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 1.5 dated 30 January 2008.

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 from 1st of January 2010.

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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 and. 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;
- 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;

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

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

- 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:

The project is located at town of Zdolbuniv, about 10 km. from Rivne – one of regional centres of Western Ukraine, 300 km west from Kyiv.

Figure1: Ukraine, the project location and neighbouring countries

A.4.1.1. Host Party(ies):

Ukraine

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.

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.

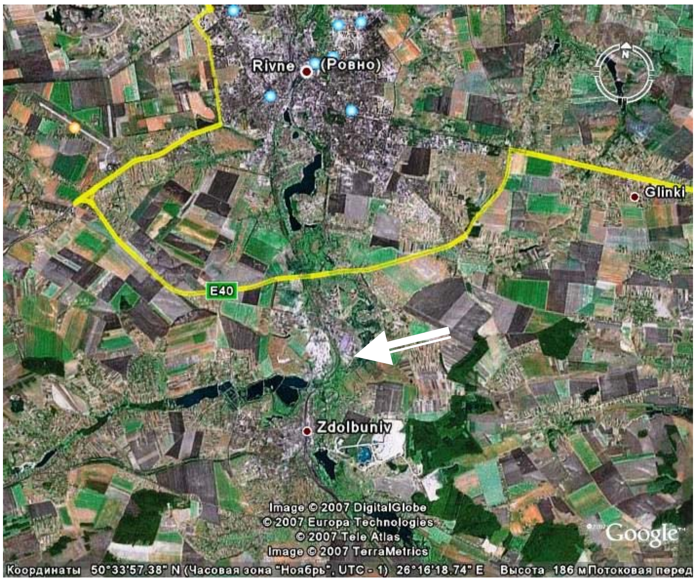

Figure 2: The town of Zdolbuniv near Rivne[3].

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°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.

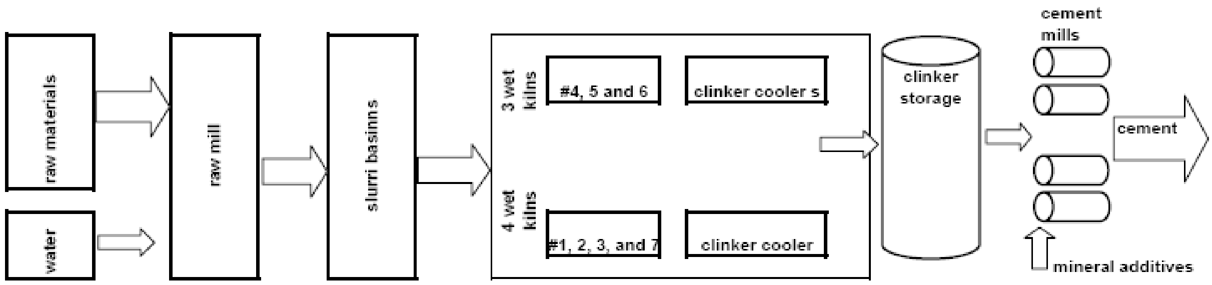

Figure 3: Existing wet cement production process at Volyn-Cement.

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).

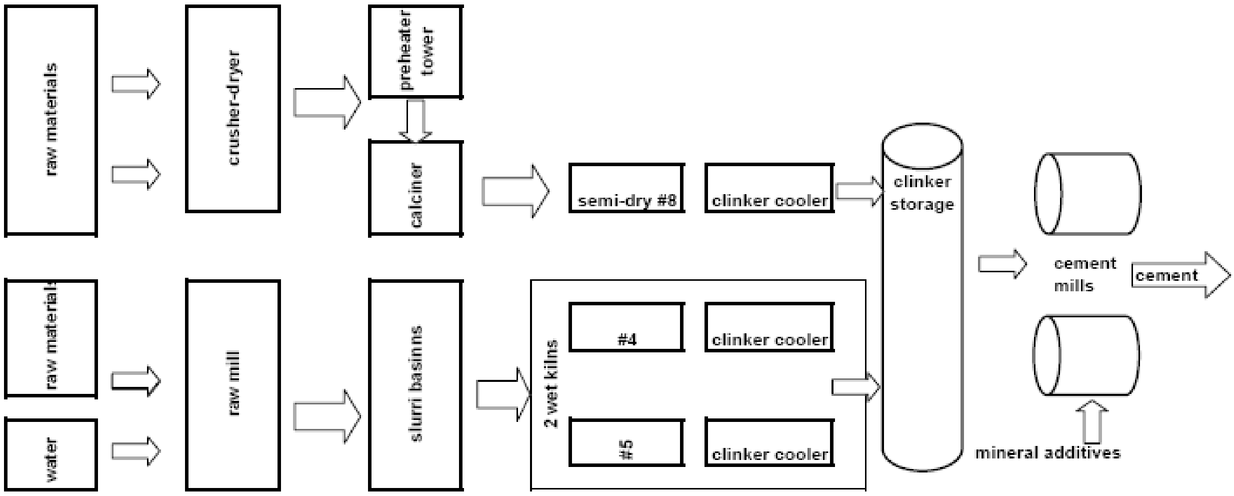

Figure 4: Semi-dry cement production process in the project scenario.

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 spring 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.

Risks of the project

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

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

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 dry technology in Ukraine.	Dyckerhoff AG is operating dry and semi-dry cement kilns, and has practical experience in switching from wet to 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 calcinated 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 period within which emission reduction units are to be earned	3
Length of the crediting period	3
Year	Estimate of annual emission reductions in tonnes of CO_2 equ.
Year 2008	0
Year 2009	0
Year 2010	377 457
Year 2011	377 457
Year 2012	377 457
Total estimated emission reductions over the period within which emission reduction units are to be earned (tonnes of CO_2 equiv.)	1 132 371
Total estimated emission reductions over the crediting period (tonnes of CO_2 equiv.)	1 132 371
Annual average of estimated emission reductions over the crediting period/period within which emission reduction units are to be earned (tonnes of CO_2 equiv.)	377 457

Table 5: Estimated emission reduction

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 has gone through the determination process, the PDD and the Determination Protocol will be presented to the Ministry of Environment of Ukraine to obtain a Letter of Approval. Subsequently a Letter of Approval of Germany and the Netherlands will be obtained.

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, 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 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.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.

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.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 reasonable.

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 it’s 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.

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.
However 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.

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 04)" 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.

[8] AM0040, page 5.

Preliminary screening
a) The project activity has not been started yet and the JI activity will start after 1st January 2010. The construction of the project is expected to start, pending JI and board approval, in 2008-2009 with the new kiln to be commissioned beginning of 2011.

b) The JI project is currently being considered by Dyckerhoff. 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 04) can not be used. The investment options (alternative scenarios) considered above are unlikely to be implemented so investment analysis (Option II), based on comparison of NPV and other indicators for different project options is not applicable. Thus in line with the CDM Additionality Tool version 04 only Option III – benchmark analysis - is relevant for the presented subprojects. The mentioned above document 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 mentioned above document 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 explicitly is not 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. Both projects will be commissioned 1 January 2010.

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 6: 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.

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 but it will soon reach its ceiling. 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 Fe 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 7: 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 04.

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.

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 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

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

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 2011 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.

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 8: Sensitivity Analysis Summary for SP2.

Calculations demonstrate that a five year pay back period is reached only when cement price grows 80% that we consider unrealistic. 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 project is not attractive for Dyckerhoff AG to be implemented and is additional in line with CDM Additionality Tool version 04.

Step 3. Barrier analysis

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

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[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 .

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 8% 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 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

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

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 in the design or implementation phase.

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	CO_2	Indirect	Included	• The electricity consumption will decrease • Emissions calculated using standardized electricity baseline Ukraine[15]

[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

	meal.				
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
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.

Table 9: Sources of emissions

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

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

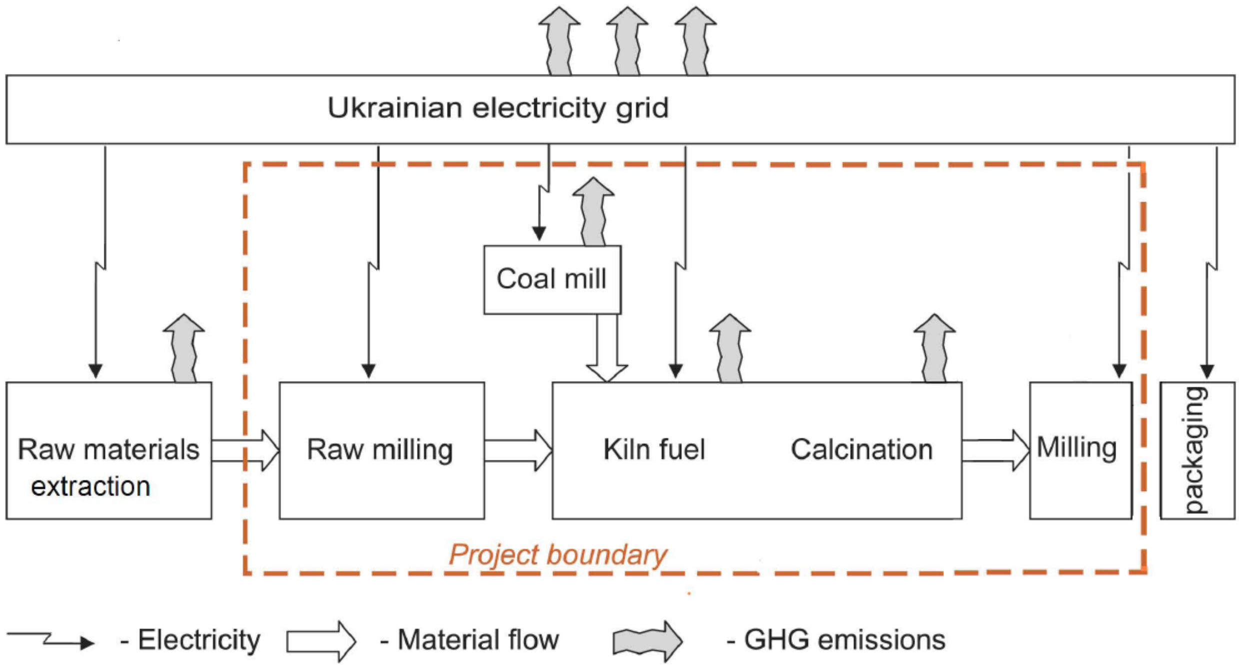

Figure 5: Sources of emissions and project boundary

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: 30 January 2008

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 January 2010 for start of operation of new semi-dry kiln.

One of the key factors determining the investment decision and, as a consequence, the date of commissioning, is JI project approval. For the purpose of setting the length of the crediting period the most optimistic scenario, being 1 January 2010, has been selected.

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 years. 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 10: Some examples of operating dry process kilns within the Dyckerhoff Group

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 BM/OM approach as given in annex 2

Assumptions:

- The emissions at the quarry;
- 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.3)	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	
P2	$PE_{calc,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P3	$PE_{calc\_wet,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P4	$PE_{calc\_s-dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P5	$PE_{kiln,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P6	$PE_{kiln\_wet,y}$	Plant records	tCO_2	c	Annually	100%	Electronic	
P7	$PE_{kiln\_s-dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	

P8	$PE_{dust,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P9	$ByPass_{s-dry,y}$	Plant records	tonnes	m/c	Annually	100%	Electronic	Annual test will be performed
P10	$CKD_{s-dry,y}$	Plant records	tonnes	m/c	Annually	100%	Electronic	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	
P12	$PE_{RM,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P13	$PE_{RMwet,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P14	$PE_{RMs-dry,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P15	$PE_{coal,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P16	$PE_{coal\_electr,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P17	$PE_{coal\_fuel,y}$	Plant records	tCO_2	c	Annually	100%	Electronic	
P18	$PE_{slag,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	

P19	$PE_{grind,y}$	Plant records	tCO_2	C	Annually	100%	Electronic	
P20	$EF_{el,y}$	Plant records	tCO_2/ MWh	C	Annually	100%	Electronic	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	
P22	NCV_{fuel_i}	Plant records	GJ/tonne	m/c	Per shipment	100%	Electronic	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	
P24	$CaO_{clnk\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic	Volyn-Cement plant laboratory measurement
P25	$MgO_{clnk\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic	Volyn-Cement plant laboratory measurement
P26	$RM_{PR\_wet,y}$	Plant records	tonnes	M	Annually	100%	Electronic	
P27	$CaO_{RM\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic	Volyn-Cement plant laboratory measurement
P28	$MgO_{RM\_PR\_wet,y}$	Plant records	%	M	daily	100%	Electronic	Volyn-Cement plant laboratory measurement

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

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

P39	$EL_{mill\&conway,y}$	Plant records	MWh	M	Continuously	100%	Electronic	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	Fuel for dryer's heat generator can be both, natural gas or coal
P41	$EL_{slag,y}$	Plant records	MWh	M	Continuously	100%	Electronic	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	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	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 11: 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.

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

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:

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

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 non-carbonate CaO content in clinker produced by semi-dry kiln in % in year y
$CaO_{RM\_PR\_s-dry,y}$	is the non-carbonate CaO content in raw meal for semidry kiln in % in year y
$MgO_{CLNK\_PR\_s-dry,y}$	is the non-carbonate MgO content in clinker produced by semidry kiln in % in year y
$MgO_{RM\_PR\_s-dry,y}$	is the non-carbonate MgO content in raw meal for semidry kiln in % in year y
$CLNK_{PR\_s-dry,y}$	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 meal 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)
$EF_{fuel\_i,\ y}$	fuel of type *i* Emission Factor (tCO_2/GJ)

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

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)

Bypass dust

It is projected that the new semi-dry kiln will be equipped with gas bypass. In this case there can be a portion of bypass dust discarded. If there is such a discarded bypass dust from kiln bypasses and dedusting units (CDK), the project emissions due to discarded dust shall be determined as follows:

$$PE_{dust,y} = PE_{calc\_s-dry,y} \times ByPass_{s-dry,y} + \frac{PE_{calc\_s-dry,y} \times d_{s-dry,y}}{\left[PE_{calc\_s-dry,y}(1-d_{s-dry,y})+1\right]} \times CKD_{s-dry,y} \qquad (8)$$

Where;

$ByPass_{s-dry,y}$ is the annual production of bypass dust living semi-dry kiln system in year y(tonnes)
$CKD_{s-dry,y}$ is the annual production of CKD dust leaving semi-dry kiln systems in year y (tonnes)
$d_{s-dry,y}$ is the CKD calcinations rate % (released CO_2 expressed as a fraction of the total carbonates CO_2 in the raw meal for semi-dry kilns)

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.

$$PE_{RM,y} = PE_{RM\_wet,y} + PE_{RM\_semi-dry,y} \qquad (9)$$

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)

$PE_{RM\_semi\text{-}dry,y}$ 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)

$$PE_{RM\_wet,y} = EF_{el,y} \times EL_{RM\_wet,y} \qquad (10)$$

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)

$$PE_{RM\_s-dry,y} = EF_{el,y} \times EL_{RM\_s-dry,y} \qquad (11)$$

Where:

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

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

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

Coal preparation

$$PE_{coal,y} = PE_{coal\_electr,y} + PE_{coal\_fuel,y} \qquad (12)$$

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:

$$PE_{coal\_electr,y} = EF_{el,y} \times EL_{mill\&convey,y} \qquad (13)$$

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)

$$PE_{coal\_fuel,y} = EF_{fuel\_i,y} \times FC_{dryer,y} \qquad (14)$$

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

$$PE_{slag,y} = EL_{slag,y} \times EF_{el,y} + FC_{slag,y} \times EF_{fuel\_i} \quad (15)$$

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.

$$PE_{grind,y} = EL_{grind,y} \times EF_{el,y} \quad (16)$$

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	

B2	$BE_{calc,y}$	Plant records	tCO2	C	annually	100%	electronic	
B3	$BE_{calc\_wet, y}$	Plant records	tCO2	C	annually	100%	electronic	
B4	$BE_{kiln,y}$	Plant records	tCO2	C	annually	100%	electronic	
B5	$BE_{kiln\_wet,y}$	Plant records	tCO2	C	annually	100%	electronic	
B6	$BE_{RM,y}$	Plant records	tCO2	C	annually	100%	electronic	
B7	$BE_{RM\_wet,y}$	Plant records	tCO2	C	annually	100%	electronic	
B8	$BE_{coal,y}$	Plant records	tCO2	C	annually	100%	electronic	
B9	$BE_{coal\_electr\_wet, y}$	Plant record	tCO2	C	annually	100%	electronic	
B10	$BE_{coal\_fuel\_wer, y}$	Plant records	tCO2	C	annually	100%	electronic	
B11	$BE_{slag,y}$	Plant records	tCO_2	C	annually	100%	electronic	
B12	$BE_{grind,y}$	Plant records	tCO_2	C	annually	100%	electronic	

B13	$BE_{incr,y}$	Plant records	tCO2	C	annually	100%	electronic	See annex 2 for explanation
B14	$CLNK_{BL\_wet,y}$	Plant records	tonnes	C	annually	100%	electronic	
B15	$CEM_{BL\_incr,y}$	Plant records	tonnes	C	annually	100%	electronic	
B16	$CLNK_{BL\_wet\_cap}$	Plant records	tonnes	C	annually	100%	electronic	Maximum capacity of all kilns operating in the baseline scenario, see annex 2.
B17	$CLNKFAC_{y}$	Plant records	%	C	annually	100%	electronic	
B18	$RM_{BL\_wet,y}$	Plant records	tonnes	C	annually	100%	electronic	
B19	$RATIO_{RM/CLNK\_wet,y}$	Plant records	tonnes	C	annually	100%	electronic	
B20	BKE_{wet}	Plant records	GJ/tonne of clinker	m/c	annually	100%	electronic	This value has been fixed using the average of 2004,2005and 2006. See annex 2
B21	$EF_{fuel\_i,y}$	Plant records	tCO2/ GJ	m/c	Per shipment	100%	electronic	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	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	

B24	$FC_{coal\_BL\_wet,y}$	Plant record	Tonnes of coal	C	annually	100%	electronic	
B25	$FSP_{coalmill\_PR,y}$	Plant record	GJ/ton of coal	m/c	annually	100%	electronic	
B26	$EL_{slag\_incr,y}$	Plant record	MWh	M	continuously	100%	electronic	
B27	$ELSP_{grind}$	Plant record	MWh/t cement	m/c	annually	100%	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	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	See annex 2.

Table 12: 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.

$$BE_y = BE_{calc\_wet,y} + BE_{kiln\_wet,y} + BE_{RM\_wet,y} + BE_{coal,y} + BE_{slag,y} + BE_{grind,y} + BE_{incr,y} \quad (17)$$

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)

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

$BE_{kiln\_wet,y}$ 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

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:

$$CLNK_{BL\_wet,y} = CLNK_{PR\_wet,y} + CLNK_{PR\_s-dry,y} \text{ with a maximum of } CLNK_{BL\_wet\_cap} \qquad (18)$$

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:

$$BE_{calc\_wet} = 0.785(CLNK_{BL\_wet,y} \times CaO_{CLNK\_PR\_wet,y} - RM_{wet,y} \times CaO_{RM\_PR\_wet,y}) + 1.092(CLNK_{BL\_wet,y} \times MgO_{CLNK\_PR\_wet,y} - RM_{wet,y} \times MgO_{RM\_PR\_wet,y}) \qquad (19)$$

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 produced by wet kilns 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

$CLNK_{BLwet,y}$ is the clinker production on wet kilns in baseline scenario in year y (tonnes)
$RM_{wet,y}$ is the consumption of raw meal by wet kilns in baseline scenario in year y (tonnes). It is calculated the following way:

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

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

$$RATIO_{RM/CLNK\_wet,y} = RM_{PR\_wet,y} \div CLNK_{PR\_wet,y} \quad (21)$$

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]:

$$BE_{kiln\_wet,y} = EF_{fuel\_i,y} \times BKE_{wet} \times CLNK_{BL\_wet,y} \quad (22)$$

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

$$BE_{RM\_wey,y} = EF_{el,y} \times BEL_{RM\_wet} \times CLNK_{BL\_wet,y} \quad (23)$$

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)

[20] JI0001

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)
$CLNK_{BLwet,y}$	is the production of clinker in the baseline scenario on wet kilns in year y (tonnes)

Coal preparation baseline

$$BE_{coal,y} = BE_{coal\_electr,y} + BE_{coal\_fuel,y} \quad (24)$$

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:

$$BE_{coal\_el\_wet,y} = ELSP_{coalmill\_PR\_y} \times FC_{coal\_BL\_wet,y} \times EF_{el,y} \quad (25)$$

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 it's specific fuel consumption as follows:

$$BE_{coal\_fuel\_wet,y} = \sum_i FSP_{heat\_gen\_i\_PR,y} \times FC_{coal\_BL\_wet,y} \times EF_{fuel\_i,y} \qquad (26)$$

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:

$$FC_{coal\_BL\_wet,y} = BKE_{wet} \times CLNK_{PR\_wet,y} \qquad (27)$$

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:

$$BE_{grind,y} = ELSP_{grind} \times CLNK_{BL\_wet,y} / CLNKFAC_y \times EF_{el,y} \qquad (28)$$

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

$$BE_{incr,y} = CEM_{BLincr,y} x BEF_{incr,y} \qquad (29)$$

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:

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

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)
$CLNK_{PR\_s-dry,y}$ 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 (%)

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

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. This leakages has not been taken into account for simplicity and to be conservative. Other leakages were not identified.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

$$ER_y = BE_y - PE_y \quad (31)$$

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)

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.

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: 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 National Accreditation Agency of Ukraine, 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.

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 laboratory 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
- Global Carbon B.V.

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
1	Kiln fuel	[tCO2/yr]	420 193	739 060	1 000 540	1 000 540	1 000 540
2	Calcination emissions	[tCO2/yr]	630 000	816 480	1 102 238	1 102 238	1 102 238
3	Raw mill and kiln	[tCO2/yr]	57 848	74 971	114 308	114 308	114 308
4	Coal mill	[tCO2/yr]	0	6 588	14 121	14 121	14 121
5	Slag preparation	[tCO2/yr]	0	0	40 799	40 799	40 799
6	Clinker grinding	[tCO2/yr]	57 976	75 138	83 317	83 317	83 317
7	Dust from kiln	[tCO2/yr]	0	0	0	0	0
8	Total	[tCO2/yr]	1 166 018	1 712 237	2 355 323	2 355 323	2 355 323
9	Total 2008 - 2012	[tCO2]	9 944 223				

Table 14: Estimated project emissions

E.2. Estimated leakage:

0

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

Project emissions			2008	2009	2010	2011	2012
1	Kiln fuel	[tCO2/yr]	420 193	739 060	1 000 540	1 000 540	1 000 540
2	Calcination emissions	[tCO2/yr]	630 000	816 480	1 102 238	1 102 238	1 102 238
3	Raw mill and kiln	[tCO2/yr]	57 848	74 971	114 308	114 308	114 308
4	Coal mill	[tCO2/yr]	0	6 588	14 121	14 121	14 121
5	Slag preparation	[tCO2/yr]	0	0	40 799	40 799	40 799
6	Clinker grinding	[tCO2/yr]	57 976	75 138	83 317	83 317	83 317
7	Dust from kiln	[tCO2/yr]	0	0	0	0	0
8	Total	[tCO2/yr]	1 166 018	1 712 237	2 355 323	2 355 323	2 355 323
9	Total 2008 - 2012	[tCO2]	9 944 223				

Table 15: Estimated project emissions

E.4. Estimated baseline emissions:

Baseline emissions			2008	2009	2010	2011	2012
1	Kiln fuel	[tCO2/yr]	420 193	739 060	1 057 447	1 057 447	1 057 447
2	Calcination emissions	[tCO2/yr]	630 000	816 480	924 840	924 840	924 840
3	Raw mill and kiln	[tCO2/yr]	57 848	74 971	84 921	84 921	84 921
4	Coal mill	[tCO2/yr]	0	6 588	14 925	14 925	14 925
5	Slag preparation	[tCO2/yr]	0	0	10 474	10 474	10 474
6	Clinker grinding	[tCO2/yr]	57 976	75 138	85 109	85 109	85 109
7	Incremental	[tCO2/yr]	0	0	555 065	555 065	555 065
8	Total	[tCO2/yr]	1 166 018	1 712 237	2 732 780	2 732 780	2 732 780
9	Total 2008 - 2012	[tCO2]	11 076 594				

Table 16: 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	377 457	377 457	377 457
Total 2008 - 2012	[tCO2]	1 132 371				

Table 17: 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 equ.)	Estimated leakage (tonnes of CO_2 equ.)	Estimated baseline emissions (tonnes of CO_2 equ.)	Estimated emission reductions (tonnes of CO_2 equ.)
Year 2008	1 166 018	0	1 166 018	0
Year 2009	1 712 237	0	1 712 237	0
Year 2010	2 355 323	0	2 732 780	377 457
Year 2011	2 355 323	0	2 732 780	377 457
Year 2012	2 355 323	0	2 732 780	377 457
Total (tonnes of CO_2 equ.)	9 944 223	0	11 076 594	1 132 371

Table 18: Overview of project, baseline, and emission reductions

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.

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.

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

1. Approval by the local authorities
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.

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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

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 by the end of 2008

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 $CLNK_{BL\_wet\text{-}cap}$. 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

Table19. 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 open competitive cement market circumstances a Volyn-Cement competitor (-s) would produce this increment unless Volyn-Cement would not produce it. Subsequently, the carbon emissions would occur from competitors incremental production. There is no existing methodology to suit the case. Therefore new approach to incremental production emission has been proposed on the next page.

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:

$$BKE_{wet} = \sum_{y} \frac{FC_y \times NCV_y}{CLNK_y} \times \frac{1}{3} \qquad (32)$$

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 20: 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 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 21: 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.

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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
Page 1 of 4

The test results refer exclusively to the units under test.

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TÜV SÜD 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 // borisov@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 national 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

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 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[24].

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 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. Should the proposed project not be implemented, the production of the cement will be partially produced by the existing facility and partly produced by a third-party.

GHG emissions at existing capacity
First the existing[25] capacity (either clinker or cement capacity[26]) 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:

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

[25] 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 faces prohibitive barriers.

[26] 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.

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

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:

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

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 ACM0002 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 with other 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[27]. Therefore all cement plants in a region (e.g. for

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

Ukraine the whole country, for Russia a certain part of Russia) for each year will be monitored[28]. 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.

$$OM_y = \frac{EF_{el,y} x EL_y + 0.525 x CLNK_y + \sum_i EF_{fuel,i} x NCV_{fuel,i} x FUEL_{i,y}}{CEM_y}$$

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][29]
$CLNK_y$	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. In ACM0002 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. 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). The selection between a 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[30] should be taken. If such a survey is not available, or the moisture content of all available raw materials is sufficiently low, 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;
- the clinker factor;
- the specific electricity consumption.

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

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

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

As an assumption the fuel mix in the BM will be identical to the fuel mix observed in a certain year in the region. The same applies to the clinker factor where it is 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:

$$BM_y = EF_{el,y} x EL_{BM,y} + CLNKFAC_y x 0.525 + EF_{fuelav,y} x KE_{BAT} x CLNKFAC_y$$

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]
$EF_{fuelav,y}$	Weighted average carbon emission factor used in region in year y [tCO2/GJ]
KE_{BAT}	BAT Kiln efficiency [GJ/t clinker]

Calculation of OM/BM

The baseline factor is then calculated by weighing the factor of the Operating Margin and the Built Margin on a 50%/50% basis as is also recommended in ACM0002.

$$BEF_{ce\min cr,y} = \frac{OM_y + BM_y}{2}$$

Where:

$BEF_{cemincr,y}$	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.

Note

Global Carbon BV
14 December 2007
Version 3

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

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 22: CO_2 emissions at operating Ukrainian cement plants.

The specific emission is growing mainly due to the fact, that natural gas is being replaced by coal. Te share of coal will inevitably grow over 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 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 the 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 this is conservative.

Modern dry kilns have kiln efficiencies from 3 to 3.8 GJ/ton of clinker[31]. 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[32] 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 23: CO_2 emissions BM

Baseline incremental factor
The baseline factor is than calculated 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.

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

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

Annex 3

MONITORING PLAN

See Section D for the monitoring plan