wet process has been already used at the site, it is well known and its construction and operation will not face technical

and staff training difficulties. However, wet kilns are considered to be an obsolete technology. Given the fact that energy prices are constantly rising, this alternative can not be considered as a reasonable and feasible alternative. Moreover, this alternative is not conservative in terms of greenhouse gas emissions.

Assessment of alternative 5: Construction of a new wet kiln, 4% slag addition.
Similarly to Alternative 4 above, this alternative would not lead to implementation of a new process. Slag addition at the level of 4% is similar to the current situation at the plant. However, wet kilns are now a days considered to be an obsolete technology. Given the fact that energy prices are constantly rising, this alternative can not be considered as a reasonable and feasible alternative.

Assessment of alternative 6: Construction of a new wet kiln, 15% slag addition.
Similarly to Alternatives 4 and 5 above, this alternative would not lead to implementation of a new production process. Slag addition would be increased to a 15% level. Please, refer to section B2 where the proof of non-profitability of slag increase is provided. Hence, the alternative 6 is not reasonable.

Assessment of alternative 7: Construction of a new semi-dry kiln, no slag addition.
The application of semi-dry process provides significant increase in fuel efficiency, changing from wet-to-semi-dry requires a significant investment plus the application of new technology in Ukraine. Estimated project cost would be approximately 190 million Euro. The financial performance of the project is however week as described in section B2, so this option could not be regarded feasible.

Assessment of alternative 8: Construction of a new semi-dry kiln, addition of 4% slag.
Similarly to alternative 7 above, high investment cost make the alternative not attractive as is described in section B2. Therefore, this alternative could not be regarded feasible.

Assessment of alternative 9: Construction of a new semi-dry kiln, addition of 15% slag.
This Alternative represents the proposed JI project in which Volyn-Cement would increase the addition of slag to 15% and construct a new semi-dry kiln of 6000 tonne of clinker a day to operate together with part of existing wet capacity. It does not take any JI incentive (transferring ERUs) into account. The required investment would be approximately 190 million Euro. This alternative would become fully possible with the increase of slag addition in 2010 and commissioning of the dry kiln expected in early 2011. However, in section B.2 it is proven that this Alternative in not an economically attractive course of action and faces barriers.

Conclusion
Only Alternatives 1 and 2 are realistic and credible alternatives. In accordance with many CDM methodologies, "when more than one credible and plausible alternative remains, as a conservative consumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario"[8].

Alternative 2 is the remaining realistic and credible alternative with the lowest emissions and is identified as the baseline scenario.

The baseline emissions of alternative 2 are elaborated in section D.

[8] AM0040, page 5.

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

The latest "Tool for demonstration and assessment of additionality (version 05)" has been applied to show that the anthropogenic emissions of the greenhouse gases are reduced below those that would have occurred in the absence of the JI project.

Preliminary screening
a) The project activity has not been started yet and the JI activity will start after 1st January 20102. The construction of the project is expected to start, pending JI and board approval, in 2010 with the new kiln to be commissioned in 2012.

b) Due to the expected low economic performance of the investment additional revenue from JI has been taken into account from the very beginning of the project development activities. The following documents are available providing evidence:

1. On the 6th of June 2007 a report was prepared for Dyckerhoff to make a preliminary assessment of the JI eligibility of the project and to estimate of the emission reduction potential;
2. On the 3rd of July 2007 a presentation concerning Kyoto and JI was given to the management of Dyckerhoff;
3. In October 2007 a Project Idea Note was prepared and presented to the Ukrainian Ministry of Environment (MoE);
4. On the 8 of November 2007 the MoE had issued a Letter of Endorsement #12036/11/10-07 supporting the project at Volyn-Cement.

Step 1. Identification of alternatives to the project activity

The identified alternatives are identical to the alternatives mentioned in section B.1.

Step 2. Investment analysis

Sub-step 2a. Determination of the analysis method
Both subprojects generate cost savings so cost analysis (sub-step 2b Option I) of the CDM Additionality Tool version 05) can not be used. The investment options (alternative scenarios) considered above, are unlikely to be implemented so an investment analysis (Option II), based on comparison of NPV and other indicators for different project options is also not applicable. Thus in line with the CDM Additionality Tool version 05 Option III – benchmark analysis - is relevant for the presented subprojects. The Tool recommends to use three methodological approaches for IRR benchmark definition specified in Section 4 – 4a, 4b, 4c.

The 4a approach of Option III is usually used in the absence of 4b and 4c opportunities. Conversion from dry to semi-dry method of cement production is not a common practice in Ukraine. So it is not possible to find the risk factor or IRR benchmark for similar projects in Ukraine and use directly or make necessary adjustments. It implies that in line with the Tool approach 4a and 4b for sub-step 2b Option III can not be used. All investment decisions in Dyckerhoff AG are taken in line with internal document "Capex guideline: Dyckerhoff AG and subsidiaries" where the discount rate for the calculation NPV of project assessed is specified. Thus in the additionality analysis presented below approach 4c for sub-step 2b of Option 3 III will be applied (company internal benchmark).

Sub-step 2b. Application of the benchmark analysis

Dyckerhoff AG Capex Guidelines specify the discount rate of 15 % for project NPV calculation. This means that the company does not consider the investment projects proposals generating positive discounted cash flow with IRR less than 15%. At the same time the Dyckerhoff management during the last years has been approving the projects with payback period not exceeded 5 years from the year of the last investment. This fact is documented though not explicitly specified in Capex Guidelines. That means that IRR benchmark is project specific highly depending on investment cost and project revenue generation.

Sub-step 2c. Calculation and comparison of the indicators

The project cash flow analysis was performed separately for two subprojects described above:

- Subproject 1 (SP1) – change of slag share in clinker produced;
- Subproject 2 (SP2) – conversion to semi-dry method of cement production.

Though the first subproject is smaller it is considered to be the first due to the specifics of decision making process.

The calculations in cash flow for SP1 are clinker based while for SP2 - cement based. Due to the specifics of cement production all costs are calculated per ton of clinker produced. SP1 results in changes of cost only while in line with SP2 the cement capacity will be increased bringing additional sales revenues. Thus to be consistent the SP2 cash flow should include indicators per ton of cement and not per ton of clinker.

The investment cost for SP1 amounts to Euro 2.7 million while to SP2 – Euro190 million. Both investment costs are likely to be increased 15-20% during procurement deals negotiations. But in cash flow analysis the conservative investment cost assessments are used.

The key assumptions for both subprojects are presented below:

1. All prices and rates are taken constant as per 1 December 2007;
2. Clinker and cement production are based on full technical capacity (taking into account necessary repair time and other factors) use;
3. Four smallest kilns will be completely scrapped while kiln #4 remains as reserve.
4. Conversion from gas to coal takes place before these subprojects are implemented so all cost and savings calculations are coal based only;
5. both projects result in coal savings;
6. SP12 has savings on maintenance and labour cost due to the reduction of quantity of kilns used and concentration of clinker production process on the same sub-site.
7. Extra sales revenues due to the cement capacity increase were taken into account in SP2 cash flows ;
8. The change of slag composition from 4 to 15% in SP 1 causes savings in chalk, clay and loam and cost increase of kaolin and Fe oxide.
9. Project life time is and 10 years for SP1 and 40 years (kiln) for SP2.

The subprojects have the following financial indicators specified in the table below:

Project/Indicator	IRR (%)	Payback Period (years)
SP1	Does not exist (NPV is never positive)	Is longer than the project life time
SP2	13	Is longer than the project life time

Table 7: Financial indicators of subprojects, base case

Both projects do not look financially attractive given full capacity is used and current prices are taken as constant.

Sub-step 2d. Sensitivity analysis
The Sensitivity analysis is presented below for each subproject separately.

Subproject 1
The following scenarios were considered for *SP1:*
- *Scenario 1* – coal price up 10%;
- *Scenario 2* – slag price 20% up;
- *Scenario 3* – raw materials price 20% up.

The company expects around 10% coal price growth next year. The coal prices in Ukraine are regulated by the Government that plans to increase them. In any case the highest margin for coal price in Ukrainian market is the world price. International experts[9] consider that price growth peak will be reached in 2009. The peak level forecasted does not exceed 10% of thermal coal price provided by the Company. The same assumption is proposed for SP2.

A 20% price growth for the other raw materials (except slag) per year is realistic as it is lower than expected inflation rate. Slag price increased several times in 2007. In any case slag cost growth is the biggest negative operation cost inflow. Therefore higher price expectations will negatively impact the final cash flow. Thus proposed 20% increase may be considered conservative. The kaolin and iron oxide cost growth does not contribute much to the cash flow result and were not included in the Sensitivity analysis.

The Sensitivity analysis results for *SP1* are summarised in a table below.

Scenario/Indicator	IRR (%)	Payback period (years)
Scenario 1	8	Longer than the project life time
Scenario 2	Does not exist	Longer than the project life time
Scenario 3	3	Longer than the project life time

Table 8: Sensitivity Analysis Summary for SP1

As it can be seen from the Table above quite significant price fluctuations of the main cost components do not make the project more financially attractive thus proving the robustness of cash flows for SP2 and his additionality in line with the CDM Additionality Tool version 05.

Subproject 2
The following scenarios were proposed for *SP1* for the key revenue driving indicators to check the robustness of cash flow financial indicators:
- *Scenario 1*: coal price 10% up;
- *Scenario 2*: cement price 23% up;
- *Scenario 3*: maximum possible production increase (11% of extra sales)
- *Scenario 4* cement price 39% up.

9 UN Credits increased price for the coke coal http://www.metal-trade.ru/news/2007/11/21/news_90266.html?template=11

We did not consider downward trends of the monetary indicators as prices unlikely go down. As for production volumes this scenario would worsen the existing picture. In this case the most significant revenue inflow due to extra sales will be decreased.

For cement we consider a price increase for more than 20% that may be relevant for the nearest years due to the emerging character of the Ukrainian cement market. So using such high distortions proves our conclusions to be firm and reliable.

Scenario 1 was developed as described above. As it is clearly seen from the Table 4 below the coal savings do not contribute significantly to the project financial performance. IRR is at the same 13% level as in the base case and payback period can not be identified within the project life time.

Scenario 3 considered the use of reserved kiln #4 that will be in operation only during the high season (three summer months). It can not be used more due to the limited capacity of coal mills. So 11% increase of cement extra sales is the maximum possible cement production increase. It improves IRR to one point still keeping it below the discount rate. So this can not be considered as cash flow robustness distortion factor.

Scenarios 2 and 4 consider different assumptions on cement price growth – 23% and 39% respectively. Publicly available forecasts on cement price expectations on Ukrainian market are based on expected natural gas price increase and its impact on production and transportation cost of cement. As soon as our JI project is coal based and cement price used in cash flows does not include transportation cost we can not use them as the basis for comparison. In macroeconomic analysis cement industry development is always correlated with GDP dynamics. Official optimistic forecasts presume 7% annual growth of GDP thus resulting in 23% in 2012 when the project is commissioned. This is considered to be realistic cement price growth and serves as the basis for *Scenario 2.*

Scenario 4 assumption is based on public information on current maximum European cement prices. The maximum cement price is in Poland and when corrected to VAT and transportation cost it is 39% higher than Volyn-Cement price[10]. This figure is used for the highest range of cement price increase. We do not consider it relevant to analyse the implications of more than 39% price growth. The situation in Europe with saturated demand and stable and excessive capacities impacts internal cement prices in Ukraine. Due to the lower cement prices in some countries (German cement is sold at 70 Euro price as states the source mentioned[11]) Ukrainian cement consumers can import European cement instead of more expensive local one, levelling the internal price fluctuations.

Both *Scenarios 2 and 4* result in IRR higher than discount rate 18% and 22 % consequently. But in both case payback period is higher than 5 years accepted (13 and 9 years respectively).

The results of the Sensitivity analysis for *SP2* are presented in the summary table below.

[10] Media report: http://www.rbcdaily.ru/2007/08/29/industry/289638 ·

[11] Media report http://www.snegirigroup.ru/yekonomika/news_2007-09-20-00-31-19-433.html ·

Scenario/Indicator	IRR (%)	Payback period (years)
Scenario 1	13	Longer than the project life time
Scenario 2	18	13
Scenario 3	14	Longer than the project life time
Scenario 4	22	9

Table 9: Sensitivity Analysis Summary for SP2.

Calculations demonstrate that a five year pay back period is reached only when cement price grows 80%. In this case IRR is 31% and this figure should be considered as IRR benchmark for SP2.

So though some scenarios result in IRR exceeding the discount rate none of scenarios meet the five year payback threshold. Thus the project is not an attractive course of action in line the CDM Additionality Tool version 05. Hence the project is additional.

Step 3. Barrier analysis

Sub-step 3a. Identification of barriers that would prevent the proposed JI project

Investment barriers.
The estimated investment cost to be allocated by Dyckerhoff into Volyn-cement reaches 190 million Euro. Investments of such size are comparable to construction of new facility and will require external long-term debt financing. Ukrainian banking system due to it's weakness at present is unable to consolidate long term credit of that size, besides the fact, that local interest rates are significantly higher. Due to the perceived high country risk of Ukraine attracting international capital at reasonable terms would be difficult, also given the fact that the project involves technology that is new to Ukraine.

The absence of domestic and international financing possibility for Volyn-Cement constitutes a barrier for the proposed project activity.

Technological barriers and prevailing practice barriers:
Since the start of industrial production of Portland cement in XIX century, few technological breakthroughs were implemented in the process. Firstly, it is the introduction of rotary kilns in late nineteenth century instead of low capacity shaft kilns.

Development of cement industry was driven by capacity and quality increase and in the 1960s the dry process became standard in the western economies. The dry process gives significant advantages in terms of efficiency of fuel usage.

Next important step was the development the pre-calciner technology which assumes calcinations (and pre-heating) of raw materials in a separate vertical tower. This allows better to recover the kiln exhaust heat and use much shorter rotary kilns. The exceptions to the common trend of dry process are these cases, where the high moisture of raw materials makes it impossible to use dry technology.

Unlike the Western world trend, in all the former Soviet Union countries the wet process is still predominant (Ukraine 85% of production in 2006 and 92% of installed clinker capacity[12]). Partly it can be explained by high moisture content of ram material deposits available, but the main reason was the

[12] UkrCemForum 2007, international conference, UkrCement Accociation Report: Ukrainian cement industry…http://ukrcement.com.ua/?sect=wiki&wiki_id=7&page=1

subsidized fuel prices. In Ukraine, apart from two cement plants using dry process and being built in 1970s, no other producers have experience of construction and operation of technology other than wet.

In addition, semi-dry process, being different from both, wet and dry, has no operating examples anywhere in Ukraine, therefore, from this point of view, the proposed project can be considered "first of it's kind" in the country cement sector.

Therefore, the prevailing practice of wet process and lack of technical expertise for dry and semi-dry process in addition to absence of semi-dry examples represent a barrier to the proposed JI project activity.

Step 4: Common practise analysis
Wet production of cement is common practice in Ukraine and neighbouring Belarus and Russia. The available raw materials generally contain excessive moisture.

The most recently commissioned kilns in the immediate region are those successfully commissioned by OAO Krasnoselkmaterialy in 2000 and 2002. These reliable units are wet kilns with a total capacity of 900 000 tonnes per annum and use wet chalk as the main raw material.

In 1997 at Chelm, close to the Polish-Ukrainian border, Cementownia Chelm SA successfully commissioned a new kiln specially designed for the marl and limestone available in the area, which contain 22 – 25 % moisture. The kiln was not a conventional dry process system but featured a special dryer crusher to accommodate the wet materials.

A new *dry* kiln is planned at Podilsky Cement Ukraine. On the 27th of March 2007 the determination of this JI project was by final at the JI Supervisory Committee. As this new kiln is additional to what would have occurred otherwise, this project does not have to be taken into consideration.

No new cement kilns have been commissioned in Ukraine in recent years. Except for the new dry kiln at Podilsky Cement Volyn-Cement is not aware of new kiln projects that have been commissioned in the past three years.

The proposed JI project activity is not common practice.

Conclusion
The registration of the proposed JI activity will:
- Allow for the largest single investment in the Ukrainian cement industry since it's independence to be made;
- Give the Volyn-Cement access to the necessary modern technology and experience.

Conclusion: the impact of the proposed JI project activity will alleviate the economic/financial hurdle and will alleviate barriers to the project. The project is additional.

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:
- Fuel combustion;
- Geogenic emission from the calcination (decarbonisation) process;
- GHG emission in the Ukrainian Power grid as a result of electricity consumption.

In the table below an overview of all emission sources in the cement production process are given. The following approach has been used in determining whether they have been included in the project boundary:

- All sources of emissions that are not influenced by the project have been excluded;
- All sources of emissions that are influenced by the project have been included.

No	Source	Gas[13]			Justification/Explanation
1	Change in fuel consumption at the quarry and raw material transport	CO_2	Direct	Excluded	• Fossil fuel consumption will not be influenced by the project[14]
2	Change in grid electricity consumption at the quarry	CO_2	Indirect	Excluded	• Electricity consumption will not be influenced by the project
3	Change in grid electricity in the raw material transport: Wet: Wet slurry mixing, pumping; Semi-dry: Conveying of raw meal.	CO_2	Indirect	Included	• The electricity consumption will decrease • Emissions calculated using standardized electricity baseline Ukraine[15]
4	Change in grid electricity consumption at the raw milling preparation: Wet: Wet slurry mixing, pumping; Semi-dry: Milling, mixing, conveying of raw meal.	CO_2	Indirect	Included	• The electricity consumption will decrease • Emissions calculated using standardized electricity baseline Ukraine[16]
5	Change in electricity consumption of the kiln (e.g. motors for rotation, fans)	CO_2	Indirect	Included	• The electricity consumption will decrease • Emissions calculated using standardized electricity baseline Ukraine
6	Change in fossil fuel combustion in kiln	CO_2	Direct	Included	• The fossil fuel combustions will decrease
7	Change in grid electricity consumption at the coal mill	CO_2	Indirect	Included	• The electricity consumption will decrease • Emissions calculated using standardized electricity baseline Ukraine
8	Fuel combustion to dry the coal	CO_2	Direct	Included	• In the project scenario the heat generator will be installed to dry the coal

[13] Only CO_2 emissions are taken into account. CH_4 and N_2O emission reduction are omitted. This is conservative and is in line with all cement CDM methodologies mentioned in section B.1. Please refer also to the general remarks in section D.1.

[14] Raw materials extraction stays the same in both baseline and project scenarios

[15] Volyn-Cement does not have on-site power generation facilities.

[16] Volyn-Cement does not have on-site power generation facilities.

9	Change in geogenic emission (calcination)	CO_2	Direct	Included	• The specific geogenic emission from calcination will be decreased due to use of slag in raw material.
10	Change in grid electricity consumption at the cement mill, adding mineral components and packaging	CO_2	Indirect	Included	• Electricity consumption will decrease in the project.
11	Change in grid electricity consumption at railroads due to increased slag transportation	CO_2	Leakage	Included	• Represents project leakage

Table 10: Sources of emissions

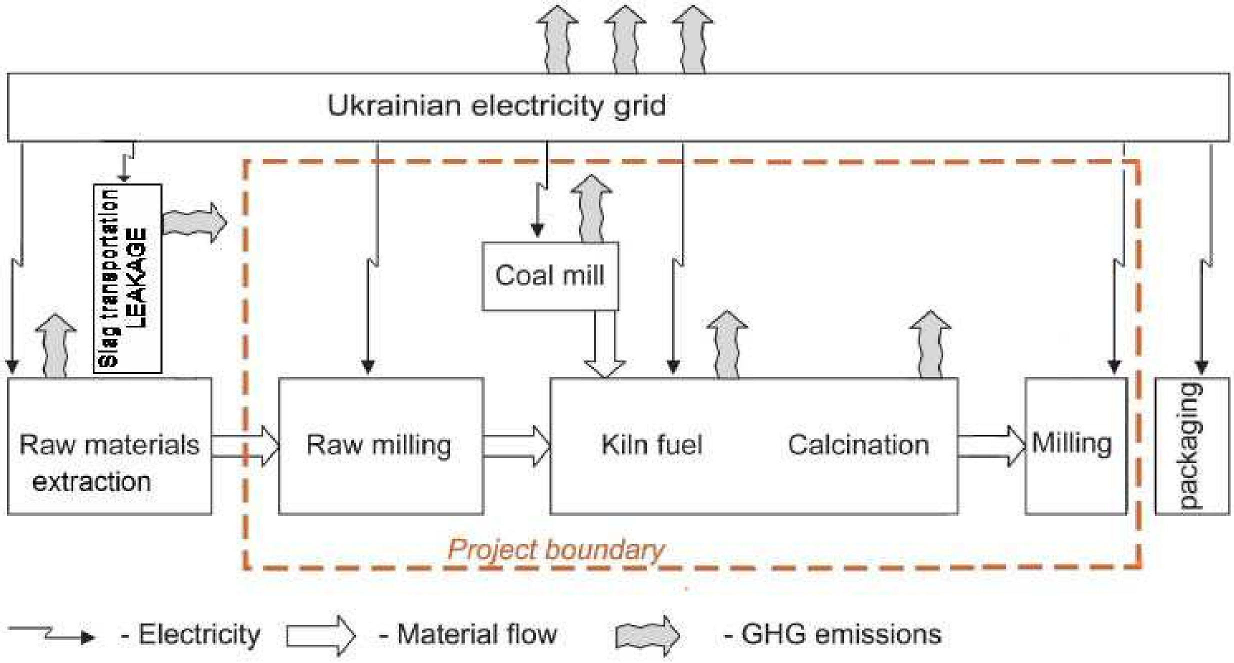

Figure 5: Sources of emissions and project boundary

Please see section E for detailed data of the emissions within the project boundary.

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: 18/02/2010

Name of person/entity setting the baseline:

- Global Carbon BV

See annex 1 for detailed contact information.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Date of commissioning: 1 January 2010 for increase of slag addition as raw material and 1 July 2012 for start of operation of new semi-dry kiln.

C.2. Expected operational lifetime of the project:

At least 30 years.

Essentially this is a project for a kiln and raw mill system. The lifetime achieved of such systems is in excess of 30 years, with many examples exceeding even 40 to 50 years. During lifetime, cement kilns can undergo many repairs and replacements of refractory materials, after which they can continue operating. Operating kilns within the Dyckerhoff AG group include the following:

Name of Plant	Country	Kiln	Age
Geseke	Germany	Kiln#1	1962
Deuna	Germany	Kiln#2	1976
Göllheim	Germany	Kiln#2	1965
Lengerich	Germany	Kiln#1	1978

Table 11: Some examples of operating dry process kilns within the Dyckerhoff Group

Volyn-Cement Kilns, constructed in the period of 1956 to 1963 were properly overhauled and maintained and can continue operation until the economically driven decision is made to reconstruct or to mothball them.

C.3. Length of the crediting period:

Within the first commitment period:
- Three years (1/1/2010 – 31/12/2012)

Within any relevant agreement under the UNFCCC from 2013 onwards:
- For the duration of the agreement but not more than the remaining operational lifetime of the project (twenty six years)[17]

[17] As discussed by the JISC in its third meeting.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

As elaborated in section B.3, the project activity only affects the emissions related to the kiln fuel, calcination (decarbonisation) the electricity consumption of the raw milling, the kilns and the coal mill, plus the emission from the heat generator of the coal mill. For the purpose of establishing the baseline emissions and to monitor the project emissions, only these emissions will be monitored.

The baseline emissions are established in the following way:

1. The baseline emission of the kiln fuel over the existing capacity is based on a three years average kiln efficiency and the carbon emission factor of the (mix of) fuel used in the project scenario. this approach is identical to the approach used in the project JI0001 “Switch from wet-to-dry process at Podilsky Cement” which determination was made final;
2. The baseline emissions of the grid are established using the Ukrainian standardized grid factor as mentioned in annex 2;
3. The baseline emissions of the incremental production are established using the Combined Margin approach as given in annex 2.

Assumptions:

- The emissions at the quarry remain the same;
- The type of fuel combusted in the kiln is not influenced by the project;
- The technical life time of the existing kiln extends to at least the end of the crediting period;
- Under the baseline scenario all existing wet kilns will be operating and will produce at maximum technical capacity;
- No energy efficiency measures will be implemented on the existing wet kilns until the end of the crediting period.

General remarks:

- In consultation with the verifier, the monitoring plan will be updated prior to the commissioning of the project;
- Social indicators such as number of people employed, safety record, training records, etc, will be available to the verifier if required;
- Environmental indicators such as dust emissions, NOx, or SOx will be available to the verifier if required;
- Should less wet kiln be decommissioned as described in section A.4.2, the emissions of these kilns will be monitored accordingly.
- To allow commissioning of the raw mill system, a heat generator will be installed to allow the crusher-dryer to produce the first raw meal before the kiln start. Conventionally, this heat generator is not required thereafter. It is not included in the project monitoring plan. In the event of its operation being required thereafter, it will be added to the plan.

- For the greenhouse gas emissions only the CO_2 emissions are taken into account. Cement kilns normally have a CH_4 emission of 0.06 g/kg of clinker and N2O emissions of 0.001 g/kg of clinker compared with more than 650 g CO2 / kg of clinker. Omitting these two emissions for a cement kiln is conservative, because they contribute to less than 0.01% of the total emissions, far below the confidence level for the CO2 data calculations. This is confirmed in the VDZ Environmental Report 2001 (English) and 2004 (German). The CH_4 and N_2O emission reductions will not be claimed. This is conservative.

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 this 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) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P1	PE_y	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P2	$PE_{calc,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P3	$PE_{calc\_wet,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P4	$PE_{calc\_s\text{-}dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P5	$PE_{kiln,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P6	$PE_{kiln\_wet,y}$	Plant records	tCO_2	c	Annually	100%	Electronic and paper	

P7	$PE_{kiln\_s-dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P8	$PE_{dust,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P9	$ByPass_{s-dry,y}$	Plant records	tonnes	m/c	Annually	100%	Electronic and paper	Annual test will be performed
P10	$CKD_{s-dry,y}$	Plant records	tonnes	m/c	Annually	100%	Electronic and paper	The value of $CKD_{s-dry,y}$ is expected to be very low, approximately 120 t/year due to high efficiency of ESP of kiln exhaust gases
P11	$D_{s-dry,y}$	Plant records	tonnes	m/c	Annually	100%	Electronic and paper	
P12	$PE_{RM,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P13	$PE_{RMwet,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P14	$PE_{RMs-dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P15	$PE_{coal,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P16	$PE_{coal\_electr,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P17	$PE_{coal\_fuel,y}$	Plant records	tCO_2	c	Annually	100%	Electronic and paper	

P18	$PE_{slag,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P19	$PE_{grind,y}$	Plant records	tCO_2	C	Annually	100%	Electronic and paper	
P20	$EF_{el,y}$	Plant records	tCO_2/ MWh	C	Annually	100%	Electronic and paper	Baseline carbon emission factors for JI projects reducing electricity consumption[18]. See annex 2.
P21	$EF_{fuel\_i,y}$	Plant records	tCO_2/ GJ	c	Annually	100%	Electronic and paper	
P22	NCV_{fuel_i}	Plant records	GJ/tonne	m/c	Per shipment	100%	Electronic and paper	Weighted average of all shipments will be taken over a calendar year for each fuel.
P23	$CLNK_{PR\_wet,y}$	Plant records	tonnes	M	Annually	100%	Electronic and paper	
P24	$CaO_{clnk\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P25	$MgO_{clnk\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P26	$RM_{PR\_wet,y}$	Plant records	tonnes	M	Annually	100%	Electronic and paper	
P27	$CaO_{RM\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement

[18] “Operational Guidelines for Project Design Documents of Joint Implementation Projects”, Version 2.3

P28	$MgO_{RM\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P29	$CLNK_{PR\_s-dry,y}$	Plant records	tonnes	M	Annually	100%	Electronic and paper	
P30	$CaO_{clnk\_PR\_s-dry,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P31	$MgO_{clnk\_PR\_s-dry,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P32	$RM_{PR\_s-dry,y}$	Plant records	tonnes	M	Annually	100%	Electronic and paper	
P33	$CaO_{RM\_PR\_s-dry,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P34	$MgO_{RM\_PR\_s-dry,y}$	Plant records	%	M	daily	100%	Electronic and paper	Volyn-Cement plant laboratory measurement
P35	$FF_{fuel\_i\_wet,y}$	Plant records	tonnes	M	continuously	100%	Electronic and paper	The metering of fuel consumption will be designed consistent with the monitoring plan.
P36	$FF_{fuel\_i\_s-dry,y}$	Plant records	tonnes	M	continuously	100%	Electronic and paper	The metering of fuel consumption will be designed consistent with the monitoring plan.
P37	$EL_{RM\_wet,y}$	Plant records	MWh	M	Continuously	100%	Electronic and paper	The monitoring of electricity consumption will be designed consistent with the monitoring plan. Calibration frequency will be in accordance with instructions of suppliers.
P38	$EL_{RM\_s-dry,,y}$	Plant	MWh	m	Continuously	100%	Electronic	The monitoring of electricity consumption will be designed consistent with the monitoring plan.

		records					and paper	Calibration frequency will be in accordance with instructions of suppliers.
P39	$EL_{mill\&conway,y}$	Plant records	MWh	M	Continuously	100%	Electronic and paper	The monitoring of electricity consumption will be designed consistent with the monitoring plan. Calibration frequency will be in accordance with instructions of suppliers.
P40	$FC_{dryer,y}$	Plant records	GJ	m/c	Continuously	100%	Electronic and paper	Fuel for dryer's heat generator can be both, natural gas or coal
P41	$EL_{slag,y}$	Plant records	MWh	M	Continuously	100%	Electronic and paper	The monitoring of electricity consumption will be designed consistent with the monitoring plan. Calibration frequency will be in accordance with instructions of suppliers.
P42	$EL_{grind,y}$	Plant records	MWh	M	Continuously	100%	Electronic and paper	The monitoring of electricity consumption will be designed consistent with the monitoring plan. Calibration frequency will be in accordance with instructions of suppliers.
P43	$FC_{slag,y}$	Plant records	GJ	m	Continuously	100%	Electronic and paper	The monitoring of fuel consumption will be designed consistent with the monitoring plan. Calibration frequency of the meter will be in accordance with instructions of suppliers.

Table 12: Data to be collected in order to monitor emissions from the project

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

$$PE_y = PE_{calc,y} + PE_{kiln,y} + PE_{dust,y} + PE_{RM,y} + PE_{coal,y} + PE_{slag,y} + PE_{grind,y} \quad (1)$$

Where:
PE_y Project emission in year y (tCO_2)
$PE_{calc,y}$ Project emission due to calcinations in year y (tCO_2)
$PE_{kiln,y}$ Project emission from combustion of kiln fuels in year y (tCO_2)
$PE_{dust,y}$ Project emission due to discarded dust from kiln bypass in year y (tCO_2)
$PE_{RM,y}$ Project emission due to fuel and electricity consumption for raw meal preparation (drying, milling, handling) and kiln electricity consumption (tCO_2)
$PE_{coal,\ y}$ Project emission due to kiln fuel (coal) preparation (grinding, drying, conveying) in year y (tCO_2)
$PE_{slag,y}$ Project emission due to slag preparation in year y (tCO_2)
$PE_{grind,y}$ Project emission due to grinding of clinker (tCO_2)

Calcination
Raw meal for wet and semi-dry kilns is prepared separately using different equipment. The parameters of the raw meal for wet and semi-dry might be different and it is necessary to measure them separately as well.

$$PE_{calc,y} = PE_{calc\_wet,y} + PE_{calc\_semi-dry,y} \quad (2)$$

Where: $PE_{calc\_wet,y}$ and $PE_{calc\_semi-dry,\ y}$ are project emissions due to raw mill calcinations in year y in wet and semidry kilns respectively (tCO_2).

They are defined as follows:

$$PE_{calc\_wet,y} = 0.785(CLNK_{PR\_wet,y} \times CaO_{CLNK\_PR\_wet,y} - RM_{PR\_wet,y} \times CaO_{RM\_PR\_wet,y}) + \\ +1.092(CLNK_{PR\_wet,y} \times MgO_{CLNK\_PR\_wet,y} - RM_{PR\_wet,y} \times MgO_{RM\_PR\_wet,y}) \quad (3)$$

Where:
0.785 is the stoichiometric emission factor for CaO (tCO2/tCaO)
1.092 is the stoichiometric emission factor for MgO (tCO2/tMgO)
$CaO_{CLNK\_PR\_wet,y}$ is the non-carbonate CaO content in clinker in % in year y
$CaO_{RM\_PR\_wet,y}$ is the non-carbonate CaO content in raw meal in % in year y
$MgO_{CLNK\_PR\_wet,y}$ is the non-carbonate MgO content in clinker in % in year y
$MgO_{RM\_PR\_wet,y}$ is the non-carbonate MgO content in raw meal in % in year y

$CLNK_{PR\_wet,y}$ is the annual production of clinker in wet kilns in year y (tonnes)
$RM\_{}_{PR\_wet,y}$ is the annual consumption of raw meal of wet kilns in year y (tonnes)

$$PE_{calc\_semi-dry,y} = 0.785(CLNK_{PR\_s-dry,y} \times CaO_{CLNK\_PR\_s-dry,y} - RM_{PR\_s-dry,y} \times CaO_{RM\_PR\_s-dry,y}) + \\ +1.092(CLNK_{PR\_s-dry,y} \times MgO_{CLNK\_PR\_s-dry,y} - RM_{PR\_s-dry,y} MgO_{RM\_PR\_s-dry,y}) \quad (4)$$

Where:
0.785 is the stoichiometric emission factor for CaO (tCO2/tCaO)
1.092 is the stoichiometric emission factor for MgO (tCO2/tMgO)
$CaO_{CLNK\_PR\_s-dry,y}$ is the CaO content in clinker produced by semi-dry kiln in year y (tonnes of CaO/ton clinker)
$CaO_{RM\_PR\_s-dry,y}$ is the non-carbonate CaO content in raw meal for semidry kiln in year y (tonnes CaO/ton raw mill)
$MgO_{CLNK\_PR\_s-dry,y}$ is the MgO content in clinker produced by semidry kiln in year y (tonnes MgO/ton clinker)
$MgO_{RM\_PR\_s-dry,y}$ is the non-carbonate MgO content in raw meal for semidry kiln in year y (tonnes MgO/ton raw mill)
$CLNK_{PR\_s-dry,y}$ is the annual production of clinker in semi-dry kilns in year y (tonnes)
$RM\_{}_{PR\_s-dry,y}$ is the annual consumption of raw mill for semi-dry kilns in year y, (tonnes)

Kiln fuel
There can be different kind of fuels used at the same time, therefore the emissions of each of fuels will be taken into account.

$$PE_{kiln,y} = PE_{kiln\_wet,y} + PE_{kiln\_semi-dry,y} \quad (5)$$

Where:
$PE_{kiln\_wet,y}$ is the project emission due to kiln fuel combustion in wet kilns in year y (tCO_2)
$PE_{kiln\_semi-dry,y}$ is the project emission due to kiln fuel combustion in semi-dry kilns in year y (tCO_2)

The emissions due to combustion of fuel of type *i* in wet kilns above are defined as follows:

$$PE_{kiln\_wet,y} = \sum_i FF_{fuel\_i\_wet,y} \times EF_{fuel\_i,y} \times NCV_{fuel\_i,y} \quad (6)$$

Where:

$FF_{fuel\_i\_wet,y}$ is the wet kilns fuel of type *i* consumption in year y (tonnes)
$NCV_{fuel\_i,y}$ is the Net Calorific Value of fuel of type *i* in year y (GJ/ton)
$EF_{fuel\_i,\ y}$ is the fuel of type *i* Emission Factor (tCO_2/GJ)

$$PE_{kiln\_semi-dry,y} = \sum_i FF_{fuel\_i\_s-dry,y} \times EF_{fuel\_i} \times NCV_{fuel\_i,y} \quad (7)$$

Where:
$FF_{fuel\_i\_s-dry,y}$ is the semi-dry kiln fuel of type *i* consumption in year y (tonnes)
$NCV_{,fuel,y}$ is the Net Calorific Value of fuel *i* in year y (GJ/ton)
$EF_{fuel\_i,\ y}$ fuel of type *i* Emission Factor (tCO_2/GJ)

Raw mill preparation and kiln electricity consumption

Raw material preparation uses different equipment for wet and semi-dry kilns, the electrical consumption of different drives also can differ. The raw materials for wet process is mixed with water and pumped to the plant, while the raw material for semi-dry process will be transported to the plant via a belt conveyor. Similarly to the raw material preparation, the wet and semi-dry kilns also differ in number and power of motors used to rotate kilns, drive the fans etc. The formula below is used to calculate the emission due to electricity consumption of raw material transportation to the site, raw material preparation and kiln electricity consumption.

$$PE_{RM,y} = PE_{RM\_wet,y} + PE_{RM\_semi-dry,y} \quad (8)$$

Where:
$PE_{RM\_wet,y}$ is the project emission due to electricity consumption for preparation of raw mill used for wet kilns and wet kilns electricity consumption in year y (tCO_2)
$PE_{RM\_semi-dry,y}$ is the project emission due to electricity consumption for preparation of raw mill used for semi-dry kilns and semi-dry kiln electricity consumption in year y (tCO_2)

$$PE_{RM\_wet,y} = EF_{el,y} \times EL_{RM\_wet,y} \quad (9)$$

Where:
$EF_{el,\ y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

$EL_{RM\_wet,y}$ is the electricity consumption of raw meal preparation and electricity consumption of wet kilns in year y (MWh)

$$PE_{RM\_s-dry,y} = EF_{el,y} \times EL_{RM\_s-dry,y} \quad (10)$$

Where:

$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

$EL_{RM\_s-dry,y}$ is the electricity consumption of raw meal preparation and electricity consumption for semidry kilns in year y (MWh)

Coal preparation

$$PE_{coal,y} = PE_{coal\_electr,y} + PE_{coal\_fuel,y} \quad (11)$$

Where $PE_{coal\_electr,y}$ and $PE_{coal\_fuel,y}$ are the project emissions due to electricity consumption for coal milling and conveying and fuel consumption by heat generator used to dry the coal in year y (tCO_2). They are defined as follows:

$$PE_{coal\_electr,y} = EF_{el,y} \times EL_{mill\&convey,y} \quad (12)$$

Where:

$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

$EL_{mill\&convey,y}$ is the electricity consumption for coal milling and conveying in year y (MWh)

$$PE_{coal\_fuel,y} = EF_{fuel\_i,y} \times FC_{dryer,y} \quad (13)$$

Where:

$EF_{fuel\_i,y}$ is the emission factor of fuel of type *i* used in heat generator for drying the coal in year y (tCO_2/GJ)

$FC_{dryer,y}$ is the fuel consumption of heat generator used for drying the coal in year y (GJ)

Slag preparation

The slag preparation and handling require grinding, heating, which therefore results in additional electricity and fuel consumption

$$PE_{slag,y} = EL_{slag,y} \times EF_{el,y} + FC_{slag,y} \times EF_{fuel\_i} \quad (14)$$

Where:

$PE_{slag,y}$ is the project emission due to slag preparation in year y (tCO_2)

$EL_{slag,y}$ is the electricity consumption due to slag milling and handling in year y (MWh)

$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

$FC_{slag,y}$ is the fuel consumption of slag dryer in year y (GJ)
EF_{fuel_i} is the carbon emission factor of fuel combusted in slag dryer, (tCO_2/GJ)

Grinding of clinker

Clinker produced requires grinding (milling). Grinding takes place into ball and rotary mills together with mineral additives. The grinding process consumes significant amount of electricity and therefore results in emissions from electricity grid. Clinker mix from both wet and semi-dry kilns will be grinded.

$$PE_{grind,y} = EL_{grind,y} \times EF_{el,y} \quad (15)$$

Where:
$EL_{grind,y}$ is the electricity consumption of mills grinding clinker with additives in year y, MWh

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
B1	BE_y	Plant records	tCO2	C	annually	100%	Electronic and paper	
B2	$BE_{calc,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B3	$BE_{calc\_wet, y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B4	$BE_{kiln,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B5	$BE_{kiln\_wet,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	

B6	$BE_{RM,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B7	$BE_{RM\_wet,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B8	$BE_{coal,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B9	$BE_{coal\_electr\_wet, y}$	Plant record	tCO2	C	annually	100%	Electronic and paper	
B10	$BE_{coal\_fuel\_wer, y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	
B11	$BE_{slag,y}$	Plant records	tCO_2	C	annually	100%	Electronic and paper	
B12	$BE_{grind,y}$	Plant records	tCO_2	C	annually	100%	Electronic and paper	
B13	$BE_{incr,y}$	Plant records	tCO2	C	annually	100%	Electronic and paper	See annex 2 for explanation
B14	$CLNK_{BL\_wet,y}$	Plant records	tonnes	C	annually	100%	Electronic and paper	
B15	$CEM_{BL\_incr,y}$	Plant records	tonnes	C	annually	100%	Electronic and paper	
B16	$CLNK_{BL\_wet\_cap}$	Plant records	tonnes	C	annually	100%	Electronic and paper	Maximum capacity of all kilns operating in the baseline scenario, see annex 2.

B17	$CLNKFAC_y$	Plant records	%	C	annually	100%	Electronic and paper	
B18	$RM_{BL\_wet,y}$	Plant records	tonnes	C	annually	100%	Electronic and paper	
B19	$RATIO_{RM/CLNK\_wet,y}$	Plant records	tonnes	C	annually	100%	Electronic and paper	
B20	BKE_{wet}	Plant records	GJ/tonne of clinker	m/c	annually	100%	Electronic and paper	This value has been fixed using the average of 2004, 2005 and 2006. See annex 2
B21	$EF_{fuel\_i,y}$	Plant records	tCO2/ GJ	m/c	Per shipment	100%	Electronic and paper	Weighted average of all shipments will be taken over a calendar year.
B22	$BEL_{RM\_wet,y}$	Plant record	MWh/ton of clinker	m/c	annually	100%	Electronic and paper	This value has been fixed using the average of 2004, 2005and 2006. See annex 2
B23	$ELSP_{coalmill\_PR,y}$	Plant record	MWh/ton of coal	C	annually	100%	Electronic and paper	
B24	$FC_{coal\_BL\_wet,y}$	Plant record	Tonnes of coal	C	annually	100%	Electronic and paper	
B25	$FSP_{coalmill\_PR,\ y}$	Plant record	GJ/ton of coal	m/c	annually	100%	Electronic and paper	
B26	$EL_{slag\_incr,\ y}$	Plant record	MWh	M	continuously	100%	Electronic and paper electronic	
B27	$ELSP_{grind}$	Plant record	MWh/t cement	m/c	annually	100%	Electronic and paper electronic	This value has been fixed using the average of 2004,2005and 2006. See annex 2

B28	$EF_{el,y}$	Plant record	tCO2/ MWh	C	Annually	100%	Electronic and paper electronic	Baseline carbon emission factors for JI projects reducing electricity consumption19. See annex 2.
B29	$BEF_{incr,y}$	Plant record	tCO_2/ton of cement	C	annually	100%	Electronic and paper electronic	See annex 2.

Table 13: Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary

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

As further described in annex 2, the baseline emissions consist of two sources: one being the emissions of existing on site wet kilns, the second one is the emissions due to incremental production. The first five items in the formula below reflect the emissions of existing on site wet kilns.

$$BE_y = BE_{calc\_wet,y} + BE_{kiln\_wet,y} + BE_{RM\_wet,y} + BE_{coal,y} + BE_{slag,y} + BE_{grind,y} + BE_{incr,y} \quad (16)$$

Where:

BE_y Baseline emission in year y (tCO_2)
$BE_{calc\_wet,y}$ Baseline emission due to raw mill calcination in existing on site wet kilns in year y (tCO_2)
$BE_{kiln\_wet,y}$ Baseline emission from combustion of fuels in wet kilns in year y (tCO_2)
$BE_{RM\_wet,y}$ Baseline emission due to fuel and electricity consumption for raw meal preparation (drying, milling, handling) and kiln electricity consumption in wet kilns(tCO_2)
$BE_{coal,y}$ Baseline emission due to kiln fuel (coal) preparation (grinding, drying, conveying) in year y (tCO_2)
$BE_{slag,y}$ Baseline emission due to slag preparation in year y (tCO_2)
$BE_{grind,y}$ Baseline emission due to grinding of clinker in year y (tCO_2)
$BE_{incr,y}$ Is the baseline emissions due to incremental production in year y (tCO_2), refer to annex 2 for explanation

[19] "Operational Guidelines for Project Design Documents of Joint Implementation Projects", Version 2.3

Baseline clinker production

In the baseline scenario the existing wet kilns would continue operation with a maximum of their technical capacity and the clinker production on the existing wet kilns in the baseline scenario is as follows:

$$CLNK_{BL\_wet,y} = CLNK_{PR\_wet,y} + CLNK_{PR\_s-dry,y} \text{ with a maximum of } CLNK_{BL\_wet\_cap} \quad (17)$$

Where:

$CLNK_{PR\_wet,y}$ Clinker production on wet kilns in project scenario in year y (tonnes)

$CLNK_{PR\_s\text{-}dry,y}$ Clinker production on semi-dry kiln in project scenario in year y (tonnes)

$CLNK_{BL\_wet\_cap}$ Clinker production capacity on existing wet kilns (tonnes)

Calcination baseline

According to ACM0015 the emission from calcinations (decarbonisation) of raw material containing $CaCO_3$ and $MgCO_3$ into the CaO and MgO with release of CO_2 in the kiln is defined as follows:

$$BE_{calc\_wet} = 0.785(CLNK_{BL\_wet,y} \times CaO_{CLNK\_PR\_wet,y} - RM_{wet,y} \times CaO_{RM\_PR\_wet,y}) + 1.092(CLNK_{BL\_wet,y} \times MgO_{CLNK\_PR\_wet,y} - RM_{wet,y} \times MgO_{RM\_PR\_wet,y}) \quad (18)$$

Where:

0.785	is the stoichiometric emission factor for CaO (tCO2/tCaO)
1.092	is the stoichiometric emission factor for MgO(tCO2/tMgO)
$CaO_{CLNK\_BL\_wet,y}$	is thee CaO content in clinker produced by wet kilns in baseline (tonnes of CaO/ton of clinker)
$CaO_{RM\_BL\_wet,y}$	is the non-carbonate CaO content in raw meal in baseline (tonnes of CaO/ton of raw meal)
$MgO_{CLNK\_BL\_wet,y}$	is the MgO content in clinker in baseline (tonnes of MgO/ton of clinker)
$MgO_{RM\_BL\_wet,y}$	is the non-carbonate MgO content in raw meal in baseline (tonnes of MgO/ton of raw meal)
$CLNK_{BLwet,y}$	is the clinker production on wet kilns in baseline scenario in year y (tonnes)
$RM_{Bl\_wet,y}$	is the consumption of raw meal by wet kilns in baseline scenario in year y (tonnes). It is calculated the following way:

$$RM_{BL\_wet,y} = CLNK_{BL\_wet,y} \times RATIO_{RM/CLNK\_wet,y} \quad (19)$$

Where:

$RATIO_{RM/CLNK\_wet,y}$ is the ratio between raw meal consumed to clinker produced by wet kilns measured in project scenario in year y

$$RATIO_{RM/CLNK\_wet,y} = RM_{PR\_wet,y} \div CLNK_{PR\_wet,y} \quad (20)$$

For detailed explanation of baseline setting of CaO and MgO contents in clinker and raw meal please, see the Annex 2.

Kiln fuel baseline

Emission of CO_2 due to combustion of fuel in the kilns is calculated using the fixed in the annex 2 value of kiln efficiency for existing on site wet kilns and volume of clinker produced in the baseline scenario on year y according to the following formula[20]:

$$BE_{kiln\_wet,y} = EF_{fuel\_i,y} \times BKE_{wet} \times CLNK_{BL\_wet,y} \quad (21)$$

Where:

BKE_{wet} is the average for 3 years baseline kiln efficiency for existing on site wet kilns (GJ/ton of clinker)
$CLNK_{BL\_wet,y}$ is the production of clinker in the baseline scenario on wet kilns in year y (tonnes)
$EF_{fuel\_i,y}$ is the fuel of type *i* Emission Factor in year y (tCO_2/GJ)

Raw meal preparation and kiln electricity consumption baseline

$$BE_{RM\_wey,y} = EF_{el,y} \times BEL_{RM\_wet} \times CLNK_{BL\_wet,y} \quad (22)$$

Where:

$BE_{RM\_wet,y}$ is the baseline emission due to electricity consumption for preparation of raw meal and kilns electricity consumption for wet kilns in year y (tCO_2)
$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)
BEL_{RM_wet} is the average for 3 last years specific electricity consumption of equipment for raw meal preparation and electricity consumption of existing on site wet kilns (MWh/ton of clinker)
$CLNK_{BL\_wet,y}$ is the production of clinker in the baseline scenario on wet kilns in year y (tonnes)

[20] JI0001

Coal preparation baseline

$$BE_{coal,y} = BE_{coal\_electr,y} + BE_{coal\_fuel,y} \quad (23)$$

Where $BE_{coal\_electr,y}$ and $BE_{coal\_fuel,y}$ are the baseline emissions due to electricity consumption (for coal milling and conveying) and fuel consumption by heat generator used to dry the coal in year y (tCO_2). They are defined as follows:

In the baseline scenario the coal mill would have to mill more coal than compared to the project scenario for the same amount of clinker produced because of lower kiln efficiencies. In the baseline scenario the coal mill consumes electricity for both wet kilns and kilns producing incremental clinker. The electricity consumed by coal mill to mill coal for wet kilns is defined as follows:

$$BE_{coal\_el\_wet,y} = ELSP_{coalmill\_PR\_y} \times FC_{coal\_BL\_wet,y} \times EF_{el,y} \quad (24)$$

Where:

$EF_{el,\ y}$	is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)
$ELSP_{coalmill\_PR,y}$	is the specific electricity consumption for coal milling and coal conveying in year y (MWh/ton of coal)
$FC_{coal\_BL\_wet,y}$	is the baseline consumption of coal for wet kilns in year y(tonnes)

In the baseline scenario no exhaust gases from the kilns can be used to dry the coal. Therefore in the baseline scenario a heat generator will be installed. The heat generator will start operating at the same time with the coal mill will be put into operation in the middle of 2009 and will continue operating under baseline scenario. The fuel for heat generator will be either natural gas or coal, or mixture of both. Similar to electricity consumption of coal mill, in the baseline scenario the coal dryer would have to dry more coal than in the project scenario for the same amount of clinker produced. And, therefore, the baseline emissions for heat generator fuel consumption are calculated by monitoring the actual fuel consumption by the heat generator and calculating its specific fuel consumption as follows:

$$BE_{coal\_fuel\_wet,y} = \sum_i FSP_{heat\_gen\_i\_PR,y} \times FC_{coal\_BL\_wet,y} \times EF_{fuel\_i,y} \quad (25)$$

Where:

$EF_{fuel\_i,\ y}$	is the emission factor of fuel of type *i* used in heat generator for drying the coal in year y (tCO_2/GJ)
$FC_{coal\_BL\_wet,y}$	is the baseline consumption of coal for wet kilns in year y(tonnes)

$FSP_{coalmill\_PR,y}$ is the specific consumption of fuel of type *i* for heat generator drying the coal (GJ/ton of coal)

$FC_{coal\_bl\_wet,y}$ is defined the following way:

$$FC_{coal\_BL\_wet,y} = BKE_{wet} \times CLNK_{PR\_wet,y} \quad (26)$$

Slag preparation baseline

At current level of slag addition (4%) slag is not milled (ground), but is only dried. The existing electricity metering system does not allow for separate measurement of electricity used actually for slag preparation and handling. It is metered together with electricity consumption of kilns and therefore is included in the $BE_{RM,y}$ which includes electricity consumed by raw material preparation and the kilns (fans and drives).

Therefore the portion of $BE_{slag,y}$ which is occurring due to electricity consumption of slag handling in the baseline is included in $BE_{RM,y}$ is not measured and calculated separately. It will be fixed as average for 3 last pre-project years within the $BE_{RM,y}$ value.

Grinding of clinker baseline

The mills grinding clinker in the baseline are consuming electricity to grind clinker from both, wet and incremental kilns.
To separate the electricity used by mills to grind the clinker of wet kilns the following formula will be applied:

$$BE_{grind,y} = ELSP_{grind} \times CLNK_{BL\_wet,y} / CLNKFAC_{y} \times EF_{el,y} \quad (27)$$

Where:
$BE_{grind,y}$ is the baseline emission from grid electricity consumed to grind clinker from wet kilns in year y (tCO_2)
$ELSP_{grind}$ is the specific baseline electricity consumption of mills (it is fixed as average specific consumption for 3 years before the project start) (tCO_2)

Baseline emissions incremental part

$$BE_{incr,y} = CEM_{BLincr,y} x BEF_{incr,y} \quad (28)$$

Where:
$BE_{incr,y}$ Baseline emissions of incremental cement production in year y (tCO_2)
$CEM_{BLincr,y}$ Incremental cement production in baseline scenario in year y (tCO_2)
$BEF_{incr,y}$ Baseline emission factor for incremental cement production in year y (tCO2/t cement), see annex 2 for explanation.

The *cement* production for the incremental part is a follows:

If $(CLNK_{PR\_wet,y} + CLNK_{PR\_s\text{-}dry,y}) > CLNK_{BL\_wet\_cap}$

$$CEM_{BL\_incr,y} = \frac{(CLNK_{PR\_wet,y} + CLNK_{PR\_s-dry,y}) - CLNK_{BL\_wet\_cap}}{CLNKFAC_y} \qquad (29)$$

If $(CLNK_{PR\_wet,y} + CLNK_{PR\_s\text{-}dry,y}) \leq CLNK_{BL\_wet\_cap}$

$$CEM_{BL\_incr,y} = \frac{CLNK_{PR\_wet,y} + CLNK_{PR\_s-dry,y}}{CLNKFAC_y} \qquad (30)$$

$$CLNKFAC_y = \frac{CLNK_{PR\_wet,y} + CLNK_{PR\_s-dry,y}}{CEM_y} \qquad (31)$$

Where:

$CEM_{BL\_incr,y}$	Incremental cement production in baseline scenario in year y (tonnes)
$CLNK_{PR\_wet,y}$	Clinker production on wet kilns in project scenario in year y (tonnes)
$CLNK_{PR\_s\text{-}dry,y}$	Clinker production on semi-dry kiln in project scenario in year y (tonnes)
$CLNK_{BL\_wet\_cap}$	Clinker production capacity on existing wet kilns (tonnes)
$CLNKFAC_y$	Clinker factor in project scenario in year y (tonnes clinker /ton of cement)

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

Not applicable.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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

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
L1	$LE_{slag\_transp, y}$	Plant records	tCO_2	C	annually	100%	Paper and Electronic	
L2	$M_{slag,y}$	Railway bills, plant records	tonnes	M, C	annually	100%	Paper and Electronic	
L3	$D_{transp,y}$	Railway bills,	km	M, C	annually	100%	Paper and	

		plant records					Electronic	
L4	$ELSP_{rail\_transp,\ y}$	Plant records	kWh/t*km	C	annually	100%	Paper and Electronic	Official statistics of Ukrainian Railroad
L5	$EF_{grid,y}$	Plant records	tCO2/MWh	C	annually	100%	Paper and Electronic	Baseline carbon emission factors for JI projects reducing electricity consumption. See annex 2.

Table 14: Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

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

Due to reduced coal consumption, fewer emissions will occur in the coal mining and the transport to the plant (see Annex 2). These leakages have not been taken into account for simplicity and to be conservative. Project foresees the increase of slag addition to raw mill to substitute natural raw materials. This slag is originated from metallurgical plants operating blast furnaces and therefore has to be transported to the project site from these remote locations by railroad, which causes emissions due to electricity consumption.

$$LE_{slag\_transp,y} = M_{slag,y} \times D_{transp,y} \times ELSP_{rail\_transp,y} \times EF_{grid} \qquad (32)$$

Where:

$LE_{slag\_transp,\,y}$	is project leakage due to increased volume of slag being transported to the plant to partly substitute raw materials for clinker in year y (tCO_2e)
$M_{slag,y}$	is the mass of slag transported to the plant and used to substitute raw materials for clinker production in year y, (tonnes)
$D_{transp,\,y}$	is the average distance of slag transportation to the project site (km)
$ELSP_{rail\_transp,\,y}$	is the specific consumption of electricity for cargo railway transport in Ukraine in year y, MWh/ton*km
$EF_{el,\,y}$	is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

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):

$$ER_y = BE_y - PE_y + LE_{slag\_transp,y} \qquad (33)$$

Where:

ER_y	is emission reduction of the JI project in year y (tCO_2e)
BE_y	is the baseline emissions in year y (tCO_2e)
PE_y	is the project emissions in year y (tCO_2e)
$LE_{slag\_transp,\,y}$	is project leakage due to increased volume of slag being transported to the plant to partly substitute raw materials for clinker in year y (tCO_2e)

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:

Atmospheric emissions are the only important source of pollution at Volyn-Cement that has an impact on the local environment. According to the national requirements, atmospheric emissions have to be measured by making samples on the quarterly basis. Volyn-Cement systematically collects data on the pollutants that have an impact on the local environment. As of November 2007 the environmental laboratory of Volyn-Cement is making measurements of the following emissions:

Gaseous pollutants (NOx & SOx)
Gaseous pollutants are measured by means of a mobile gas spectrometer. It is used to measure the gaseous emissions periodically every three months by taking samples with. Currently there are little emissions of SOx at Volyn-Cement, but the existing gas spectrometers would measure SOx emissions should they appear.

Dust emissions
The emissions of dust are measured by the laboratory of Volyn-Cement using the weighing method. The level of dust is being 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 kiln
In case of the proposed JI project four existing wet kilns will be mothballed, and only two wet and the new semi-dry kiln will be in operation. The existing scheme of air pollution measurement will be used in the project scenario. In this case, the gaseous pollutants (NOx and SOx, if any) will be measured on a real-time basis by the existing gas spectrometer that will be installed on the new dry kiln. Dust measurements will be made by the plant's environmental laboratory using the in-line meter on the permanent basis.

Reporting of emissions and state permissions
According to the local environment regulations in force, the atmospheric emissions are reported by Volyn-Cement to the State regional statistics department on a quarterly and annual basis in a form of standard documents (State Reporting Form F2-TP (atmospheric emissions)).
According to the regulations, a special document named Draft Permissible Emissions Limits (DPEL) was developed by external independent company “Promeco”, city of Rivne and based on it the Permission was issued by the State Rivne Region Environmental and Natural Resources Control to the Volyn-Cement allowing to emit from stationary sources valid until 01/11/2008. New updated DPEL is under development and will be submitted to obtain permission before expiration of the existing Permission in force.

D.2. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table 11		
P9 $ByPass_{s-dry,y}$	1%	
P10 $CKD_{s-dry,y}$	1%	
P11 $D_{s-dry,y}$	1%	
P21 $EF_{fuel\_i,y}$	0.5%	An independent certification company will take samples of coal with frequency defined after the commissioning and will issue a certificate of the Net Calorific Value of each shipment. The IPCC default factors then will be used to calculate the EF. The financial department will store these certificates and will calculate the weighted average value of the Carbon Emission Factor (and the Net Calorific Value) at the end of each year. The natural gas supplier's laboratory will carry out measurement of NCV of gas supplied and issue a certificate. The financial department will store these certificates and will calculate the weighted average value of the Carbon Emission Factor (and the Net Calorific Value) at the end of each year.
P22 NCV_{fuel_i}	0.5%	Please, refer to P21

P23 $CLNK_{PR\_wet,y}$	2%	Annual sum of daily reports of kiln department. The measurements are based on constant measurement of slurry consumed by each rotary kiln and takes into account composition, moisture content and loss of Ignition (LOI) of slurry. These properties of slurry are tested every 4 hours by laboratory of Volyn-Cement.
P24 $CaO_{clnk\_PR\_wet,y}$	0.15%	Accredited laboratory of Volyn-Cement is taking samples and conduct the test. The data are archived. Frequency of tests every 4 hours. The laboratory department will calculate the weighted average.
P25 $MgO_{clnk\_PR\_wet,y}$	See P23	Accredited laboratory of Volyn-Cement is taking samples and conduct the test. The data are archived. Frequency of tests is once a day. The laboratory department will calculate the weighted average.
P26 $RM_{PR\_wet,y}$	2%	Annual sum of daily reports of quarrying and raw material departments. See P23.
P27 $CaO_{RM\_PR\_wet,y}$	See P24	Please refer to P24.
P28 $MgO_{RM\_PR\_wet,y}$	See P24	Please refer to P24.
P29 $CLNK_{PR\_s\text{-}dry,y}$	1%	A weighting measuring system will be installed to constantly measure the raw meal mass flow fed into the kiln and that the clinker produced is calculated in function of raw meal composition and moisture.
P30 $CaO_{clnk\_PR\_s\text{-}dry,y}$	See P24	Please refer to P24
P31 $MgO_{clnk\_PR\_s\text{-}dry,y}$	See P24	Please refer to P24
P32 $RM_{PR\_s\text{-}dry,y}$	1%	Please, refer to P26

P33 $CaO_{RM\_PR\_s\text{-}dry,y}$	See P23	Please refer to P24
P34 $MgO_{RM\_PR\_s\text{-}dry,y}$	See P23	Please refer to P24
P35 $FF_{fuel\_i\_wet,y}$	1%	Before each kiln, a coal weighting system will be installed to measure coal consumption of each kiln individually. The coal consumption will be metered and stored in electronic form. Calibration procedure to be done with respect to suppliers requirements by an authorized organization.
P36 $FF_{fuel\_i\_s\text{-}dry,y}$	1%	Please refer to P35
P37 $EL_{RM\_wet,y}$	1% or better	Individual electricity meters will be installed at the raw mill conveying and preparation and kiln system, enabling continuous measurement of the electricity consumption. Electricity meters are calibrated once every 3-6 years depending on the model selected; calibration is done by an authorized organization. The data metered will be supplied by the energy department to the Financial department.
P38 $EL_{RM\_s\text{-}dry,,y}$	1% or better	Please refer to P37.
P39 $EL_{mill\&conway,y}$	1% or better	Please refer to P37
P40 $FC_{dryer,y}$	1%	Fuel for heat generator of coal dryer can be both coal or natural gas. Coal consumption to the heat generator will be measured by weighting system. In case of gas consumed as fuel, gas meter will be used. Metered data will be supplied by the energy department to the Financial department.
P41 $EL_{slag,y}$	1%	Individual electricity meters will be installed to measure electricity consumption for slag milling and conveying. Electricity meters are calibrated once every 3-6 years depending on the model selected; calibration is done by an authorized organization. The data metered will be supplied by the energy department to the Financial department.

P42 $EL_{grind,y}$	1%	Individual electricity meters will be installed to measure the consumption of each of mills. Electricity meters are calibrated once every 3-6 years depending on the model selected; calibration is done by an authorized organization. The data metered will be supplied by the energy department to the Financial department.
P43 $FC_{slag,y}$	1%	Fuel for heat generator of slag dryer will be gas. It's consumption to the heat generator will be measured by gas flow meter/ Metered data will be supplied by the energy department to the Financial department.
Table 12		
B23 $ELSP_{coalmill\_PR,y}$	1%	The metering system will be designed according to the monitoring plan to allow measurement of electricity consumption of coal milling and conveying and to measure the volume of coal milled. Therefore the specific value can be calculated.
B25 $FSP_{coalmill\_PR,y}$	1%	The metering system will be designed according to the monitoring plan to allow measurement of fuel consumed by heat generator of coal mill and to measure the volume of coal milled. Therefore the specific value will be calculated.
B26 $EL_{slag\_incr,y}$	1%	The metering system will be designed according to monitoring plan to allow measurement of electricity consumption for incremental slag milling and handling
B27 $ELSP_{grind}$	1%	The value is fixed based on average 3 year consumption before the project implementation
Table 13		
L2 $M_{slag,y}$	1%	The mass of slag added to the raw mix will be measured by means of slag feeding machines, which are equipped with measurement devices

Table 15: Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Internal quality system at Volyn-Cement

The internal quality system at Volyn-Cement is functioning in accordance with the national standards and regulations in force. The quality of cement, clinker and all raw components is continuously controlled by the laboratory of the plant. The laboratory is certified by the Local certification body "Rivnestandartmetrology", certificate №PT-0061/2007 from 27.07.2007

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

Three departments of Volyn-Cement will be responsible for collecting the information for monitoring purposes.

The laboratory of Volyn-cement
The laboratory of Volyn-Cement, in general responsible for quality control of cement, clinker and raw components.

Energy department
The energy department is responsible for control of fuel and electricity consumption at Volyn-Cement. It collects data from the individual electricity meters installed at the production units that consume electricity, and the data of the commercial electricity meter that belongs to the regional power distribution company and measures the overall electricity consumption at the plant. The 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 electricity consumption level of the kiln system and the raw milling system, and provide it to the financial department.

Financial department
The financial department of is responsible for accounting, controlling and planning/ It will hold the overall responsibility for implementation of the monitoring plan, like organizing and storing the data and calculation the emission reductions, including project leakages.
The financial department will also prepare the annual Monitoring Protocols, to be presented to a Verifier of the emission reductions. Other departments of Volyn-Cement will submit relevant data to the financial department for the monitoring purposes.
In addition to the preparation of the Annual Monitoring Protocols, the Department will conduct an internal audit annually to assess project performance and if necessary make corrective actions.

Apart of internal departments of Volyn-Cement, three independent external organizations will be contracted to provide the data necessary for monitoring plan implementation:

The laboratory of the Gas transportation system of Ukraine (Lvivtransgas division of UkrTransgas)
The laboratory will provide data on the net calorific value of the natural gas consumed.

Independent certification body
This body will be contracted by Volyn-Cement to measure the net calorific value of fuel delivered.

Independent surveying company
This company will be contracted if needed, to supervise and approve the in-house survey of the opening (and closing) stocks of coal, cement, clinker, and mineral components.

The data from all external organizations will be collected by the laboratory of Volyn-Cement for monitoring purposes. For the usual routine procedures all the data has to be stored for three years for the purposes of the independent financial audit. For the purpose of the monitoring system implementation, the collected data will be stored by the Laboratory department at least for two years after the end of the crediting period – i.e. at least until 2014.
For a detailed description of each measured value, please refer to section D.2.

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

- JSC Volyn-Cement, Mr. Stanislav Lukin, financial director
- Global Carbon B.V., Mr. Lennard de Klerk, director

For contact details refer to annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Project emissions		2008	2009	2010	2011	2012
Kiln fuel	[tCO2/yr]	420,193	544,571	415,833	415,833	708,186
Calcination emissions	[tCO2/yr]	626,797	812,328	322,014	322,014	712,126
Raw mill and kiln	[tCO2/yr]	57,848	74,971	33,394	33,394	73,851
Coal mill	[tCO2/yr]	0	0	2,791	2,791	4,753
Slag preparation	[tCO2/yr]	3,441	4,460	8,037	8,037	17,774
Clinker grinding	[tCO2/yr]	57,976	75,138	24,341	24,341	53,829
Dust from kiln	[tCO2/yr]	0	0	0	0	0
Total	[tCO2/yr]	1,166,256	1,511,467	806,410	806,410	1,570,519
Total 2008 - 2012	[tCO2]	5,861,063				

Table 16: Estimated project emissions

E.2. Estimated leakage:

Project leakage		2008	2009	2010	2011	2012
Leakage from slag transportation	[tCO2/yr]	0	0	472	472	1,043
Total	[tCO2/yr]	0	0	472	472	1,043
Total 2008 - 2012	[tCO2]	2,263				

Table 17: Estimated project emissions

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

Project emissions and leakage		2008	2009	2010	2011	2012
Kiln fuel	[tCO2/yr]	420,193	544,571	415,833	415,833	708,186
Calcination emissions	[tCO2/yr]	626,797	812,328	322,014	322,014	712,126
Raw mill and kiln	[tCO2/yr]	57,848	74,971	33,394	33,394	73,851
Coal mill	[tCO2/yr]	0	0	2,791	2,791	4,753
Slag preparation	[tCO2/yr]	3,441	4,460	8,037	8,037	17,774
Clinker grinding	[tCO2/yr]	57,976	75,138	24,341	24,341	53,829
Dust from kiln	[tCO2/yr]	0	0	0	0	0
Leakage	[tCO2/yr]	0	0	472	472	1,043
Total	[tCO2/yr]	1,166,256	1,511,467	806,882	806,882	1,571,562
Total 2008 - 2012	[tCO2]	5,863,049				

Table 18: Estimated project emissions

E.4. Estimated baseline emissions:

Baseline emissions		2008	2009	2010	2011	2012
Kiln fuel	[tCO2/yr]	420,193	544,571	415,833	415,833	919,604
Calcination emissions	[tCO2/yr]	626,797	812,328	361,837	361,837	800,194
Raw mill and kiln	[tCO2/yr]	57,848	74,971	33,394	33,394	73,851
Coal mill	[tCO2/yr]	0	0	5,869	5,869	12,979
Slag preparation	[tCO2/yr]	3,441	4,460	2,574	2,574	5,693
Clinker grinding	[tCO2/yr]	57,976	75,138	33,469	33,469	74,015

Incremental	[tCO2/yr]	0	0	0	0	0
Total	[tCO2/yr]	1,166,256	1,511,467	852,976	852,976	1,886,336
Total 2008 - 2012	[tCO2]	6,270,011				

Table 19: Estimated baseline emissions

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

Reductions		2008	2009	2010	2011	2012
Total	[tCO2/yr]	0	0	46,095	46,095	314,773
Total 2008 - 2012	[tCO2]	406,962				

Table 20: Difference representing the emission reductions of the project

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated Emission reductions (tonnes of CO_2 equivalent)
Year 2008	1,166,256	0	1,166,256	0
Year 2009	1,511,467	0	1,511,467	0
Year 2010	806,410	472	852,976	46,095
Year 2011	806,410	472	852,976	46,095
Year 2012	1,570,519	1,043	1,886,336	314,773
Total (tonnes of CO_2 equivalent)	5,861,063	1,986	6,270,011	406,962

Table 21: Overview of project, baseline, and emission reductions

Estimated emission reductions (tonnes of CO2 equivalent) during 2013	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2014	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2015	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2016	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2017	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2018	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2019	326,345
Estimated emission reductions (tonnes of CO2 equivalent) during 2020	326,345
Total emission reductions (tonnes of CO2 equivalent) during 2013-2020	2,610,762

Table 22: Emission reductions during the period of 2013-2020

Risks and uncertainties

The estimation of the emissions reductions of this project is based on several assumptions. The following factors are of influence of the actual emission reductions. The assumptions are given that have been used for the estimation:

- Commissioning date of the slag subproject is 1/1/2010 and semi-dry kiln is 1/1/2010
- Kiln economy of semi-dry kiln is 3.48 GJ/t clinker with addition of 15% of slag into raw meal
- Kiln economy of wet kilns is 5.48 GJ/t clinker with addition of 15% of slag into raw meal

- Fuel Carbon Emission Factor of coal fuel is 0.096 tCO_2/GJ

The first two assumptions are not within the full control of Volyn-Cement as clinker (cement) production depends on the development of the cement market in Ukraine and the commissioning data depends on obtaining JI approval. The other three factors have a higher certainty.

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 certain impact on the local environment. In Ukraine emission levels in industry are regulated by operating licenses issued by regional offices of the Ministry for Environmental Protection on the individual basis for every enterprise that has significant impact on the environment. The current levels of the emissions of the main pollutants (dust, sulphur oxides and nitrogen oxides), are in compliance with the requirements of the plant's operational license.

Types of atmospheric emissions (as described in the operational licence) and relevant measurement techniques are presented below.

The project foresees introduction of modern auxiliary equipment, designed to meet the strongest pollution restrictions (mainly enhanced bag filtering systems) instead of existing worn out electrostatic precipitators and outdated systems. Also important is that due to approximately 40% better kiln efficiency and also due to usage of slag as part of raw material less fuel will be combusted. New burners, having modern control systems will allow to better maintain optimal combustion mode thus contributing to reduction of such pollutants, like CO and NO_x.

Currently the design of the new installations has been started and will be followed by detailed assessment of environmental impact (OVNS in Ukrainian abbreviation) when complete.

According to the information from design company in charge of design documentation, including environmental impact assessment, there is no transboundary impact to be expected as all pollution will occur within the sanitary zone of the Volyn-Cement.

Dust
Dust, emitted from cement production processes, is not a toxic substance but is considered a nuisance. The main sources of dust from cement production are the raw materials mill, the kiln, clinker coolers and cement mills. Dust emissions from Volyn-Cement are monitored on a regular basis in compliance with norms and regulations in force.

Dust concentration in the exhaust gases is determined on the basis of changes in filter weight measured in a flow of a dust-laden gas for certain period of time. Dust is sampled by gravimetric method in accordance with the national “Methodology of dust concentration measurement in dust-laden process gases”. Accuracy of the measurement is within +/-25%. Testing (calibration) of measurement equipment used to measure dust emissions is carried out once a year by an independent state body (State Organization for Standardization, Metrology and Certification).

After the installation of new kiln, new dust modern electrostatic precipitators will be installed. These will impact emissions from the raw materials mill, the kiln and clinker cooler. With the implementation of the JI project, airborne emissions of kiln dust are expected to significantly fall from the current levels of approximately 2100 tonne in 2006 and 1630 tonne during 9 months 2007. According to preliminary assessment, the dust emissions will be reduced about 4 times.

Nitrogen and sulphur oxides
NOx is formed due to the inevitable oxidation reaction of the atmospheric nitrogen at high temperatures in the cement kiln. It is expected that after project commissioning the emissions will stay the

requirements of the Ukrainian legislation and within the range the Best Available Technology[21] levels of IPPC.

SOx emissions in cement production originate mainly from raw material and also from coal with sulphur content combustion. The sulphur content in the raw materials used at Volyn-Cement is insignificant and SOx emissions are not observed and should not increase after the implementation of the project. However, the gas analyzing equipment of Volyn-Cement will allow to monitor the gaseous emissions of sulphur oxide in case they will appear.

Process water consumption
Semi-dry and dry processes have significantly lower water consumption due to the difference in mixing and homogenization of raw materials as to compare with wet process. Therefore, it is expected significant reduction of water consumption by Volyn-Cement after the project implementation.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The environmental impacts of the project are positive as the project expects to reduce the impact of the existing facility. An Environmental Impact Assessment is not deemed necessary at this stage of project development. The impact on the environment of the project will be assessed by the Ukrainian authorities in the following way.

The environmental impacts will be assessed before obtaining a construction permit. The general principles of evaluating the environmental impact (OVNS, which is the Ukrainian abbreviation) procedure in Ukraine are described by the national laws “On the environmental protection” and “On the environmental expertise”. According to the national legislation in force, every project or new activity that can be potentially harmful for the environment, must evaluate the environmental impact[22] [23].

These environmental impacts are analysed after the development of the detailed project design in order to obtain a construction permit. The OVNS document must provide a list of viable project alternatives, a description of the current state of local environment, description of the main pollutants, risk evaluation and an action plan for pollution minimisation. The final OVNS document has to be presented as a separate volume of the project documentation for the evaluation by a state expert company and, optionally may be the subject of public hearing.

The OVNS is to be ready by the end of 2008. According to the information from design company in charge, there no transboundary impacts to be expected as all pollution will occur within the sanitary zone of the Volyn-Cement.

The national procedure for receiving the construction permit in general cases is described below.

1. Approval by the local authorities

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[21] IPPC Reference Document on Best Available Techniques in the Cement and Lime Manufacturing Industries, December 2001

[22] The Law of Ukraine “On the environmental expertise”, Articles 8, 15, 36

[23] The Law of Ukraine “On the environmental protection”, Article 51

On the initial stage of the project design preparation Volyn-Cement will conduct consultations with the local authorities, namely the council of town Zdolbuniv and the administration of the Zdolbuniv district (rayon). Local authorities will be provided with the general information (the so-called notification on the planned activity) about the envisaged project.

2. Setting requirements for the project
In the case of positive conclusion of the consultations, local authorities will issue approval for developing: a) general project design; b) architectural and planning document; c) terms of reference for the project. These three documents are to contain specific environmental, sanitary, architectural and other requirements for the project.

3. Project design phase
Upon the formulation of the requirements from the local authorities and developing the terms of reference, Volyn-Cement will contract a design institute to prepare the project design documentation package. This package has to include:

- general project description;
- assessment of environmental impact (OVNS);
- time schedule for the construction works;
- project budget;
- blueprints of the architectural design, general planning and transport;
- Project evaluation.

After the preparation of the full project design documentation, as elaborated above, Volyn-Cement will contract an authorized state company to conduct independent evaluation of the project. The evaluation procedure includes receiving of approvals from the following state authorities:

- sanitary authority;
- state authority on environmental protection;
- fire prevention authority;
- energy saving authority;
- labour safety authority.

One of the mandatory parts of the state evaluation procedure is the stakeholder consultation process. All interested parties can submit their comments to the project to the company performing the evaluation process. National regulations do not formulate how the stakeholder consultations have to be held. However, Volyn-Cement is committed to actively publish the information about potential impacts of the project (including the environmental impact) and will take into account the comments from all stakeholders.

4. Construction design
Either after receiving positive conclusion of the state evaluation or in parallel with the evaluation process, Volyn-Cement can start the design of construction documentation. The construction documents shall include construction blueprints, specifications of the equipment and construction materials, construction budget, etc.

5. Receiving the construction permit
The package of construction design documents, project design documentation and positive conclusions of the state evaluation have to be submitted to the local authority on the construction and architecture, that finally issues the construction permit.

The preliminary schedule for the preparation of the project to Ukrainian permitting requirements is as follows:

• Preliminary Discussion with Local Authorities	January 2008
• Preliminary Engineering	January 2008
• Permit Application Procedure	March 2008
• Permit Application Evaluation	May 2008
• Detailed construction design	October 2008
• Grant of Permit	November 2008
• Construction Start	during 2009

SECTION G. Stakeholders' comments

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

JI projects are not required to go through a (local) stakeholders' consultation. However, Volyn-Cement and Dyckerhoff are planning to present the project to the regional authorities at a later stage. In the course of obtaining the construction permit, Volyn-Cement will actively publish information about the project to stakeholders.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

Capacity of wet and semi-dry kilns

Current wet kilns
Since 1970s Volyn-Cement operates seven wet process rotary kilns. Four kilns have design capacity of 22 t clinker/hour and three have capacity 53 t clinker/hour. Wet rotary kilns can be operated 320 days per year. The total production capacity of the existing installation is 1.835 million tonnes of clinker per year and this figure will be used as $CLNK_{BL\_wet-cap}$. With existing clinker factor of 0,85 t clinker/t cement the existing capacity can produce close to 2 million tonnes of cement annually.

It is possible to intensify the operation of existing capacity in terms of increase the number of run-days and decrease the duration of stops to produce more clinker at the existing capacities, but not very much. Lower number has been taken to be conservative.

Proposed new kiln and process layout
The new kiln (one) will be a semi-dry process calciner kiln system. A new semi-dry kiln having capacity of 250 t/h will be installed and operate together with 2 existing wet kilns of 53 t/h.

Kilns in operation	Process type	Kiln clinker capacity, t/h each
#8	Semi-dry	250
#4, 5	Wet	53

Table 23. Production capacity after project implementation

The new process layout would allow increasing the production of clinker and cement. The production capacity of the new kiln will be approximately 6,000 tonnes of clinker per day. It is expected that the dry kiln will work 310 days a year with a 6% allowance for emergency stops. Therefore, the yearly capacity of the new semi-dry installation will be approximately 1.75 million tonnes of clinker. Together with two remaining wet kilns, producing 0.741 million tonnes of clinker, the total capacity of Volyn-Cement after project implementation can be approximately 2.49 million tonnes of clinker or 2.93 million tonnes of cement. For the calculation, however slightly lower value of 2.47 million ton of clinker was used.

Determination of baseline factors

To keep the market share on the growing cement market, Volyn-Cement would need to increase the production over existing wet production capacity in the baseline. This increase represents an "incremental" production. In an open competitive cement market circumstances, a , competitor (-s) would produce this increment unless Volyn-Cement would produce it. Subsequently, the carbon emissions would occur from competitor's incremental production. A methodological approach how to establish these emissions is given further in this Annex.

Baseline kiln economy of wet kilns
The baseline kiln economy BKE is determined by taking the average of the most recent three years available measurements by the following formula:

$$BKE_{wet} = \sum_{y} \frac{FC_y \times NCV_y}{CLNK_y} \times \frac{1}{3} \qquad (34)$$

Where:
KE_{av} Average kiln economy per tonne of clinker (GJ/t clinker)
y Years 2004, 2005 and 2006
$FC_{,y}$ Quantity of fossil fuel burnt for clinker production in year y (1000 Nm^3)
NCV_y Net calorific value fossil fuel in year y (GJ/1000 Nm^3)
$CLNK_y$ Amount of clinker produced in year y (tonne of clinker)

The result is presented below in the table:

Year	2004	2005	2006	Average
Kiln economy (GJ/t clinker)	6.021	6.033	5.954	6.003

Table 24: Measured kiln economy and calculated average

As can be seen in the table above, the kiln economy is rather a stable figure with small fluctuations. Therefore the baseline kiln economy can be established by taking the historic average value of the kiln economy and the BKE_{wet} is taken as 6.003 GJ/tonne of clinker.

Baseline calcinations
The level of slag addition prior to the start of project activity is 4%. Raw meal contains non-carbonated CaO and MgO originated only from slag addition. Slag, being originated from high temperature processed during iron production contains these oxides only in non-carbonated form.
Natural raw materials used for raw mill contain negligible quantities of non-carbonated CaO and MgO (<1%) which were not taken into account for simplicity. Mass content of non-carbonated CaO and CaO in RM in therefore depends on proportion (percent) of slag addition and on these non-carbonated oxides content in the slag.

To set the baseline content of the non-carbonated CaO and MgO in the raw meal and clinker, the historical data of most recent three years for clinker and two years for raw meal preceding the start of project activity were used, as shown below:

		clinker %	raw meal %
2004	CaO	66.61	n/a
	MgO	0.64	n/a
2005	CaO	66.48	1.886

	MgO	0.64	0.246
	CaO	66.62	1.9192
2006	MgO	0.68	0.2548

Table 25: non carbonated CaO and MgO in clinker

As seen from the table, the contents of these oxides in clinker produced do not fluctuate significantly. Therefore, average content data was set as baseline parameters:
CaO_{Clnk_Bsl} is 66.57 % and MgO_{Clnk_Bsl} is 0.65 %

To calculate the baseline contents of non-carbonated CaO and MgO in raw meal only their content, admitted by addition of 4% of slag is calculated. Neglecting their content in natural raw materials is conservative.
The average non-carbonated content of CaO and MgO in the raw meal would be:
CaO_{RM_Bsl} is 1.9026 % and MgO_{RM_Bsl} is 0.2504 %.

Baseline electricity consumption raw milling and kiln drives for wet kilns
The specific electricity consumption of the raw milling and the kiln BEL_{RM_wet} (MWh/t clinker) has been determined by extrapolating historic measured consumption.

The specific data are presented in a table below.

Year	2004	2005	2006	Average
BEL_{RM_wet}, kWh/t clinker	52.35	49.70	52.90	51.65

Table 26: Measured electricity consumption of raw milling and kiln drives and calculated average

The average BEL_{RM_wet} is 51.65 kWh/t clinker.

Baseline electricity consumption coal mill
The electricity consumption of the coal mill in the baseline scenario will be calculated as described in section D.1.1.4. For the purpose of estimating the emission reduction potential in section E, the electricity consumption of the coal mill in the baseline scenario has been set at 17 kWh/t coal, based on preliminary equipment specifications.

Baseline specific fuel consumption heat generator coal mill
The specific natural gas consumption of the heat generator $FSP_{coalmill\_PR,y}$ (GJ/tonne coal) will be determined by taking actual measurements of operation of the heat generator (since second half of 2009 onwards), after commissioning of the coal mill, and before commissioning of the semi-dry kiln.

For the purpose of estimating the emission reduction potential in section E, the specific fuel consumption $FSP_{coalmill\_PR,y}$ has been set at 0.3 GJ/tonne coal based on 12% coal moisture content assumption.

Baseline specific electricity consumption for slag milling and conveying
At current level of slag addition (4%) slag is not being milled (ground). With the increase of slag addition it will be required to mill the slag. The specific baseline electricity consumption for preparation of incremental slag to calculate the EL_{slag_incr} is set as 45 kWh/t of slag, based on preliminary equipment specifications.

Baseline specific fuel consumption for slag drying
The specific baseline fuel consumption by slag drying to calculate the FC_{slag_incr} is set as 0,509 GJ/t of

slag based on average gas consumption of slag dryer.

Baseline specific electricity consumption for clinker grinding
The specific baseline electricity consumption $ELSP_{grind}$ is obtained by extrapolating the measured historical data of mills consumption at a level of 44 kWh/t cement based on average 3 year

Baseline electricity factor
The baseline emission factor of the Ukrainian grid $EF_{el,y}$ is taken as 0,896 tCO_2 /MWh as set in the standardised baseline factor for Ukrainian electricity grid for JI projects reducing electricity consumption in years 2008-2012 and presented it the document below.

TÜV SÜD Industrie Service

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Ukraine - Assessment of new calculation of CEF

Introduction

Many Joint Implementation (JI) projects have an impact on the CO_2 emissions of the regional or national electricity grid. Given the fact that in most Economies in Transition an integrated electricity grid exists, a standardized baseline should be used to estimate the amount of CO_2 emission reductions on the national grid.

The Ukraine is one of the major JI host countries where many grid related projects have been developed or will be implemented. In order to enhance the project development and reliability in emission reductions from the Ukraine a standardized and common agreed grid factor expressing the carbondioxid density per kWh is crucial.

Objective

Global Carbon B.V. is one of the pioneers developing JI projects in Ukraine who has developed a baseline approach for determining the Ukrainian grid factor. The approach is implied from the approved CDM methodology ACM0002.

The team of Carbon Management Service (CMS) of TÜV SÜD Industrie Service GmbH with its accredited certification body "Climate and Energy" has been ordered to verify the developed approach and the calculated grid factor.

Once an approach is agreed it should be used for calculating the grid by using current available data served from the Ukraine Ministry for Fuel and Energy. Such annual grid factor shall be used as a binding grid factor for JI projects developed in the Ukraine.

Scope

The baseline approach to which this confirmation is referring is attached. The confirmation includes the inherent approach if the algorithms are developed reasonable and from a technical point of view correct. Furthermore the verified the

Date: 17.08.2007

Our reference:
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This document consists of
4 Pages
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Industrie Service

origin of the data. The team consists of:

- Werner Betzenbichler (Head of the certification Body “Climate and Energy”),
- Thomas Kleiser (Head of division JI/CDM, GHG-Auditor and Project Manager)
- Markus Knödlseder (GHG-Auditor and Project Manager)

Mr. Kleiser and Betzenbichler assessed the baseline approach and agreed with Global Carbon on the conclusive approach. Mr. Kleiser and Mr. Knödlseder assessed the calculation model whereas Mr. Knödlseder interviewed also Mr. Nikolay Andreevich Borisov, Deputy Director for Strategic Development in Ministry of Fuel and Energy (+380 (44) 2349312 // bo-risov@mintop.energy.gov.ua) who explained the process of data gathering in the Ukraine. He also confirmed that GlobalCarbon B.V. uses the served data.

Conclusion

The conclusive assessment does not include potential uncertainties that might be occurred in the data gathering process of the ministry. Considering that we confirm that applied data served by Ministry of Fuel and Energy are reliable and correctly used.

Based on submitted calculation method, developed baseline study (see attachment), applied data and written confirmation from Ministry of Fuel and Energy (see attached documents) the team of Carbon Management Service of TÜV SÜD Industrie Service GmbH with its accredited certification body “Climate and Energy” confirms further that developed approach is eligible to determine the Ukrainian electricity grid factor as a standard value for JI project in the Ukraine.

The team recommends updating the calculation annually depending on point of time when na-tional consolidated data are available.

Munich,17/08/2007	Munich, 17/08/2007
Markus Knödlseder	Werner Betzenbichler
GHG-Auditor and Project Manager	Head of the certification Body “Climate and Energy” and Carbon Management Service

Standardized emission factors for the Ukrainian electricity grid

Introduction

Many Joint Implementation (JI) projects have an impact on the CO_2 emissions of the regional or national electricity grid. Given the fact that in most Economies in Transition (IET) an integrated electricity grid exists, a standardized baseline can be used to estimate the amount of CO_2 emission reductions on the national grid in case of:

a) Additional electricity production and supply to the grid as a result of a JI project (=producing projects);
b) Reduction of electricity consumption due to the JI project resulting in less electricity generation in the grid (= reducing projects);
c) Efficient on-site electricity generation with on-site consumption. Such a JI project can either be a), b), or a combination of both (e.g. on-site cogeneration with partial on-site consumption and partial delivery to the grid).

So far most JI projects in EIT, including Ukraine, have used the standardized Emission Factors (EFs) of the ERUPT programme. In the ERUPT programme for each EIT a baseline for producing projects and reducing projects was developed. The ERUPT approach is generic and does not take into account specific local circumstances. Therefore in recent years new standardized baselines were developed for countries like Romania, Bulgaria, and Estonia. In Ukraine a similar need exist to develop a new standardized electricity baseline to take the specific circumstances of Ukraine into account. The following baseline study establishes a new electricity grid baseline for Ukraine for both producing JI projects and reducing JI projects.

This new baseline has been based on the following guidance and approaches:

- The "Guidance on criteria for baseline setting and monitoring" for JI projects, issued by the Joint Implementation Supervisory Committee[24];
- The "Operational Guidelines for the Project Design Document", further referred to as ERUPT approach or baseline [25];
- The approved CDM methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" [26];
- Specific circumstances for Ukraine as described below.

ERUPT

The ERUPT baseline was based on the following main principles:

- Based mainly on indirect data sources for electricity grids (i.e. IEA/OECD reports);
- Inclusion of grid losses for reducing JI projects;
- An assumption that all fossil fuel power plants are operating on the margin and in the period of 2000-2030 all fossil fuel power plants will gradually switch to natural gas.

The weak point of this approach is the fact that the date sources are not specific. For example, the Net Calorific Value (NCV) of coals was not determined on installation level but was taken from IPCC default values. Furthermore the IEA data included electricity data until 2002 only. ERUPT assumes that

---

[24] Guidance on criteria for baseline setting and monitoring, version 01, Joint Implementation Supervisory Committee, ji.unfccc.int

[25] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Ministry of Economic Affairs of the Netherlands, May 2004

[26] Consolidated baseline methodology for grid-connected electricity generation from renewable sources, version 06, 19 May 2006, cdm.unfccc.int

Ukraine would switch all its fossil-fuel plant from coal to natural gas. In Ukraine such an assumption is unrealistic as the tendency is currently in the opposite direction.

ACM0002

The ACM0002 methodology was developed in the context of CDM projects. The methodology takes a combination of the Operating Margin (OM) and the Build Margin (BM) to estimate the emissions in absence of the CDM project activity. To calculate the OM four different methodologies can be used. The BM in the methodology assumes that recent built power plants are indicative for future additions to the grid in the baseline scenario and as a result of the CDM project activity construction of new power plants is avoided. This approach is valid in electricity grids in which the installed generating capacity is increasing, which is mostly the case in developing countries. However, the Ukrainian grid has a significant overcapacity and many power plants are either operating below capacity or have been moth-balled.

Nuclear is providing the base load in Ukraine

In Ukraine nuclear power plants are providing the base load of the electricity in Ukraine. To reduce the dependence on imported fuel the nuclear power plants are running at maximum capacity where possible. In the past five years nuclear power plants provide almost 50% of the total electricity:

Year	2001	2002	2003	2004	2005
Share of AES	44%	45%	45%	48%	48%

Table 27: Share of nuclear power plant in the annual electricity generation

All other power stations are operating on the margin. This includes hydro power plants which is show in the table below.

	Minimum; 03:00	Maximum; 19:00
Consumption, MW	21,287	27,126
Generation, MW	22,464	28,354
Thermal power plants	*10,049*	*13,506*
Hydro power plants	*527*	*3,971*
Nuclear power plants	*11,888*	*10,877*
Balance imports/export, MW	-1,177	-1,228

Table 28: Electricity demand in Ukraine on 31 March 2005[27]

Development of the Ukrainian electricity sector

The National Energy Strategy[28] sets the approach for the overall energy complex of Ukraine and the electricity sector in particular. The main priority of Ukraine is to reduce the dependence of imported fossil fuels. The strategy sets the following priorities[29]:

- increased use of local coal as a fuel;
- construction of the new nuclear power plants;
- energy efficiency and energy saving.

[27] Ukrenergo, http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/article?art_id=39047&cat_id=35061

[28] http://mpe.kmu.gov.ua/fuel/control/uk/doccatalog/list?currDir=50505

[29] Energy Strategy of Ukraine for the Period until 2030, section 16.1, page 127.

Due to the sharp increase of imported natural gas prices a gradual switch from natural gas to coal at the power plants is planned in the nearest future. Ukraine possesses a large overcapacity of the fossil-powered plants of which many are mothballed. These moth-balled plants might be connected to the grid in case of growing demand.

In the table below the installed capacity and load factor is given in Ukraine. As one can see the average load factor of thermal power plant is very low.

	Installed capacity (GW)	Average load factor, %
Thermal power plants	33.6	28.0
Hydro power plants	4.8	81.4
Nuclear power plants	13.8	26.0
Total	**52.2**	**39.0**

Table 29: Installed capacity in Ukraine in 2004[30]

According to IEA's estimations, about 25% of thermal units might not be able to operate (though there is no official statistics). This means that still at least 45% of the installed thermal power capacity could be utilized, but is currently not used. In accordance with the IEA report the 'current capacity will be sufficient to meet the demand in the next decade'[31].

In the table below the peak load of the years 2001- 2005 are given which is approximately 50% of the installed capacity.

	2001	2002	2003	2004	2005
Peak load (GW)	28.3	29.3	26.4	27.9	28.7

Table 30: Peak load in Ukraine in 2001 - 2005[32]

New nuclear power plants will take significant time to be constructed will not get on-line before the end of the second commitment period in 2012. There is no nuclear reactor construction site at such an advanced stage remaining in Ukraine, it is unlikely that Ukraine will have enough resources to commission any new nuclear units in the foreseeable future (before 2012)[33].

Latest nuclear additions (since 1991):
- Zaporizhzhya NPP unit 6, capacity 1 GW, commissioned in 1995;
- Rivne NPP unit 4, capacity 1 GW, commissioned in 2004;
- Khmelnitsky NPP unit 2, capacity 1 GW, commissioned in 2004.

Nuclear power plants under planning or at early stage of construction:
- South Ukraine NPP one additional unit, capacity 1 GW;
- Khmelnitsky NPP two additional units, capacity 1 GW each.

[30] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 272, table 8.1

[31] Source: Ukraine Energy Policy Review. OECD/IEA, Paris 2006. p. 269

[32] Ministry of Energy, letter dated 11 January 2007

[33] http://www.xaec.org.ua/index-ua.html

Approach chosen

In the selected approach of the new Ukrainian baseline the BM is not a valid parameter. Strictly applying BM in accordance with ACM0002 would result in a BM of zero as the latest additions to the Ukrainian grid were nuclear power plants. Therefore applying BM taking past additions to the Ukrainian grid would result in an unrealistic and distorted picture of the emission factor of the Ukrainian grid. Therefore the Operating Margin only will be used to develop the baseline in Ukraine.

The following assumptions from ACM0002 will be applied:

1) The grid must constitute of all the power plants connected to the grid. This assumption has been met as all power plants have been considered;
2) There should be no significant electricity imports. This assumption has been met in Ukraine as Ukraine is a net exporting country as shown in the table below;
3) Electricity exports are not accounted separately and are not excluded from the calculations.

	2001	2002	2003
Electricity produced, GWh	175,109	179,195	187,595
Exports, GWh	5,196	8,576	12,175
Imports, GWh	2,137	5,461	7,235

Table 31: Imports and exports balance in Ukraine[34]

ACM0002 offers several choices for calculating the OM. Dispatch data analysis cannot be applied, since the grid data is not available[35]. Simple adjusted OM approach is not applicable for the same reason. The average OM calculation would not present a realistic picture and distort the results, since nuclear power plants always work in the base load due to the technical limitations (and therefore cannot be displaced) and constitute up to 48% of the overall electricity generation during the past 5 years.

Therefore, the simple OM approach is used to calculate the grid emission factor. In Ukraine the low-cost must-run power plants are nuclear power stations. Their total contribution to the electricity production is below 50% of the total electricity production. The remaining power plants, all being the fossil-fuel plants and hydro power plants, are used to calculate the Simple OM.

%	2001	2002	2003	2004	2005
Nuclear power plants	44.23	45.08	45.32	47.99	47.92
Thermal power plants	38.81	38.32	37.24	32.50	33.22
Combined heat and power	9.92	11.02	12.28	13.04	12.21
Hydro power plants	7.04	5.58	5.15	6.47	6.65

Table 32: Share of power plants in the annual electricity generation of Ukraine[36]

[34] Source: State Committee of Statistics of Ukraine. Fuel and energy resources of Ukraine 2001-2003. Kyiv, 2004

[35] Ministry of Energy, letter dated 11 January 2007

[36] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

The simple OM is calculated using the following formula:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum GEN_{j,y}} \qquad \textit{(Equation 35)}$$

Where:

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y* (2001-2005);

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid;

$COEF_{i,j,y}$ is the CO2 emission coefficient of fuel *I* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*;

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The CO2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad \textit{(Equation 36)}$$

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;

$OXID_i$ is the oxidation factor of the fuel;

$EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel *i*.

Individual data for power generation and fuel properties was obtained from the individual power plants[37]. The majority of the electricity (up to 95%) is generated centrally and therefore the data is comprehensive[38].

The Net Calorific Value (NCV) of fossil fuel can change considerably, in particular when using coal. Therefore the local NCV values of individual power plants for natural gas and coal were used. For heavy fuel oil, the IPCC[39] default NCV was used. Local CO_2 emission factors for all types of fuels were taken for the purposes of the calculations and Ukrainian oxidation factors were used. In the case of small-scale power plants some data regarding the fuel NCV is missing in the reports. For the purpose of simplicity, the NCV of similar fuel from a power plant from the same region of Ukraine was used.

[37] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

[38] The data for small units (usually categorized in the Ukrainian statistics as 'CHPs and others') is scattered and was not always available. As it was rather unrealistic to collect the comprehensive data from each small-scale power plant, an average CO2 emission factor was calculated for the small-scale plants that provided the data. For the purpose of simplicity it was considered that all the electricity generated by the small power plants has the same average emission factor obtained.

[39] IPCC 1996. Revised guidelines for national greenhouse gas inventories.

Reducing JI projects

The Simple OM is applicable for additional electricity production delivered to the grid as a result of the project (producing JI projects). However, reducing JI projects also reduce grid losses. For example a JI project reduces on-site electricity *consumption* with 100,000 MWh and the losses in the grid are 10%. This means that the actual reduction in electricity *production* is 111,111 MWh. Therefore a reduction of these grid losses should be taken into account for reducing JI projects to calculate the actual emission reductions.

The losses in the Ukrainian grid are given in the table below and are based on the data obtained directly from the Ukrainian power plants through the Ministry of Energy.

Year	Technical losses %	Non-technical losses %	Total %
2001	14,2	7	21,2
2002	14,6	6,5	21,1
2003	14,2	5,4	19,6
2004	13,4	3,2	16,6
2005	13,1	1,6	14,7

Table 33: Grid losses in Ukraine[40]

As one can see grid losses are divided into technical losses and non-technical losses. For the purpose of estimating the EF only technical losses[41] are taken into account. As can been seen in the table the technical grid losses are decreasing. The average decrease of grid losses in this period was 0.275% per annum. Extrapolating these decreasing losses to 2012 results in technical grid losses of 12% by 2012. However, in order to be conservative the grid losses *over the full period 2006-2012* have been taken as 10%.

Further considerations

The "Guidance on criteria for baseline setting and monitoring" for JI projects requires baselines to be conservative. The following measures have been taken to adhere to this guidance and to be conservative:

- The grid emission factor is actually expected to grow due to the current tendency to switch from gas to coal;
- Hydro power plants have been included in the OM. This is conservative;
- With the growing electricity demand, out-dated mothballed fossil fired power plants are likely to come on-line as existing nuclear power plants are working on full load and new nuclear power plants are unlikely to come on-line before 2012. The emission factor of those moth-balled power plants is higher as all of them are coal of heavy fuel oil fired[42];
- The technical grid losses in Ukraine are high, though decreasing. With the current pace the grid losses in Ukraine will be around 12% in 2012. To be conservative the losses have been taken 10%;
- The emissions of methane and nitrous oxide have not taken into consideration, which is in line with ACM0002. This is conservative.

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[40] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

[41] Ukrainian electricity statistics gives two types of losses – the so-called 'technical' and 'non-technical'. 'Non-technical' losses describe the non-payments and other losses of unknown origin.

[42] "Overview of data on electrical power plants in Ukraine 2001 - 2005", Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

Conclusion
An average CO_2 emission factor was calculated based on the years 2003-2005. The proposed baseline factors is based on the average constituting a fixed emission factor of the Ukrainian grid for the period of 2006-2012. Both baseline factors are calculated using the formulae below:

$$EF_{grid,produced,y} = EF_{OM,y} \qquad \textit{(Equation 37)}$$

and

$$EF_{grid,reduced,y} = \frac{EF_{grid,produced,y}}{1 - loss_{grid}} \qquad \textit{(Equation 38)}$$

Where:
$EF_{grid,produced,y}$ is the emission factor for JI projects supplying additional electricity to the grid (tCO2/MWh);
$EF_{grid,reduced,y}$ is the emission factor for JI projects reducing electricity consumptionfrom the grid (tCO2/MWh)factor of the fuel;
$EF_{OM,y}$ is the simple OM of the Ukrainian grid (tCO2/MWh);
$loss_{grid}$ is the technical losses in the grid (%).

The following result was obtained:

Type of project	Parameter	EF (tCO2/MWh)
JI project producing electricity	$EF_{grid,produced,y}$	0.807
JI projects reducing electricity	$EF_{grid,reduced,y}$	0.896

Table 34: Emission Factors for the Ukrainian grid 2006 - 2012

Monitoring
This baseline requires the monitoring of the following parameters:

- Electricity produced by the project and delivered to the grid in year y (in MWh);
- Electricity consumption reduced by the project in year (in MWh);
- Electricity produced by the project and consumed on-site in year y (in MWh);

The baseline emissions are calculated as follows:

$$BE_y = EF_{grid,produced,y} x EL_{produced,y} + EF_{grid,reduced,y} x \left(EL_{reduced,y} + EL_{consumed,y} \right) \qquad \textit{(Equation 39)}$$

Where:
BE_y are the baseline emissions in year y (tCO2);
$EF_{grid,produced,y}$ is the emission factor of producing projects (tCO2/MWh);
$EL_{produced,y}$ is electricity produced and delivered to the grid by the project in year y (MWh);
$EF_{grid,reduced,y}$ is the emission factor of reducing projects (tCO2/MWh);
$EL_{produced,y}$ is electricity consumption reduced by the project in year y(MWh);
$EL_{consumed,y}$ is electricity produced by the project and consumed on-site in year y (MWh).

This baseline can be used as ex-ante (fixed for the period 2006 – 2012) or ex-post. In case an ex-post baseline is chosen the data of the Ukrainian grid have to be obtained of the year in which the emission reductions are being claimed. Monitoring will have to be done in accordance with the monitoring plan of ACM0002 with the following exceptions:

- the Monitoring Plan should also include monitoring of the grid losses in year y;
- power plants at which JI projects take place should be excluded. Such a JI project should have been approved by Ukraine and have been determined by an Accredited Independent Entity.

Acknowledgements
The development of this new baseline has been made possible by funding of the EBRD and the Netherlands' Ministry of Economic Affairs. The authors would further like to thank the Ukrainian Ministry of Energy for supplying the data and the Ministry of Environmental Protection for their support. This baseline study can be used freely in case of proper reference.

Global Carbon B.V.
Version 5, 2 February 2007

Methodological approach towards incremental cement production

Introduction

In many developing countries, but also in Economies in Transition, like Ukraine and Russia, the cement demand has increased significantly over the years. This requires the construction of green field cement factories or the extension of existing cement plants. In countries like Ukraine and Russia the extension of the production capacity goes often hand in hand with the (partial) replacement of wet kilns with semi-dry or dry kilns.

Such projects could qualify as a JI or CDM projects. For the replacement of existing capacity, the characteristics of the existing facility can be used. However for an increase of capacity (further referred to as incremental production or incremental capacity) a different baseline has to be taken. This was ruled by the Executive Board of the CDM in its eighth meeting:

10. If a proposed CDM project activity seeks to retrofit or otherwise modify an existing facility, the baseline may refer to the characteristics (i.e. emissions) of the existing facility only to the extent that the project activity does not increase the output or lifetime of the existing facility. For any increase of output or lifetime of the facility which is due to the project activity, a different baseline shall apply[43].

The following methodological approach describes a how such a baseline could be established.

Baseline scenario versus baseline emission

Under any methodology first the baseline scenario has to be established by listing all options available to the project participant, identifying the alternative baseline scenarios and finally select the most credible and/or conservative baseline scenario. The proposed methodological approach assumes that these three steps are implemented and that the outcome of the baseline scenario is a continuation of the existing situation plus the displacement of other cement facilities for the production exceeding the existing production capacity.

Production versus capacity

A clear distinction has to be made by the actual production of cement and production *capacity*. The production of cement is defined as the actual monitored production of cement in a particular year in the project scenario. The production capacity relates to the maximum technical production of cement (or clinker) at a certain facility. It is assumed that the demand of cement is not affected by the project. Therefore, should the proposed project not be implemented, the production of the cement will be partially produced by the existing facility, if any, and partly produced by a third-party.

GHG emissions at existing capacity

First the existing[44] capacity (either clinker or cement capacity[45]) in the baseline scenario will be defined. It should be proven that he technical lifetime of the existing kilns are at least until the end of the crediting period.

The baseline production on the existing facility is calculated as follows:

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[43] EB08: Clarifications on issues relating to baseline and monitoring methodologies

[44] If any moth-balled and/or decommissioned kilns exist at the plant, these capacities can only be taken into account if a recommissioning would not require significant investments or does not face prohibitive barriers.

[45] The production capacity of a cement plant is mainly defined by the clinker capacity of the kilns. Therefore it is recommended to establish the production capacity for clinker.

$$CLNK_{exist,y} = CLNK_{actual,y} \quad \text{with a maximum of } CLNK_{existcap} \quad \text{(Equation 40)}$$

Where:
$CLNK_{exist,y}$ Clinker production in the baseline scenario on the existing kilns in year y [t clinker]
$CLNK_{actual,y}$ Clinker production in the project scenario in year y [t clinker]
$CLNK_{existcap}$ Clinker production *capacity* of the existing kilns [t clinker]

It is assumed that in the baseline scenario the existing facility would work on maximum capacity if the actual production in a particular year exceeds the existing capacity. The baseline emissions of the existing capacity are calculated by fixing the specific emissions of the existing kiln using a three year average prior to project start. Depending on the project boundary of the project, the electricity consumption, calcination and/or fuel emission have to be taken into account.

GHG emissions incremental production
The baseline incremental production is then calculated as follows:

$$CLNK_{incre,y} = CLNK_{actual,y} - CLNK_{existcap} \quad \text{if } CLNK_{actual,y} > CLNK_{existcap} \quad \text{(Equation 41)}$$

Where:
$CLNK_{incre,y}$ Incremental clinker production in the baseline scenario in year y [t clinker]
$CLNK_{actual,y}$ Clinker production in the project scenario in year y [t clinker]
$CLNK_{existcap}$ Clinker production *capacity* of the existing kilns [t clinker]

The baseline emissions of the incremental production should be calculated on the basis of displaced cement production at a third party producer. As this is a counterfactual situation, an approach needs to be developed how such counterfactual situation can be constructed while remaining transparent and conservative.

The cement industry is a transparent market where standardized types of cement products exist. Within a certain region or country cement can be transported from any producer to any consumer. A similar situation exists in an interconnected electricity grid where electricity can be transported from the producer to the consumer. Giving the similarity, the following approach is based on the underlying principles of “Tool to calculate the emission factor for an electricity system” adopted by the CDM Executive Board (further referred to as the CDM tool) which deals with additional capacities to be connected to an interconnected electricity grid.

If the JI/CDM project would not take place somebody else will have to produce the incremental capacity. This could either be:
1. Another cement plant, that exists in year y, would produce the incremental amount of cement (Operating Margin or OM);
2. A new cement plant that would have been built prior to year y, would produce the incremental amount of cement (Built Margin or BM).

Emissions of another existing cement plant (OM)
It is not possible to define which other existing cement plant would be producing the cement because it is a counterfactual situation. The most transparent approach is to calculate the weighted average of specific CO_2 emissions of cement plants in a specific region[46]. Therefore all cement plants in a region

[46] All cement plants in this context excludes cement plants hosting registered JI or CDM projects.

(e.g. for Ukraine the whole country, for Russia the 10 cement plants close to the project located in Russia) for each year will be monitored[47]. The result will be a factor expressed in tCO_2/t cement.

The OM will be calculated by using the following components
1. Emission from fuel consumption;
2. Emission from calcinations;
3. Emission from electricity consumption.

$$OM_y = \frac{EF_{el,y} x EL_y + 0.525 x CLNK_y + \sum_i EF_{fuel,i} x NCV_{fuel,i} x FUEL_{i,y}}{CEM_y} \quad \text{(Equation 42)}$$

Where:

OM_y	OM of cement production in year y [tCO2/t cement]
$EF_{el,y}$	Baseline grid factor in year y [tCO2/MWh]
EL_y	Total electricity consumption cement sector in year y [MWh]
0.525	Calcination emissions [tCO2/t clinker][48]
$CLNK_y$	Total clinker production in region in year y [tonne]
$EF_{fuel,i}$	Carbon emission factor of kiln fuel i [tCO2/GJ]
$NCV_{fuel,i}$	Net calorific value of kiln fuel i [GJ/tonne or 1000 m3]
$FUEL_{i,y}$	Total fuel consumption of kiln fuel i [tonne or 1000 m3]

Emissions of a new cement plant (BM)

In absence of the project a competitor could decide to build a new cement plant or extend an existing cement plant to meet the market demands. It is not possible to define with other new cement plant would have built as it is a counterfactual situation. In the CDM tool the most recent capacity additions to the electricity grid are to be taking into account comprising 20% of the installed capacity. This approach is very well applicable for regions were recently cement plants have been built. However this approach would not work in the cement sector in Ukraine or Russia as hardly any capacities have been added in the past decades. Such approach will lead to taking cement factories built 30 years ago or earlier and lead to a distorted picture (though many new cement plants are being planned). Therefore, in such a case the most *conservative* approach is to assume a cement plant would be built taking the Best Available Technology (BAT) in the region. The most important factor is to decide which production technology would be used (wet, semi-dry or dry). Although dry process the most efficient process, the selection of a production process depends on the moisture content of the available material in the region. A survey of the moisture content of the available raw material will have to be performed. Based on this survey a combination of dry and semi-dry processes[49] should be taken. If such a survey is not available, a survey should be presented of all new cement plants that are being planned in the region and the weighted average combination of the production technology should be taken. If such a survey is not available the most conservative process should be taken, i.e. a dry process has to be selected. The result is a certain kiln efficiency [GJ/t clinker] under the BM.

To determine the CO_2 emission the following factors will have to be established:
- fuel (mix) used as kiln fuels;

[47] CDM methodologies for the cement sector give certain guidance how to define a region.

[48] The calcination factor taken here is a default factor. If more detailed data exist the calcination factor should be based on this detailed information.

[49] A wet process can be considered to be an outdated technology.

- the clinker factor;
- the specific electricity consumption.

As an assumption the fuel in the BM will be identical to the fuel that will be used for cement plants under development (or commissioned in the past three years) in the country or the region. The clinker factor observed in a certain year in the region will be used as it can be assumed that the clinker factor does not depend on the process type (semi-dry or dry) but on the observed factor in the region in year y. The specific electricity consumption should be taken as BAT for the selected process type (semi-dry or dry).

The Built Margin is then calculated as follows:

$$BM_y = EF_{el,y} xEL_{BM,y} + CLNKFAC_y x0.525 + EF_{fuel} xKE_{BAT} xCLNKFAC_y \quad \text{(Equation 43)}$$

where:

BM_y	Specific emission of cement production in year y [tCO2/t cement]
$EF_{el,y}$	Baseline grid factor in year y [tCO2/MWh]
$EL_{BM,y}$	BAT specific electricity consumption [MWh/t cement]
CLNKFAC	Average clinker factor monitored in region in year y [t clinker/t cement]
0.525	Calcination emissions [tCO2/t clinker]
EF_{fuel}	Carbon emission factor of fuel [tCO2/GJ]
KE_{BAT}	BAT Kiln efficiency [GJ/t clinker]

Calculation of CM

The baseline factor is then the Combined Margin calculated by weighing the factor of the Operating Margin and the Built Margin on a 50%/50% basis as is also recommended in the CDM tool.

$$BEF_{ce\min cr,y} = \frac{OM_y + BM_y}{2} \quad \text{(Equation 44)}$$

Where:

$BEF_{cemincr,y}$	Combined Margin emission factor for incremental cement production (tCO2/t cement)
OM_y	Operating Margin (tCO2/t cement)
BM_y	Built Margin (tCO2/t cement)

The resulting factor is expressed in tCO2/t cement. The Combined Margin can be fixed ex-ante for the whole crediting period or used ex-post. When ex-ante is used a three year average over the parameters to be monitored should be taken prior to the setting of the baseline. When the Combined Margin is established ex-post the parameters should be monitored for the year in which the emission reductions are claimed.

Note

Global Carbon BV
16 July 2008
Version 4

Application of incremental cement approach

Baseline kiln economy of incremental kilns using Operating Margin
An investigation was conducted to assess the average kiln efficiencies of all 12 operating cement plants (only those plants producing clinker) in Ukraine and average electricity consumption. The data were processed accordingly to obtain the resulting figures presented below in a table.

Year		2005	2006
Average emissions at cement plants	tCO2/t cement	0.742	0.775

Table 35: CO_2 emissions at operating Ukrainian cement plants.

The specific emission factor is growing mainly due to the fact that natural gas is being replaced by coal and the share of coal will inevitably grow over the next years. The specific electricity consumption is within 0.107-0.109 MWh/t cement and emissions from electricity and calcinations are taken into account in the resulting figure. The value of 0.775 tCO_2 was used for baseline specific emission in the Operating Margin to calculate baseline emission and emission reduction in section E.

Baseline kiln economy of incremental kilns using Built Margin
The best available technology for cement production, not taking into account the moisture of raw material available is a dry process (However, Volyn-Cement can not use it exactly for the reason of having raw material of up to 24% moisture). From this point of view taking dry as a the Built Margin technology is conservative.

Modern dry kilns have kiln efficiencies from 3 to 3.8 GJ/ton of clinker[50]. The kiln efficiency of 3.20 GJ/ton of clinker, which is close to the one used in JI Project at Podilsky cement (3.18 GJ/ton of clinker) is used for Built Margin[51] for calculation of emission reductions in section E. The fuel to be used in the dry kiln would be coal, which is the most probable fuel for newly built cement kilns, as justified in section B.
The result of calculation of the BM specific emission factor is presented in a table below.

Parameter	Unit	
BL grid factor	tCO2/MWh	0.896
Specific electricity consumption BAT	MWh/t cement	0.110
Specific calcination emission	tCO2/t clnk	0.525
Average clinker factor in 2006	T clnk/t cement	0.736
Specific calcination emission	tCO2/cement	0.386
Carbon emission factor (coal):	tCO2/GJ	0.096
BAT kiln economy (dry)	GJ/t clinker	3.20
Specific emissions BM	tCO2/t cement	0.711

Table 36: CO_2 emissions BM

Combined Margin: Baseline incremental factor
The baseline factor is than calculated calculating the Combined Margin. using OM and BM on a 50%/50% basis. Therefore, currently in Ukraine the baseline incremental production factor $BEF_{incr,y}$ can be set as (0.775+0.711)/2=0.743 tCO_2/ton of cement. The baseline will be used ex-post and will be monitored each calendar year of the crediting period.

[50] Cement and lime brief revision. Specific energy consumption: http://iea.org/Textbase/work/2006/cement/bref.pdf

[51] Switch from wet-to-dry process at Podilsky Cement, Ukraine: http://ji.unfccc.int/JI_Projects/DB/BPTY

Calculation of leakage

Slag will be used to partially replace the traditional raw materials. It will be transported via Ukrainian railroads from metallurgical plants, where it is originated, to the project site. Transportation of slag will cause grid emissions due to consumption of electricity by rail locomotives, which represents the project leakage. Formula to be used for calculating of leakage is given in section D.1.3. Data of slag transported and consumed for raw mix preparation, average transportation distance of slag and specific emissions due to consumption of electricity by railroads will be monitored each calendar year of the crediting period to obtain the exact value of annual leakage.

Annex 3

MONITORING PLAN

See Section D for the monitoring plan