INITIAL AND FIRST PERIODIC ANNUAL JI MONITORING REPORT

Version 2.2

24 July 2012

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SECTION A. General project activity and monitoring information

A.1 Title of the project activity:

"Switch from wet-to-dry process at Podilsky Cement, Ukraine".

Sectoral scope: 4. Manufacturing industries

A.2. JI registration number:

Reference number: 0001

ITL Project ID: UA2000001

A.3. Short description of the project activity:

Cement production is a highly energy intensive process that generates significant emissions of greenhouse gases, in particular CO_2. There are two 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 project aims to significantly decrease emissions of the first source (fossil fuel combustion) at Podilsky Cement Plant in Ukraine by changing the cement production process from wet to dry.

The Podilsky Cement Plant has been constructed in the 1970s and was originally equipped with six cement producing kilns using wet production process. The project significantly decreases the emissions of fossil fuel combustion by changing the technology of cement production from wet to dry.

The average energy consumption at Podilsky Cement over the years of only wet process production was 6.771 GJ per tonne of clinker produced. The expected energy consumption of the dry cement production system at Podilsky Cement will be approximately 3.180 GJ per tonne of clinker produced. This constitutes reduction of 53% in energy consumption.

The proposed JI project includes the following activities:

- Preparation of the site, including removal of obsolete installations;
- Installation of equipment for milling and homogenization of the raw material;
- Installation of a pre-calciner and preheater tower;
- Installation of a new kiln for dry cement production;
- Gradual switch of production to the dry process.

A.4. Monitoring period:

- Monitoring period starting date: 01/10/2011;
- Monitoring period closing date: 31/12/2011[1].

A.5. Methodology applied to the project activity:

The JI-specific approach is used for the monitoring of emission reductions in accordance with the appendix B of the JI guidelines[2].

[1] Both days included.

[2] The annex of decision 9/CMP.1.

A.5.1. Baseline methodology:

The baseline methodology and scenario has been described in the PDD version 2.1. dated 2nd of February 2007, Section B.1. The determination of the project has been deemed final by the JISC.

The baseline is the scenario that reasonably represents the anthropogenic emission by source of greenhouse gases that would occur in absence of the proposed project. In many CDM methodologies the approach to establish the baseline is firstly to identify several baseline alternatives. As the proposed project is not registered as a JI project, should be included as an alternative as well. These alternatives should be assessed whether or not these alternatives are credible and plausible. Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario. There should be consistency between baseline scenario determination and additionality determination.

The approach described above has been used to identify the baseline scenario for this JI project. The identified baseline scenario for this project is: *Production of cement using a wet process with coal as fuel.*

A.5.2. Monitoring methodology:

For the elaboration of monitoring methodology JI-specific approach was used (see baseline methodology). The project activity only affects the emissions related to the kiln fuel, 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. Please note that, as part of the in-house reporting system at Podilsky Cement Plant, all emissions are monitored using the WBCSD[3] "CO_2 Emissions Monitoring and Reporting Protocol for the Cement Industry".

A.6. Status of implementation including time table for major project parts:

The project has been started in year 2006 when the decision to proceed with the project has been taken by the ownership of Podilsky Cement Plant – CRH Group.

Activity	Date in the PDD	Actual date
Kiln for wet cement production #1 stopped	-	August 2011
Kiln for wet cement production #3 stopped*	-	October 2011
Kiln for wet cement production #4 stopped	-	November 2011
Kiln for wet cement production #5 stopped	-	October 2011
Kiln for wet cement production #6 stopped	-	October 2011
Project approval by the CRH Board	December 2006	December 2006
Determination of the project has been deemed final by the JISC	March 2007	March 2007
Start of construction of the new dry kiln	December 2007	December 2007
Start-up of the new kiln for dry cement production	July 2009	July 2011

* There is no kiln for wet cement production #2

Table 1: Implementation plan

The commissioning of the new kiln has occurred later than expected in the PDD. According to the initial plan it should have happened in 2009. Due to the slowdown in the second half 2008 and following significant recession in construction industry in Ukraine in 2009 and 2010 the construction of the kiln was slowed down so that the commissioning has been postponed until late 2011.

[3] World Business Council for Sustainable Development

Letters of Approval were issued by both Parties involved mentioned in the PDD:

Letter of Approval from the Ministry of Environmental Protection of Ukraine #11672/10/3-10 dated 27th of December 2006.

Letter of Approval from the Environmental Protection Agency of Ireland #FP-IE-07-001a dated 19th of January 2007.

A.7. Intended deviations or revisions to the registered PDD:

There are no deviations to the PDD, except for revisions of the monitoring plan (refer to Section A.8.). This JI project was made publicly available on the UNFCCC website. The full text of PDD could be found at

http://ji.unfccc.int/UserManagement/FileStorage/62HINFHR08HYV4Y0O6C0074UVY11VL

The actual emission reductions in the monitoring report are different from the forecast in the registered PDD:

	Data in the PDD	Data in this report
Emission reductions in 2011 (adjusted for the 3 month period), tCO_2e	183 411	108 915

Table 2: Emission reduction comparison

The differences are due to the fact that estimates in the PDD were based on forecasted data for clinker production as of 2007. Another factor was the necessity to run equipment in the commissioning mode during the initial operation period. As the result the emission reductions are lower than expected which is conservative.

A.8. Intended deviations or revisions to the monitoring plan:

The monitoring plan (MP) for this project has been revised. Please refer to Annex 2 of this report for the full text of the revised monitoring plan as well as reasons for such revisions.

A.9. Changes since last verification:

Not applicable.

A.10. Person(s) responsible for the preparation and submission of the monitoring report:

PJSC Podilsky Cement, CRH Ukraine:

- Barnes Murphy, Project Manager.

Global Carbon B.V.:

- Denis Prusakov, Senior JI consultant.

SECTION B. Key monitoring activities

(According to the monitoring plan for the monitoring period stated in A.4.)

For the monitoring period stated in A.4. the following parameters have to be collected and registered:

1. **Indirect specific carbon dioxide emissions from electricity consumption**

   This parameter is determined as indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052. These data are provided by the Designated Focal Point (DFP) of Ukraine in form of Orders or other communications. Data for 2008-2011 are already available in the orders of the National Environmental Investment Agency of Ukraine. Regular cross-checks with the DFP of Ukraine and checks of the updates of this information are performed.

2. **Coal consumption by the kilns**

   For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. The direct coal consumption in the system is measured continuously during its operation by the proportioning belt scales. Write-off certificates, purchase data and stock surveys as well as other commercial documents are used in order to confirm the amount of coal consumed. For the period when both dry and wet kilns are operating simultaneously, coal consumption by both kilns is taken into account. These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice as well as reported to national and local authorities.

3. **Natural gas consumption by the kilns**

   For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total natural gas consumption by the entire plant is measured by the commercial metering system and natural gas consumption for each unit is monitored by internal technical meters. As the result of previous units' operation analysis, standard values of specific natural gas consumption have been developed for each unit. Operation of previous units was analysed in different modes. The standard values are used for technical meter readings cross-checks. But for the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of technical natural gas metering equipment mistakes or breakdown, consumption can be evaluated using standard specific values. This fact should be described in relevant monitoring report.

   For the period when both dry and wet kilns are operating simultaneously natural gas consumption by both kilns is taken into account. These data are collected by the internal monitoring and reporting systems at Podilsky Cement, and used in the existing normal business practice as well as reported to national and local authorities.

4. **Net Calorific Value of coal**

   For the monitoring of this parameter the laboratory reports with cross-checks from the suppliers certificates are used. When purchased, coal is accompanied by the certificate containing Net Calorific Value of coal. The Podilsky Cement's laboratory department will store these certificates, perform its own tests, if necessary, and will calculate the weighted average value of the Net Calorific Value at the end of each monitoring period.

5. Net Calorific Value of natural gas

For the monitoring of this parameter the laboratory reports with cross-checks from the supplier certificates are used. The official reports (statements) from the local gas distribution company (supplier) contain these data. Podilsky Cement's laboratory department will store these certificates and will provide the value of the Net Calorific Value at the end of each monitoring period.

6. Electricity consumption of raw milling and kiln

For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total electricity consumption by the entire plant is measured by the commercial metering system and electricity consumption for each unit is monitored by internal technical meters. As the result of previous units' operation analysis, standard values of specific electricity consumption have been developed for each unit. Operation of previous units was analysed in different modes. The standard values are used for technical meters' readings cross-checks. For the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of electricity metering equipment mistakes or breakdown, consumption can be evaluated using standard specific electricity values. This fact should be described in relevant monitoring report.

For the period when dry and wet kilns are operating simultaneously electricity consumption by both kilns is taken into account. These data are collected by the internal monitoring and reporting systems at Podilsky Cement, and used in the existing normal business practice as well as reported to national and local authorities.

7. Electricity consumption of coal mill

For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total electricity consumption by the entire plant is measured by the commercial metering system and electricity consumption for each unit is monitored by internal technical meters. As the result of previous units' operation analysis, standard values of specific electricity consumption have been developed for each unit. Operation of previous units was analysed in different modes. The standard values are used for technical meter' readings cross-check. For the preparation of production report (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of electricity metering equipment mistakes or breakdown, consumption can be evaluated using standard specific electricity values. This fact should be described in relevant monitoring report.

For the period when dry and wet kilns are operating simultaneously electricity consumption by both kilns is taken into account. These data are collected by the internal monitoring and reporting systems at Podilsky Cement, and used in the existing normal business practice as well as reported to national and local authorities.

8. Natural gas consumption of the coal mill heat generator

For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total natural gas consumption by the entire plant is measured by the commercial metering system and natural gas consumption for each unit is monitored by internal technical meters.

As the result of previous units' operation analysis, standard values of specific electricity consumption have been developed for each unit. Operation of previous units was analysed in different modes. The standard values are used for cross-check of technical meter readings. For the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter' readings are used. Only in case of metering equipment mistakes or breakdown, consumption can be evaluated using standard specific values. This fact should be described in relevant monitoring report.

9. Amount of clinker produced

For the monitoring of this parameter the operational data, production reports and commercial data of the company are used. Kiln feed management system on Podilsky Cement is used as the monitoring and reporting system of clinker production as well as for data collection. Amount of clinker produced is calculated by multiplying special transition coefficient by feed (raw meal) consumption in the kiln feed management system. These data are collected by the internal monitoring and reporting systems at Podilsky Cement, and used in the existing normal business practice as well as reported to national and local authorities. For the period when dry and wet kilns are operating simultaneously electricity consumption by both kilns is taken into account.

B.1.1. Monitoring equipment types

The monitoring equipment used for the monitoring of emission reductions in this project falls into several categories:

1. Electricity meters: "ACE 6000"
2. Natural gas meters: "FlouTek-TM-1-3" "TERZ 94"
3. Proportioning belt scales: "Gravit 100"
4. Raw Meal Feeders: "FlowMeter"

B.1.2. Table providing information on the equipment used:

ID	Measuring instrument	Unit	Manufacturer	Type	Serial number	Accuracy class or error	Last calibration	Next Calibration	Comment
NG1	"FlouTek-TM-1-3"	m^3	"DP UkrGasTech" LTD, Kiev, Ukraine	Metering system for natural gas consumption measurement	1-1891	for 10-100 % ± 0.35% for 1-10 % ± 0.50%	02/09/2011	02/09/2013	Commercial metering system at gas distribution station[4].
NG2	"TERZ 94"	m^3	RMG Group, Germany	Electronic Turbine Meter	600787	for 20-100 % ± 2% for 1-20 % ± 3%	03/10/2011	03/10/2013	Natural gas consumption by the heat generator of the coal mill
EL1	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065369	1.0	IV/2010	IV /2016	Raw materials conveying Substation 22A Input 1 Cell 106
EL2	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065379	1.0	II/2010	II/2016	Raw materials conveying Substation 22A Input 2 Cell 202
EL3	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065516	1.0	III/2010	III/2016	Raw mill Substation 22B Input 1 Cell 105
EL4	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065507	1.0	III/2010	III/2016	Raw mill Substation 22B Input 2 Cell 203
EL5	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065525	1.0	III/2010	III/2016	Kiln Substation 22C Input 1 Cell 104

[4] The natural gas volume for all devices is provided as of 20°C temperature and 101325 Pa absolute pressure.

EL6	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065506	1.0	III/2010	III/2016	Kiln Substation 22C Input 2 Cell 402
EL7	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065509	1.0	III/2010	III/2016	Clinker cooling Substation 22D Input 1 Cell 306
EL8	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065511	1.0	III/2010	III/2016	Clinker cooling Substation 22D Input 2 Cell 204
EL9	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065426	1.0	I/2010	I/2016	Coal mill Substation 22F Input 1 Cell 302
EL10	"ACE 6000"	MWh	Itron (Actaris), France	Multifunctional Electronic Electricity Meter	50065429	1.0	I/2010	I/2016	Coal mill Substation 22F Input 2 Cell 406
BS1	"Gravit 100"	t	Hasler, Germany	Weigh Belt Feeder	5D0371.51	± 0,5 %	Calibration is performed by plant personnel in accordance with the calibration instruction issued by the manufacturer. Calibration frequency is usually once per shift (12 hours)		Coaldust feeders
BS2	"Gravit 100"	t	Hasler, Germany	Weigh Belt Feeder	5D0371.52	± 0,5 %			Coaldust feeders
RM1	"FlowMeter"	t	Hasler, Germany	Raw meal feeder	AD0562.41	± 0,5 %			Raw meal feeder

Table 3: Equipment used for monitoring activities

Calibration dates are provided in following formats:

- DD/MM/YYYY – exact date;
- MM/YYYY – month of the year in which calibration should be performed;
- QQ/YYYY – quarter of the year in which calibration should be performed.

Calibration of the metering devices and equipment has been conducted on a periodic basis according to the procedures of the Host Party and internal company policies.

B.1.3. Calibration procedures:

For natural gas meters:

QA/QC procedures	Body responsible for calibration and certification
Calibration interval for the electricity meters is: For "FlouTek-TM-1-3" – two years. For "TERZ 94" – two years. Regular cross-checks with the natural gas supply company.	Calibration will be performed by the authorized representatives of the State Metrological System of Ukraine

For electricity meters:

QA/QC procedures	Body responsible for calibration and certification
Calibration interval for the electricity meters is: For "ACE 6000" – six years. Regular cross-checks with the electricity supply company.	Calibration will be performed by the authorized representatives of the State Metrological System of Ukraine

For proportioning belt scales:

QA/QC procedures	Body responsible for calibration and certification
Calibration for coaldust feeders is performed regularly Regular cross-checks with the stock survey data.	Plant internal services

For raw meal feeder:

QA/QC procedures	Body responsible for calibration and certification
Calibration for raw meal feeder is performed regularly Regular cross-checks with the stock survey data.	Plant internal services

B.1.4. Involvement of Third Parties:

Authorized representatives of the State Metrological System of Ukraine – calibration/verification of the metering equipment.

B.2.1. Data collection (accumulated data for the whole monitoring period):

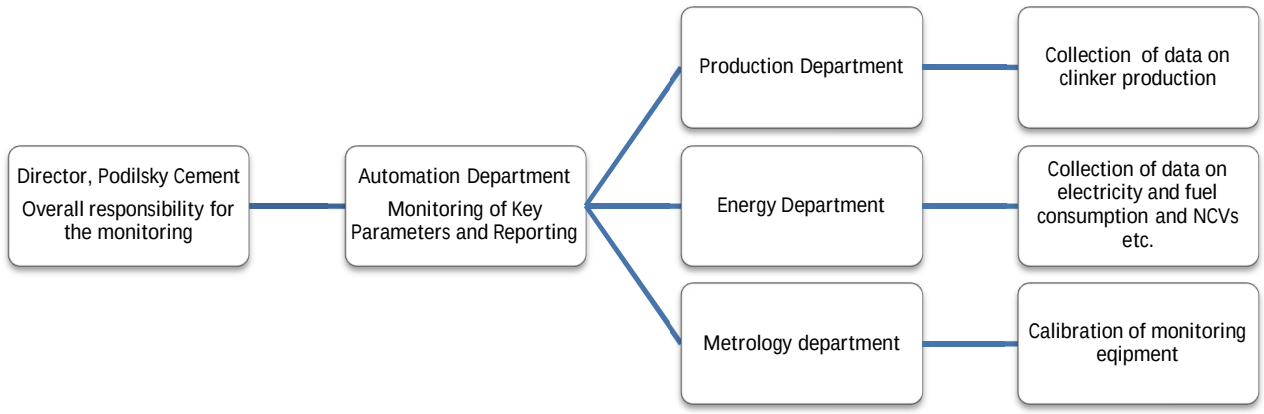

Figure 1: Data collection.

B.2.2. List of fixed default values and ex-ante emission factors:

Data / Parameter	Data unit	Description	Data Source	Value	Uncertainty level of data
EF_{NG}	tCO_2/GJ*	Carbon dioxide emission factor for the combustion of natural gas	IPCC 2006[5]	0.0561	Low
EF_{coal}	tCO_2/GJ**	Carbon dioxide emission factor for the combustion of coal	IPCC 2006[6]	0.0946	Low
BKE	GJ/t (of clinker)	Baseline specific kiln energy consumption	Annex 2 of the PDD Version 2.1 dated 02/02/2007	6.684	Low
$SEC_{BL,rwmkln}$	MWh/t (of clinker)	Baseline specific electricity consumption of raw milling and kiln	Annex 2 of the PDD Version 2.1 dated 02/02/2007	0.0653	Low
$SFC_{BL,NG,heatgen}$	m^3/t (of coal)	Baseline specific natural gas consumption of the coal mill heat generator	See Annex 2 of this report	17.39	Low
$W_{BL,coal}$	fraction	Baseline share of coal in the fuel mix of the kilns	See Annex 2 of this report	0.9939	Low

*56100 $kgCO_2/TJ$ = 0.0561 tCO_2/GJ
**4600 $kgCO_2/TJ$ = 0.0946 tCO_2/GJ
Table 4: Fixed parameters

[5] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion, Page 2.16, Table 2.2.

[6] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion, Page 2.16, Table 2.2. Value for other bituminous coal.

B.2.3. List of variables:

Project emissions variables to be monitored:

Parameter	Calculation method (Measured/Calculated)	Unit	Comment	Meters used (as per B.1.2)	Data aggregation frequency
$EF_{el,y}$ - Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y	(C) Calculated by the DFP on the annual basis	tCO_2/MWh	The data will be archived and kept for two years after the last transfer of ERUs from the project.	-	Data are aggregated every year by collecting the publicly available information
$FC_{coal,y}$ - Coal consumption by the kilns in period y	(M/C) Measured continuously by the specialised meters. Summarized monthly by calculation. Direct input from company records and reports.	t	The data will be archived and kept for two years after the last transfer of ERUs from the project.	BS1-2	Data are aggregated monthly. Periodic reports are prepared.
$FC_{NG,y}$ - Natural gas consumption by the kilns in period y	(M/C) Measured continuously by the specialised meters. Summarized monthly by calculation. Direct input from company records and reports.	m^3	The data will be archived and kept for two years after the last transfer of ERUs from the project.	NG1	Data are aggregated monthly. Periodic reports are prepared.
$NCV_{coal,y}$ - Net Calorific Value of coal in period y	(C/E) Calculated/estimated by the third party. Accepted in accordance with certificates.	GJ/t	The data will be archived and kept for two years after the last transfer of ERUs from the project.	-	Data are aggregated monthly. Periodic reports are prepared.
$NCV_{NG,y}$ - Net Calorific Value of natural gas in period y	(C/E) Calculated/estimated by the third party. Accepted in accordance with certificates.	GJ/m^3	The data will be archived and kept for two years after the last transfer of ERUs from the project.	-	Data are aggregated monthly. Periodic reports are prepared.

$EC_{rwmkln,y}$ - Electricity consumption of raw milling and kiln in period y	(M/C) Measured continuously by the specialised meter. Summarized monthly by calculation. Direct input from company record, electricity meters	MWh	The data will be archived and kept for two years after the last transfer of ERUs from the project.	EL1-8[7]	Data are aggregated monthly. Periodic reports are prepared.
$EC_{coalmill,y}$ - Electricity consumption of coal mill in period y	(M/C) Measured continuously by the specialised meter. Summarized monthly by calculation. Direct input from company record, electricity meters	MWh	The data will be archived and kept for two years after the last transfer of ERUs from the project.	EL9-10	Data are aggregated monthly. Periodic reports are prepared.
$FC_{NG,coalmill,y}$ - Natural gas consumption of the coal mill heat generator in period y	(M/C) Measured continuously by the specialised meters. Summarized monthly by calculation. Direct input from company records and reports.	m^3	The data will be archived and kept for two years after the last transfer of ERUs from the project.	NG2	Data are aggregated monthly. Periodic reports are prepared.
$CLNK_y$ - Amount of clinker produced in period y	(C) Calculated continuously by multiplying special transition coefficient by raw meal consumption in the kiln feed management system. Summarized monthly by calculation. Direct input from company records and reports.	t	The data will be archived and kept for two years after the last transfer of ERUs from the project.	RM1	Data are aggregated monthly. Periodic reports are prepared.

Table 5: Monitored project emissions variables

All variables required to calculate baseline emissions are also used to calculate project emissions

B2.4. Data concerning GHG emissions by sources of the project activity and the baseline:

Variable	Description	Units	Values		
			October 2011	November 2011	December 2011
$EF_{el,y}$	Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y	tCO_2/MWh*	1.090	1.090	1.090

[7] Data from the meter and documents of energy supply company provided in kWh are converted into MWh for the monitoring purposes.

$FC_{coal,y}$	Coal consumption by the kilns in period y	t	37 478	31 600	14 170
$FC_{NG,y}$	Natural gas consumption by the kilns in period y	m^3	2 274 021	855 617	689 364
$NCV_{coal,y}$	Net Calorific Value of coal in period y	GJ/t	21.14	21.35	21.56
$NCV_{NG,y}$	Net Calorific Value of natural gas in period y	GJ/m^3	0.03387	0.03379	0.03409
$EC_{rwmkln,y}$	Electricity consumption of raw milling and kiln in period y	MWh	14 873	13 708	7 588
$EC_{coalmill,y}$	Electricity consumption of coal mill in period y	MWh	1 835	1 574	674
$FC_{NG,heatgen,y}$	Natural gas consumption of the coal mill heat generator in period y	m^3	454 206	350 780	49 153
$CLNK_y$	Amount of clinker produced in period y	t	184 026	186 149	80 696

*$kgCO_2/kWh = tCO_2/MWh$

Table 6: Data that were collected in the monitoring of the emission reductions

B.2.5. Data concerning leakage:

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

Due to reduced coal consumption, fewer emissions will occur in the coal mining and the transport to the factory. This leakage has not been taken into account for simplification and to be conservative. Other leakage was not identified.

B.2.6. Data concerning environmental impacts:

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

Gaseous pollutants (NO_x & SO_x)

NO_x is formed due to the inevitable oxidation reaction of atmospheric nitrogen at high temperatures in the cement kiln. SO_x emissions in cement production originate mainly from raw material. The sulphur content in the raw materials used at Podilsky Cement is insignificant and SO_x emissions are not observed. Gaseous pollutants are measured by means of stationery gas spectrometers and mobile gas spectrometer. Both gas spectrometers used by the laboratory of Podilsky Cement are monitoring the levels of carbon monoxide, SO_x and NO_x emissions.

Dust emissions

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 Podilsky Cement are monitored. The emissions of dust are measured by the laboratory of Podilsky Cement by 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 quarterly basis.

Dry kiln monitoring

The existing scheme of air pollution measurement is used in the project scenario. In this case, the gaseous pollutants (NO_x and SO_x, if any) will be measured on a real-time basis by the existing gas spectrometer that is installed on the new dry kiln. Dust measurements are made by the plant's laboratory using the weighing method on the quarterly basis.

Cement production has certain impact on the local 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.

B.3. Data processing and archiving:

All data will be archived electronic and paper. Data acquisition and processing procedure for each parameter monitored:

1. **Indirect specific carbon dioxide emissions from electricity consumption**

   This parameter is documented in the best available study at the time of monitoring plan preparation – data of the Designated Focal Point (DFP) of Ukraine. This methodology and the resulting carbon emission factor have been developed by the National Environmental Investment Agency (NEIA) - DFP of Ukraine - for the application in JI projects. Carbon emission factors for the years 2008, 2009, 2010 and 2011 estimate are available[8]. It is established that actual ex-post emission factors will be calculated and published every year for the previous year before the 1st of March. As these data are more recent and detailed it is proposed to utilize it for the purpose of the monitoring. The new emission factors are higher than the one used in the PDD and they influence project emissions. Proposed approach is, therefore, conservative. Source document containing the applicable value is stored electronically and in paper form at the time of monitoring report preparation. The IT and data storage system containing this information at the head office of Podilsky Cement has back-ups and allows for reliable data storage with virtually no chance of data loss.

2. **Coal consumption by the kilns**

   Operational data (in the absence - production reports and commercial data) of the company are used in order to confirm the amount of coal consumption by the kilns. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on coal consumption are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

3. **Natural gas consumption by the kilns**

   Operational data (in the absence - production reports and commercial data) of the company are used in order to confirm the amount of natural gas consumption by the kilns. The documents obtained are

[8] http://neia.gov.ua/nature/control/uk/publish/category?cat_id=111922

collected by the energy and automation department on a monthly basis. The paper originals are binded into the special folder. Data on natural gas consumption are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

4. Net Calorific Value (NCV) of coal

The laboratory reports (in the absence – supplier statements or certificates) of the company are used in order to confirm the NCV of coal used. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on coal NCV are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

5. Net Calorific Value (NCV) of natural gas

The laboratory reports (in the absence – supplier statements or certificates) of the company are used in order to confirm the NCV of natural gas used. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on natural gas NCV are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

6. Electricity consumption of raw milling and kiln

The operational data (in the absence – production reports and energy department statements) of the company are used in order to confirm the electricity consumption of raw milling and kiln. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on electricity consumption of raw milling and kiln are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

7. Electricity consumption of coal mill

The operational data (in the absence – production reports and energy department statements) of the company are used in order to confirm the electricity consumption of coal mill. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on electricity consumption of coal mill are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

8. Natural gas consumption of the coal mill heat generator

The operational data (in the absence – production reports and energy department statements) of the company are used in order to confirm the natural gas consumption of the coal mill heat generator. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on natural gas consumption of the coal mill heat generator are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

9. Amount of clinker produced

The operational data (in the absence – production reports, stock survey data) of the company are used in order to confirm the amount of clinker produced. The documents obtained are collected by the automation department on a monthly basis. The paper originals are binded into the special folder. Data on clinker production are logged into the electronic register that is maintained at the head office of the company. The IT and data storage system containing this information at the head office has back-ups and allows for reliable data storage with virtually no chance of data loss. These reports are kept in electronic form in the IT system of the company and in paper form with signatures of the responsible persons.

B.4. Special event log:

All special and exceptional events (critical equipment failures, reconstruction works, emergencies etc.) are documented by the special notes provided to the management of the company. No such events were observed during the monitoring period.

The nature of the project and underlying operations does not foresee any factors that can cause unintended emissions due to emergencies. Possible emergencies can have impact on the continuation of operations (shutdowns) which could lead to a decreased number of ERUs which is, in turn, conservative.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

The general project management will be implemented by the General Director of the Podilsky Cement through supervising and coordinating activities of his subordinates, such as the head of the automation department, the head of the energy department, the head of the production department, the head of the metrology department etc. On-site day-to-day control of electricity consumption will be implemented by the manager of the production unit who will direct on-duty electrician. During the daytime a group of mechanics responsible for maintenance of all technological and measuring equipment as well as automation tools will be present on-site. Online information will be transmitted to the head of energy department. The head of energy department will collect monthly data on net calorific values of natural gas and coal data from the local gas supplier and other suppliers. The head of the production department will gather monthly data about clinker production. The head of energy department will gather monthly data about electricity and fuel consumption. All this information will be submitted in paper and electronic form monthly to the head of the automation department.

Documents and reports on the data that are monitored will be archived and stored by the project participants. The following documents will be stored: primary documents for the accounting of monitored parameters in paper form; intermediate reports, orders and other monitoring documents in paper and electronic form; documents on measurement devices in paper and electronic form. These documents and other data monitored and required for determination and verification, as well as any other data that are relevant to the operation of the project will be kept for at least two years after the last transfer of ERUs.

C.1.2. Trainings:

The project is utilizing technology that requires skills and knowledge in dry-technology cement plant machinery operation, coal dust fuel preparation technology operation, electric equipment operation etc. This kind of skills and knowledge is available locally through the system of vocational training and higher education. This system is state-supervised in Ukraine. Professionals who graduate from vocational schools receive a standard certificate in the field of their professional study. Only workers with proper training can be allowed to operate industrial equipment like. Management of the project host ensures that personnel of the project have received proper training and are eligible to work with the prescribed equipment.

Key positions requiring deep knowledge and experience in dry-technology cement plant operation will be supported by the international staff recruited from companies of CRH Group.

Training on safety issues is mandatory and must be provided to all personnel of the project as required by local regulations. Procedure for safety trainings includes the scope of the trainings, training intervals, forms of training, knowledge checks etc. The project host management maintains records for such trainings and periodic knowledge check-ups.

Activities that are directly related to the monitoring do not require specific training other than provided by the professional education. However, monitoring personnel will receive training on monitoring procedures and requirements. Personnel of the project host management will receive necessary training and consultations on Kyoto Protocol, JI projects and monitoring from the project consultant – Global Carbon B.V.

C.2. Internal audits and control measures:

Internal cross-checks and audits are performed for all of the data monitored as the raw documents used for monitoring are also used in the commercial dealings of the company. General Director of the company reviews monthly and yearly reports and conducts selective cross-checks with the raw documents.

For the fixed data and ex-ante parameters and factors the quality assurance requires to check that the data were acquired from the reliable (i.e. recognised and/or based on research), verifiable (data are open for access, or are available for the project participants) sources.

C.4. Troubleshooting procedures:

All exceptional and troubleshooting events are documented by internal notes. As the data monitored to calculate emission reductions are also used in the commercial dealings of the company and correlate to the clinker produced no emission reductions can be earned if the plant is not in operation.

In cases if any errors, fraud or inconsistencies will be identified during the monitoring process special commission will be appointed by project host management that will conduct a review of such case and issue an order that must also include provisions for necessary corrective actions to be implemented that will ensure such situations are avoided in future.

The project host management also established a communication channel that makes it possible submitting suggestions, proposals and project ideas improvement for more accurate future monitoring for every person involved in the monitoring activities. Such communications will be delivered to the project host management who is required to review these communications and in case it is found appropriate implement necessary corrective actions and improvements. Project consultant – Global Carbon B.V. – will conduct periodic review of the monitoring plan and procedures and if necessary propose improvements to the project participants.

SECTION D. Calculation of GHG emission reductions

D.1. Table providing the formulas used:

Formula number from Revised Monitoring Plan	Formula	Formula description
-	$ER_y = BE_y - PE_y$	Calculation of emission reductions
Equation 6	$BE_y = BE_{kiln,y} + BE_{rwmkln,y} + BE_{coalmill,y} + BE_{heatgen,y}$	Baseline emissions calculation
Equation 7	$BE_{kiln,y} = BKE \times CLNK_y \times EF_{mix}$	Baseline emissions of kiln fuel mix in period y
Equation 8	$EF_{mix} = W_{BL,coal} \times EF_{coal} + (1 - W_{BL,coal}) \times EF_{NG}$	Carbon dioxide emission factor of kiln fuel mix
Equation 9	$BE_{rwmkln,y} = SEC_{BL,rwmkln} \times CLNK_y \times EF_{el,y}$	Baseline emissions from electricity consumption of raw milling and kiln in period y
Equation 10	$BE_{coalmill,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times \frac{EC_{coalmill,y}}{FC_{coal,y}} \times EF_{el,y}$	Baseline emissions of electricity consumption of coal mill in period y
Equation 11	$BE_{heatgen,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times SFC_{BL,NG,heatgen} \times NCV_{NG,y} \times EF_{NG}$	Baseline emissions of natural gas consumption of coal mill heat generator in period y
Equation 1	$PE_y = PE_{kiln,y} + PE_{rwmkln,y} + PE_{coalmill,y} + PE_{heatgen,y}$	Project emissions calculation
Equation 2	$PE_{kiln,y} = EF_{NG} \times FC_{NG,y} \times NCV_{NG,y} + EF_{coal} \times FC_{coal,y} \times NCV_{coal,y}$	Project emissions of kiln fuel mix in period y
Equation 3	$PE_{rwmkln,y} = EF_{el,y} \times EC_{rwmkln,y}$	Project emissions of electricity consumption of raw milling and kiln in period y
Equation 4	$PE_{coalmill,y} = EF_{el,y} \times EC_{coalmill,y}$	Project emissions of electricity consumption of coal mill in period y
Equation 5	$PE_{heatgen,y} = EF_{NG} \times FC_{NG,heatgen,y} \times NCV_{NG,y}$	Project emissions of natural gas consumption of coal mill heat generator in period y

Table 7: Calculation formulas

Parameters in the formulas are as per Sections B.2.1 and B.2.2 of this report.

Additionally in the formulas:

Parameter	Data unit	Description
ER_y	tCO_2e	Emissions reductions of the JI project in period y
BE_y	tCO_2e	Baseline emissions in period y
PE_y	tCO_2e	Project emissions in period y
$PE_{kiln,y}$	tCO_2	Project emissions of kiln fuel mix in period y
$PE_{rwmkln,y}$	tCO_2	Project emissions of electricity consumption of raw milling and kiln in period y
$PE_{coalmill,y}$	tCO_2	Project emissions of electricity consumption of coal mill in period y
$PE_{heatgen,y}$	tCO_2	Project emissions of natural gas consumption of coal mill heat generator in period y.
$BE_{kiln,y}$	tCO_2	Baseline emissions of kiln fuel mix in period y
$BE_{rwmkln,y}$	tCO_2	Baseline emissions from electricity consumption of raw milling and kiln in period y
$BE_{coalmill,y}$	tCO_2	Baseline emissions of electricity consumption of coal mill in period y
$BE_{heatgen,y}$	tCO_2	Baseline emissions of natural gas consumption of coal mill heat generator in period y

Table 8: Parameters in formulas

Results of the emissions calculations above are presented in metric tons of carbon dioxide equivalent (tCO_2e). The metric ton of carbon dioxide equivalent is equal to the metric ton of carbon dioxide (tCO_2). Therefore 1 tCO_2e = 1 tCO_2.

D.2. Description and consideration of measurement uncertainties and error propagation:

All measurement uncertainties and error propagation of the measured parameters are according to the manuals of equipment manufacturers. Uncertainty level of the fixed values and external data is low as they are taken from reliable and publicly available, verifiable sources.

D.3. GHG emission reductions (referring to B.2. of this document):

D.3.1. Project emissions:

Parameter	Unit	October 2011	November 2011	December 2011	Total
Project emissions	tCO_2e	98 346	82 768	39 319	220 433

Table 9: Project emissions

D.3.2. Baseline emissions:

Parameter	Unit	October 2011	November 2011	December 2011	Total
Baseline emissions	tCO_2e	134 456	136 007	58 885	329 348

Table 10: Baseline emissions

D.3.3. Leakage:

Not Applicable.

D.3.4. Summary of the emissions reductions during the monitoring period:

Parameter	Unit	October 2011	November 2011	December 2011	Total
Emission reductions	tCO_2e	36 110	53 239	19 566	108 915

Table 11: Emission reductions

Annex 1

Definitions and acronyms

Acronyms and Abbreviations

CH_4	METHANE
CO_2	CARBON DIOXIDE
GHG	GREENHOUSE GASES
GWP	GLOBAL WARMING POTENTIAL
IPCC	INTERGOVERMENTAL PANEL ON CLIMATE CHANGE
PDD	PROJECT DESIGN DOCUMENT

Definitions

Baseline	The scenario that reasonably represents what would have happened to greenhouse gases in the absence of the proposed project, and covers emissions from all gases, sectors and source categories listed in Annex A of the Protocol and anthropogenic Removals by sinks, within the project boundary.
Emissions reductions	Emissions reductions generated by a JI project that have not undergone a verification or determination process as specified under the JI guidelines, but are contracted for purchase.
Global Warming Potential (GWP)	An index that compares the ability of greenhouse gases to absorb heat in the atmosphere in comparison to carbon dioxide. The index was established by the Intergovernmental Panel of Climate Change.
Greenhouse gas (GHG)	A gas that contributes to climate change. The greenhouse gases included in the Kyoto Protocol are: carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorcarbons (HFCs), Perfluorcarbons (PFCs) and Sulphurhexafluoride (SF6).
Joint Implementation (JI)	Mechanism established under Article 6 of the Kyoto Protocol. JI provides Annex I countries or their companies the ability to jointly implement greenhouse gas emissions reduction or sequestration projects that generate Emissions Reduction Units.
Monitoring plan	Plan describing how monitoring of emission reductions will be undertaken. The monitoring plan forms a part of the Project Design Document (PDD).

Annex 2

Revised Monitoring Plan

Introduction

The monitoring plan for this project has been determined as part of the Project Design Document Version 2.1 dated the 2nd of February 2007 (hereinafter – the final PDD). The monitoring plan chosen has been described in the Section D. Monitoring Plan of this final PDD. Already at the time of the establishing of the monitoring plan it has been noted in the Section D.1. of the final PDD that the monitoring plan will be updated prior the commissioning of the project. The monitoring plan as described in the final PDD has been established prior to the commissioning and reliable operation of the systems designed for using coal as a fuel at the Podilsky Cement and prior to the construction and commissioning of the dry line for clinker production at the Podilsky Cement which is the project equipment in this case. The necessity to address these and other issues during the monitoring calls for a revision of the Monitoring Plan.

Justification for the Monitoring Plan Revision

The revisions to the Monitoring Plan implemented here are aimed at:

- Improvement of accuracy and applicability of information collected compared to the original monitoring plan;
- Maintaining conformity with the relevant rules and regulations for the establishment of monitoring plans.

The key issues that needed to be addressed in the revised monitoring plan are as follows:

1) The necessity to take into account the simultaneous operation of wet and dry kilns until 27th November 2011 both in the baseline scenario and the project scenario. The kilns both in the baseline and project scenarios work simultaneously and this needs to be transparently incorporated into the revised monitoring plan and emission reduction calculations. But this is a temporary situation, and in the future only dry kiln will operate as provided in the PDD;
2) The necessity to take into account the fuel mix consumed by the kilns both in the baseline scenario and the project scenario. The kilns both in the baseline and project scenarios consume a mixture of coal (main fuel) and natural gas (auxiliary fuel) and this needs to be transparently incorporated into the revised monitoring plan and emission reduction calculations;
3) The necessity to take into account the natural gas consumed by the coal mill heat generator both in the baseline scenario and the project scenario. The heat generator both in the baseline and project scenarios consumes natural gas and this needs to be transparently incorporated into the revised monitoring plan and emission reduction calculations. As the dry kiln will become fully operational the waste heat of the kiln will be used to dry the coal and the heat generator may become unnecessary;
4) Amount of clinker produced calculated continuously by multiplying special transition coefficient by raw meal consumption in the kiln feed management system.
5) The setup and configuration of all the measurement instruments was not known at the time the monitoring plan in the final PDD has been established. The actual setup of the measurement equipment and the data collection methods need to be reflected in the revised monitoring plan;
6) The structure of the information to be collected as well as its content has changed since the time the monitoring plan has been established in the final PDD. Some of the data envisaged to be collected in the monitoring plan may not be available from the source and may need to be replaced with the other data or source of the data may need to be changed.

The following elements of the monitoring plan have been revised and updated:

1) Data, parameters and variables that are collected in order to monitor emissions from the project;
2) Data, parameters and variables that are necessary for determining the emissions in the baseline scenario;
3) Formulae used to calculate baseline emissions;
4) Formulae used to calculate project emissions.

The revised Monitoring Plan is provided below.

Description of monitoring plan chosen

The revised monitoring plan follows the same approach towards monitoring as described in the final PDD. This approach is the JI-Specific Approach in accordance with the Guidance criteria for baseline setting and monitoring (hereinafter – the Guidance). This revised monitoring plan is based on the Version 03 of the Guidance. Accordingly, this monitoring plan is established using the approach outlined in the Paragraph 9(a) of the Guidance.

The monitoring plan described here below:

1) Describes all relevant factors and key characteristics that will be monitored, and the period in which they will be monitored, in particular also all decisive factors for the control and reporting of project performance in the form of variables used for the monitoring, default and fixed ex-ante parameters etc.;

2) Specifies the indicators, constants and variables used for the monitoring of project emissions and baseline emissions;

3) Draws on the list of standard variables contained in appendix B to the Guidance, as appropriate;

4) Describes the methods employed for data monitoring (including its frequency) and recording as provided in the tables below;

5) Presents the quality assurance and control procedures for the monitoring process. This includes, as appropriate, information on calibration and on how records on data and/or method validity and accuracy are kept and made available on request;

6) Clearly identifies the responsibilities and the authority regarding the monitoring activities;

7) On the whole, reflects good monitoring practices appropriate to the project type.

8) Provides a complete compilation of the data that need to be collected for its application. This includes data that are measured or sampled and data that are collected from other sources (e.g. official statistics, expert judgments, proprietary data, IPCC, commercial and scientific literature, etc.). Data that are calculated with equations are not included in the compilation. The information in the monitoring plan is provided in tabular form below.

The indicators, constants, variables and/or models that were used are reliable (i.e. provide consistent and accurate values) and valid (i.e. are clearly connected with the effect measured), and provide a transparent picture of the emission reductions monitored. The indicators that are already used in normal business practice and are reported to national and local authorities are used for project-specific indicators. Default values are used, as appropriate. In the selection of default values, accuracy and reasonableness were carefully balanced. The default values chosen originate from recognized sources, are supported by statistical analyses and are presented in a transparent manner.

The monitoring system at Podilsky Cement is based on the requirements of the following international monitoring standard *CO_2 Accounting and Reporting Standard for the Cement Industry*[9] *(Version 3.0)*developed by the Cement Sustainability Initiative of the World Business Council for Sustainable Development.

[9] http://www.wbcsdcement.org/pdf/tf1_co2%20protocol%20v3.pdf

The monitoring system for the project is designed based on the following assumptions and applicability constraints:

- The amount of clinker produced is not influenced by the project;
- In the baseline scenario the production capacity would be sufficient to meet the production in the project scenario;
- The emissions at the quarry and raw materials are not influenced by the project;
- The type of fossil fuel combusted in the kiln is not influenced by the project;
- Geogenic emissions do not change;
- The emissions after clinker production are not influenced by the project;
- No legal requirement exists to implement the switch from wet to dry method of cement production.

In the sections below, the following data are explicitly and clearly distinguished:

a) Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination regarding the monitoring plan;

b) Data and parameters that are monitored throughout the crediting period.

Data and parameters that are fixed throughout the crediting period

The data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination regarding the monitoring plan are presented in this section in the tabular format:

Data/Parameter	EF_{NG}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor for the combustion of natural gas
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Default CO_2 emission factor for natural gas from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion, Page 2.16, Table 2.2
Value of data applied (for ex ante calculations/ determinations)	0.0561
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This emission factor is the default emission factor proposed by the IPCC.
QA/QC procedures (to be) applied	Standard procedures are used.
Any comment	In the 2006 IPCC Guidelines emission factors are provided in measurement units of kg of greenhouse gas per TJ on a Net Calorific Value Basis. The value of the emission factor has been converted from these units to tCO_2/GJ for the purposes of this monitoring report.

Data/Parameter	EF_{coal}
Data unit	tCO_2/GJ
Description	Carbon dioxide emission factor for the combustion of coal
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Default CO_2 emission factor for Other Bituminous Coal from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 2: Stationary Combustion, Page 2.16, Table 2.2
Value of data applied (for ex ante calculations/determinations)	0.0946
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This emission factor is the default emission factor proposed by the IPCC. The value of emission factor is taken for the category of Other Bituminous Coal as the characteristics (e.g. net calorific value) of the coal used by the Podilsky Cement are within the range specified for this fuel type by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy, Chapter 1: Introduction, Page 1.18, Table 1.2. This is conservative.
QA/QC procedures (to be) applied	Standard procedures are used.
Any comment	In the 2006 IPCC Guidelines emission factors are provided in measurement units of kg of greenhouse gas per TJ on a Net Calorific Basis. The value of the emission factor has been converted from these units to tCO_2/GJ for the purposes of this monitoring report.

Data/Parameter	BKE
Data unit	GJ/t (of clinker)
Description	Baseline specific kiln energy consumption
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Data from the Annex 2 of the PDD Version 2.1 dated 02/02/2007.
Value of data applied (for ex ante calculations/determinations)	6.684
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Fixed conservatively by measuring actual historic kiln efficiency before the project and calculating the average and reducing the average historic kiln efficiency to a standard value used in the cement sector.
QA/QC procedures (to be) applied	Check correspondence with the data source.
Any comment	N/A

Data/Parameter	$SEC_{BL,rwmkln}$
Data unit	MWh/t (of clinker)
Description	Baseline specific electricity consumption of raw milling and kiln
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Data from the Annex 2 of the PDD Version 2.1 dated 02/02/2007.
Value of data applied (for ex ante calculations/determinations)	0.0653
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Fixed conservatively by measuring actual electricity consumption of the raw milling and kiln before the project and selecting the lowest value.
QA/QC procedures (to be) applied	Check correspondence with the data source.
Any comment	N/A

Data/Parameter	$SFC_{BL,NG,heatgen}$
Data unit	m^3/t (of coal)
Description	Baseline specific natural gas consumption of the coal mill heat generator
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	This value has been calculated as average by taking the actual measurements of the two years of operation of the heat generator (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln.
Value of data applied (for ex ante calculations/determinations)	17.39
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Fixed conservatively by measuring actual fuel consumption and taking the average of two most recent measurements for the period before the dry kiln started operation. As the dry kiln will become fully operational the waste heat of the kiln will be used to dry the coal and the heat generator may become unnecessary.
QA/QC procedures (to be) applied	Check correspondence with the data source.
Any comment	The value of this parameter has been calculated through the following procedure: The actual data for the two years of 2009 and 2010:

Parameter	**2009**	**2010**
Natural gas consumption of the coal mill heat generator (volume at 20°C and 101325 Pa absolute pressure), m^3	5234673	6118376
Coal consumption by the kilns, t	294005	360579
Specific natural gas consumption of the coal mill heat generator, m^3/t	17.80	16.97

The average between the two numbers for specific natural gas consumption of the coal mill heat generator is 17.39 (m^3/t).

<table>
<tr><td>Data/Parameter</td><td>$W_{BL,coal}$</td></tr>
<tr><td>Data unit</td><td>fraction</td></tr>
<tr><td>Description</td><td>Baseline share of coal in the fuel mix of the kilns</td></tr>
<tr><td>Time of determination/monitoring</td><td>Fixed ex-ante</td></tr>
<tr><td>Source of data (to be) used</td><td>This value has been calculated as average by taking the actual measurements of the two years of operation of the baseline wet kilns (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln.</td></tr>
<tr><td>Value of data applied (for ex ante calculations/determinations)</td><td>0.9939</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Fixed conservatively by measuring actual fuel consumption and taking the average of two most recent measurements for the period before the dry kiln started operation.</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>Check correspondence with the data source.</td></tr>
<tr><td>Any comment</td><td>The value of this parameter has been calculated through the following procedure:
The actual data for the two years of 2009 and 2010 are:
<table>
<tr><th>Parameter</th><th>2009</th><th>2010</th></tr>
<tr><td>Natural gas consumption by the kilns (volume at 20°C and 101325 Pa absolute pressure), m^3</td><td>1513250</td><td>1342266</td></tr>
<tr><td>Coal consumption by the kilns, t</td><td>294005</td><td>360579</td></tr>
<tr><td>Net Calorific Value of natural gas, GJ/m^3</td><td>0.0337</td><td>0.0337</td></tr>
<tr><td>Net Calorific Value of coal, GJ/t</td><td>25.41</td><td>22.80</td></tr>
</table>
The baseline share of coal in the fuel mix of the kilns is calculated as:
$W_{BL,coal} = \frac{1}{2} \times \sum_{y=2009}^{2010} \frac{FC_{coal,y} \times NCV_{coal,y}}{FC_{coal,y} \times NCV_{coal,y} + FC_{NG,y} \times NCV_{NG,y}}$,
where:
$W_{BL,coal}$ - Baseline share of coal in the fuel mix of the kilns, fraction;
$FC_{coal,y}$ - Coal consumption by the kilns in period y, t;
$FC_{NG,y}$ - Natural gas consumption by the kilns (volume at 20°C and 101325 Pa absolute pressure) in period y, m^3;
$NCV_{coal,y}$ – Net Calorific Value of coal in period y, GJ/t;
$NCV_{NG,y}$ – Net Calorific Value of natural gas in period y, GJ/m^3.
As the result of this calculation the baseline share of coal in the fuel mix of the kilns is equal to 0.9939.</td></tr>
</table>

Data and parameters that are monitored throughout the crediting period

This section provides data and parameters that are monitored throughout the crediting period in the tabular form:

Data/Parameter	$EF_{el,y}$
Data unit	$kgCO_2/kWh = tCO_2/MWh$
Description	Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y
Time of determination/monitoring	Ex-post as provided by the Designated Focal Point (DFP) of Ukraine on the annual basis
Source of data (to be) used	Orders or other communications of the DFP of Ukraine (data for 2008-2011 are available in orders of the National Environmental Investment Agency of Ukraine (Order #62 dated 15/04/2011, Order #63 dated 15/04/2011, Order #43 dated 28/03/2011, Order #75 dated 12/05/2011): http://www.neia.gov.ua/nature/control/uk/publish/category?cat_id=111922
Value of data applied (for ex ante calculations/determinations)	As provided by the source identified above. If the data for the particular period are not (yet) available from the source the most recent available data are used instead.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This emission factor is the latest carbon emission factor for Ukrainian electricity grid approved by the DFP of Ukraine.
QA/QC procedures (to be) applied	Standard procedures are used.
Any comment	In the NEIA Order this parameter is provided in $kgCO_2/kWh$ measurement units that are equivalent to tCO_2/MWh.

Data/Parameter	$FC_{coal,y}$
Data unit	t
Description	Coal consumption by the kilns in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the coal consumption of the kilns are collected by the monitoring and reporting systems at Podilsky Cement by the use of proportioning belt scales, production reports, stocks measurement etc.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	The reported numbers of the coal consumption by the kilns in period will be cross-checked between the data collected by the proportioning belt scales for kiln fuel and coal stock surveys performed periodically at Podilsky Cement.
Any comment	The coal consumption is provided in tonnes of coal on a moist basis.

Data/Parameter	$FC_{NG,y}$
Data unit	m^3
Description	Natural gas consumption by the kilns in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the natural gas consumption by the kilns are collected by the monitoring and reporting systems at Podilsky Cement by the use of specialized natural gas meters.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total natural gas consumption by the entire plant is measured by the commercial metering system and natural gas consumption for each unit is monitored by internal technical meters. In addition, as the result of previous units' performance analysis in different modes, standard values of specific natural gas consumption have been developed for each unit. The standard values are used for technical meter readings cross-checks. But for the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of technical natural gas metering equipment mistakes or breakdown, natural gas consumption by the unit can be evaluated using standard values of specific natural gas consumption. This fact should be described in relevant monitoring report.
Any comment	The natural gas volume is provided as of 20°C temperature and 101325 Pa absolute pressures.

Data/Parameter	$NCV_{coal,y}$
Data unit	GJ/t
Description	Net Calorific Value of coal in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the Net Calorific Value of coal are collected by the monitoring and reporting systems at Podilsky Cement by the use of laboratory measurements and certificates for purchased coal.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	The coal purchased is accompanied by the certificate containing the Net Calorific Value of coal purchased. The laboratory department of Podilsky Cement will store these certificates, perform its own tests if necessary and will calculate the weighted average value of the Net Calorific Value at the end of each monitoring period.

Any comment	The Net Calorific Value of coal is provided per tonne of coal on the moist basis. If the reports issued by Podilsky Cement will contain the values of the Net Calorific Value of coal in kcal/kg measurement units then such values will be converted into GJ/t measurement units by multiplying these values by $4.1868 \cdot 10^{-3}$. (1 cal = 4.1868 J; 1 kcal = $4.1868 \cdot 10^{-6}$ GJ; 1 kcal/kg = $4.1868 \cdot 10^{-3}$ GJ/t. Conversion factors are taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Annex 8A.1: Prefixes, units and abbreviations, standard equivalents; Pages 8A1.2-8A1.3).

Data/Parameter	$NCV_{NG,y}$
Data unit	GJ/m^3
Description	Net Calorific Value of natural gas in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the Net Calorific Value of natural gas are collected by the monitoring and reporting systems at Podilsky Cement by the use of official reports (statements) from the local gas distribution company (supplier).
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	The reported values of the Net Calorific Value of natural gas are periodically collected by the energy department of Podilsky Cement. The average value for the period is provided in the reports.
Any comment	The Net Calorific Value of natural gas is provided per volume of natural gas as of 20°C temperature and 101325 Pa absolute pressure. If the reports issued by Podilsky Cement will contain the values of the Net Calorific Value of natural gas in kcal/m^3 measurement units then such values will be converted into GJ/m^3 measurement units by multiplying these values by $4.1868 \cdot 10^{-6}$. (1 cal = 4.1868 J; 1 kcal = $4.1868 \cdot 10^{-6}$ GJ; 1 kcal/m^3 = $4.1868 \cdot 10^{-6}$ GJ/m^3. Conversion factors are taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Annex 8A.1: Prefixes, units and abbreviations, standard equivalents; Pages 8A1.2-8A1.3).

Data/Parameter	$EC_{rwmkln,y}$
Data unit	MWh
Description	Electricity consumption of raw milling and kiln in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the electricity consumption of raw milling and kiln are collected by the monitoring and reporting systems at Podilsky Cement by the use of the specialized electricity meters.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.

QA/QC procedures (to be) applied	Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total electricity consumption by the entire plant is measured by the commercial metering system and electricity consumption for each unit is monitored by internal technical meters. In addition, as the result of previous units' performance analysis in different modes, standard values of specific electricity consumption have been developed for each unit. The standard values are used for technical meter readings cross-checks. But for the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of technical electricity metering equipment mistakes or breakdown, electricity consumption by the unit can be evaluated using standard values of specific electricity consumption. This fact should be described in relevant monitoring report.
Any comment	If the values in the reports are provided in kWh then these values are converted into MWh for the purposes of the monitoring.

Data/Parameter	$EC_{coalmill,y}$
Data unit	MWh
Description	Electricity consumption of coal mill in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement
Source of data (to be) used	The data on the electricity consumption of coal mill are collected by the monitoring and reporting systems at Podilsky Cement by the use of the specialized electricity meters.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total electricity consumption by the entire plant is measured by the commercial metering system and electricity consumption for each unit is monitored by internal technical meters. In addition, as the result of previous units' performance analysis in different modes, standard values of specific electricity consumption have been developed for each unit. The standard values are used for technical meter readings cross-checks. But for the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of technical electricity metering equipment mistakes or breakdown, electricity consumption by the unit can be evaluated using standard values of specific electricity consumption. This fact should be described in relevant monitoring report.
Any comment	If the values in the reports are provided in kWh then these values are converted into MWh for the purposes of the monitoring.

Data/Parameter	$FC_{NG,heatgen,y}$
Data unit	m^3
Description	Natural gas consumption of the coal mill heat generator in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement.

Source of data (to be) used	The data on the natural gas consumption of the coal mill heat generator are collected by the monitoring and reporting systems at Podilsky Cement by the use of the specialized gas meters.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	Podilsky Cement uses multi-stage accounting system, and provides data cross-check. Total natural gas consumption by the entire plant is measured by the commercial metering system and natural gas consumption for each unit is monitored by internal technical meters. In addition, as the result of previous units' performance analysis in different modes, standard values of specific natural gas consumption have been developed for each unit. The standard values are used for technical meter readings cross-checks. But for the preparation of production reports (data source for the monitoring of JI project) more accurate and transparent internal technical meter readings are used. Only in case of technical natural gas metering equipment mistakes or breakdown, natural gas consumption by the unit can be evaluated using standard values of specific natural gas consumption. This fact should be described in relevant monitoring report.
Any comment	The natural gas volume is provided as of 20°C temperature and 101325 Pa absolute pressure.

Data/Parameter	$CLNK_y$
Data unit	t
Description	Amount of clinker produced in period y
Time of determination/monitoring	Ex-post as provided by the Podilsky Cement.
Source of data (to be) used	The data on the clinker production are collected by the monitoring and reporting systems at Podilsky Cement by the use of the kiln feed management system and also stock surveys if necessary.
Value of data applied (for ex ante calculations/determinations)	As provided by the reports of Podilsky Cement for the period.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	These data are collected by the internal monitoring and reporting systems at Podilsky Cement and are used in the existing normal business practice and are reported to national and local authorities.
QA/QC procedures (to be) applied	The reported numbers of the amount of clinker production will be cross-checked between the data collected by the kiln feed measurement system and data from the stock surveys, sales and purchases of cement, mineral additives, limestone etc.
Any comment	N/A

Formulae used to calculate project emissions

Project emissions:

$$PE_y = PE_{kiln,y} + PE_{rwmkln,y} + PE_{coalmill,y} + PE_{heatgen,y}, \quad \text{(Equation 1)}$$

Where:

PE_y – Project emissions in period y, tCO_2;

$PE_{kiln,y}$ – Project emissions of kiln fuel mix in period y, tCO_2;

$PE_{rwmkln,y}$ – Project emissions of electricity consumption of raw milling and kiln in period y, tCO_2;

$PE_{coalmill,y}$ – Project emissions of electricity consumption of coal mill in period y, tCO_2;

$PE_{heatgen,y}$ – Project emissions of natural gas consumption of coal mill heat generator in period y, tCO_2.

Project emissions of kiln fuel mix:

$$PE_{kiln,y} = EF_{NG} \times FC_{NG,y} \times NCV_{NG,y} + EF_{coal} \times FC_{coal,y} \times NCV_{coal,y}, \quad \text{(Equation 2)}$$

Where:

EF_{NG} – Carbon dioxide emission factor for the combustion of natural gas, tCO_2/GJ;

EF_{coal} – Carbon dioxide emission factor for the combustion of coal, tCO_2/GJ;

$FC_{coal,y}$ – Coal consumption by the kilns in period y, t;

$FC_{NG,y}$ – Natural gas consumption by the kilns in period y, m^3;

$NCV_{coal,y}$ – Net Calorific Value of coal in period y, GJ/t;

$NCV_{NG,y}$ – Net Calorific Value of natural gas in period y, GJ/m^3.

Project emissions of electricity consumption of raw milling and kiln:

$$PE_{rwmkln,y} = EF_{el,y} \times EC_{rwmkln,y}, \quad \text{(Equation 3)}$$

Where:

$EF_{el,y}$ – Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y, tCO_2/MWh;

$EC_{rwmkln,y}$ – Electricity consumption of raw milling and kiln in period y, MWh.

Project emissions of electricity consumption of coal mill:

$$PE_{coalmill,y} = EF_{el,y} \times EC_{coalmill,y}, \quad \text{(Equation 4)}$$

Where:

$EC_{coalmill,y}$ – Electricity consumption of coal mill in period y, MWh.

Project emissions of natural gas consumption of coal mill heat generator:

$$PE_{heatgen,y} = EF_{NG} \times FC_{NG,heatgen,y} \times NCV_{NG,y}, \quad \text{(Equation 5)}$$

Where:

$FC_{NG,heatgen,y}$ – Natural gas consumption of the coal mill heat generator in period y, m^3.

In the project scenario the waste heat of the kiln will be utilized to dry the coal. Therefore no heat generator of the coal mill will be in operation under the project scenario but will be in the baseline scenario. Until the new dry kiln is fully commissioned, the fuel consumption of coal mill heat generator will be in both, baseline and project scenario.

Formulae used to calculate baseline emissions

Baseline emissions:

$$BE_y = BE_{kiln,y} + BE_{rwmkln,y} + BE_{coalmill,y} + BE_{heatgen,y}, \quad \text{(Equation 6)}$$

Where:

BE_y – Baseline emissions in period y, tCO_2;

$BE_{kiln,y}$ – Baseline emissions of kiln fuel mix in period y, tCO_2;

$BE_{rwmkln,y}$ – Baseline emissions from electricity consumption of raw milling and kiln in period y, tCO_2;

$BE_{coalmill,y}$ – Baseline emissions of electricity consumption of coal mill in period y, tCO_2;

$BE_{heatgen,y}$ – Baseline emissions of natural gas consumption of coal mill heat generator in period y, tCO_2.

Baseline emissions of kiln fuel mix:

$$BE_{kiln,y} = BKE \times CLNK_y \times EF_{mix}, \quad \text{(Equation 7)}$$

Where:

BKE – Baseline specific kiln energy consumption, GJ/t (of clinker);

$CLNK_y$ – Amount of clinker produced in period y, t

EF_{mix} – Carbon dioxide emission factor of kiln fuel mix, tCO_2/GJ.

The baseline emissions from the combustion of the kiln fuel are calculated by multiplying the amount of clinker produced with the emission factor of the fossil fuel (in tCO2/GJ) and the specific kiln energy consumption. The emission factor of the fossil fuel mix in the kilns (coal and natural gas) can be calculated as a weighted average emission factor of coal and natural gas. Also, as the shares of the fuels may be different between the baseline and the project scenario the share of coal in the baseline fuel mix is taken as the average of the actual measurements of the two years of operation of the baseline wet kilns (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln.

Carbon dioxide emission factor of kiln fuel mix:

$$EF_{mix} = W_{BL,coal} \times EF_{coal} + (1 - W_{BL,coal}) \times EF_{NG}, \quad \text{(Equation 8)}$$

Where:

$W_{BL,coal}$ – Baseline share of coal in the fuel mix of the kilns, fraction.

Baseline emissions from electricity consumption of raw milling and kiln:

$$BE_{rwmkln,y} = SEC_{BL,rwmkln} \times CLNK_y \times EF_{el,y}, \quad \text{(Equation 9)}$$

Where:

$SEC_{BL,rwmkln}$ – Baseline specific electricity consumption of raw milling and kiln, MWh/t (of clinker).

Baseline emissions of electricity consumption of coal mill:

$$BE_{coalmill,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times \frac{EC_{coalmill,y}}{FC_{coal,y}} \times EF_{el,y}, \quad \text{(Equation 10)}$$

The baseline emissions of electricity consumption of the coal mill are calculated by multiplying the baseline consumption of coal by the actual specific electricity consumption of the coal mill and relevant emission factor. The baseline consumption of coal is calculated as the baseline share of coal in the fuel mix of the kilns multiplied by the baseline specific kiln energy consumption and then multiplied by the amount of clinker produced in relevant period divided by the Net Calorific Value of coal in relevant period. The actual specific electricity consumption of the coal mill is calculated by dividing the electricity consumption of coal mill in relevant period by the coal consumption by the kilns in the same period.

Baseline emissions of natural gas consumption of coal mill heat generator:

$$BE_{heatgen,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times SFC_{BL,NG,heatgen} \times NCV_{NG,y} \times EF_{NG}, \quad \text{(Equation 11)}$$

Where:

$SFC_{BL,NG,heatgen}$ – Baseline specific natural gas consumption of the coal mill heat generator, m^3/t (of coal).

The baseline emissions of natural gas consumption of coal mill heat generator are calculated by multiplying the baseline consumption of coal by the baseline specific natural gas consumption of the coal mill heat generator and Net Calorific Value of the natural gas and relevant emission factor.

Annex 3

Comparison of formulae and parameters

Following formulae and parameters from PDD version 2.1, dated 2 February 2007[10]	Following formulae and parameters from the revised monitoring plan in this monitoring report
Project emissions $PE_y = PE_{kiln,y} + PE_{rwmkln,y} + PE_{coalmill,y}$ (Equation 1) Where: PE_y Project emissions in year y (tCO_2) $PE_{kiln,y}$ Project emissions of kiln fuel in year y (tCO_2) $PE_{rwmkln,y}$ Project emissions of electricity consumption of raw milling and kiln in year y (tCO_2) $PE_{coalmill,y}$ Project emissions of electricity consumption of coal mill in year y (tCO_2)	Project emissions: $PE_y = PE_{kiln,y} + PE_{rwmkln,y} + PE_{coalmill,y} + PE_{heatgen,y}$, (Equation 1) Where: PE_y – Project emissions in period y, tCO_2; $PE_{kiln,y}$ – Project emissions of kiln fuel mix in period y, tCO_2; $PE_{rwmkln,y}$ – Project emissions of electricity consumption of raw milling and kiln in period y, tCO_2; $PE_{coalmill,y}$ – Project emissions of electricity consumption of coal mill in period y, tCO_2; $PE_{heatgen,y}$ – Project emissions of natural gas consumption of coal mill heat generator in period y, tCO_2.
Kiln fuel $PE_{kiln,y} = FF_{kiln,y} \times EF_{ff,y} \times NCV_{ff,y}$ (Equation 2) Where: $PE_{kiln,y}$ Project emissions of kiln fuel in year y (tCO_2) $FF_{kiln,y}$ Quantity of kiln fuel combusted in year y (tonne) $EF_{ff,,y}$ Carbon emission factor of kiln fuel in year y (tCO_2/GJ) $NCV_{ff,y}$ Net Calorific Value of kiln fuel in year y (GJ/tonne)	Project emissions of kiln fuel mix: $PE_{kiln,y} = EF_{NG} \times FC_{NG,y} \times NCV_{NG,y} + EF_{coal} \times FC_{coal,y} \times NCV_{coal,y}$, (Equation 2) Where: EF_{NG} – Carbon dioxide emission factor for the combustion of natural gas, tCO_2/GJ; EF_{coal} – Carbon dioxide emission factor for the combustion of coal, tCO_2/GJ; $FC_{coal,y}$ – Coal consumption by the kilns in period y, t; $FC_{NG,y}$ – Natural gas consumption by the kilns in period y, m^3; $NCV_{coal,y}$ – Net Calorific Value of coal in period y, GJ/t; $NCV_{NG,y}$ – Net Calorific Value of natural gas in period y, GJ/m^3. The kilns both in the baseline and project scenarios consume a mixture of coal (main fuel) and natural gas (auxiliary fuel) and this needs to be transparently incorporated into the revised monitoring plan and emission reduction calculations;

[10] http://ji.unfccc.int/UserManagement/FileStorage/62HINFHR08HYV4Y0O6C0074UVY11VL

Electricity consumption raw milling and kiln $PE_{rwmkln,y} = EF_{el,y} \times EL_{rwmkln,y}$ (Equation 3) Where: $PE_{rwmkiln,y}$ Project emissions of electricity consumption of raw milling and kiln in year y (tCO_2) $EF_{el,y}$ Carbon emission factor of Ukrainian grid in year y (tCO_2/MWh) $EL_{rwmkln,y}$ Electricity consumption of raw milling and kiln in year y (MWh)	Project emissions of electricity consumption of raw milling and kiln: $PE_{rwmkln,y} = EF_{el,y} \times EC_{rwmkln,y}$, (Equation 3) Where: $EF_{el,y}$ – Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y, tCO_2/MWh; $EC_{rwmkln,y}$ – Electricity consumption of raw milling and kiln in period y, MWh. Draws on the list of standard variables contained in appendix B to the Guidance.
Electricity consumption coal mill $PE_{coalmill,y} = EF_{el,y} \times EL_{coalmill,y}$ (Equation 4) Where: $PE_{coalmill,y}$ Project emissions of electricity consumption of coal mill in year y (tCO_2) $EF_{el,y}$ Carbon emission factor of Ukrainian grid in year y (tCO_2/MWh) $EL_{rawmill,y}$ Electricity consumption of coal mill in year y (MWh)	Project emissions of electricity consumption of coal mill: $PE_{coalmill,y} = EF_{el,y} \times EC_{coalmill,y}$, (Equation 4) Where: $EF_{el,y}$ – Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y, tCO_2/MWh; $EC_{coalmill,y}$ – Electricity consumption of coal mill in period y, MWh.
Heat generator of coal mill In the project scenario the waste heat of the kiln will be utilized to dry the coal. Therefore no heat generator of the coal mill will be in operation under the project scenario but will be in the baseline scenario. Refer to section D.1.1.4.	Project emissions of natural gas consumption of coal mill heat generator: $PE_{heatgen,y} = EF_{NG} \times FC_{NG,heatgen,y} \times NCV_{NG,y}$, (Equation 5) Where: $FC_{NG,heatgen,y}$ – Natural gas consumption of the coal mill heat generator in period y, m^3. In the project scenario the waste heat of the kiln will be utilized to dry the coal. Therefore no heat generator of the coal mill will be in operation under the project scenario but will be in the baseline scenario. Until the new dry kiln is fully commissioned, the fuel consumption of coal mill heat generator will be in both, baseline and project scenario.
Quantity of coal combusted during a year The amount of combusted coal in the kiln will be calculated as the total amount of coal purchased during a calendar year, including difference between the amount of stocks at the end of the year and stocks in the beginning of the year. $FF_{kiln,y} = PRC_y - COAL_{stkend,y} + COAL_{stkbgn,y}$ (Equation 5)	Coal consumption by the kilns in period y $FC_{coal,y}$ Measured continuously by the specialised meters. Summarized monthly by calculation. Direct input from company records and reports.

Where: $FF_{kln,y}$ the amount of coal combusted in kiln in year y (tonne) PRC_y the amount of coal purchased during the year y (tonne) $COAL_{stkend,y}$ the amount of coal stocks at the end of the year y (tonne) $COAL_{stkbgn,y}$ the amount of coal stocks at the beginning of the year y (tonne)	
Baseline emissions $BE_y = BE_{kiln,y} + BE_{rwmkln,y} + BE_{coalmill,y} + BE_{heatgen,y}$ (Equation 6) Where: BE_y Baseline emissions in year y (tCO_2) $BE_{kiln,y}$ Baseline emissions of kiln fuel in year y (tCO_2) $BE_{rwmkln,y}$ Baseline emissions of electricity consumption of raw milling and kiln in year y (tCO_2) $BE_{coalmill,y}$ Baseline emissions of electricity consumption of coal mill in year (tCO_2) $BE_{heatgen,y}$ Baseline emissions of heat generator of coal mill (tCO_2)	Baseline emissions: $BE_y = BE_{kiln,y} + BE_{rwmkln,y} + BE_{coalmill,y} + BE_{heatgen,y}$, (Equation 6) Where: BE_y – Baseline emissions in period y, tCO_2; $BE_{kiln,y}$ – Baseline emissions of kiln fuel mix in period y, tCO_2; $BE_{rwmkln,y}$ – Baseline emissions from electricity consumption of raw milling and kiln in period y, tCO_2; $BE_{coalmill,y}$ – Baseline emissions of electricity consumption of coal mill in period y, tCO_2; $BE_{heatgen,y}$ – Baseline emissions of natural gas consumption of coal mill heat generator in period y, tCO_2.
Kiln fuel The baseline emissions from the combustion of the kiln fuel are calculated by multiplying the amount of clinker produced with the emission factor of the fossil fuel (in tCO2/GJ) and the baseline kiln economy. The kiln economy is a stable figure with small variations over the years. Therefore, the baseline kiln economy BKE can be established by extrapolating the average of the most recent available measure values of the years 2003, 2004 and 2005 (=6.771 GJ/t clinker). In order to be conservative BKE is reduced to 6.684 GJ/t clinker (=1600 Kcal/kg clinker). This value also represents a standard factor used in the cement industry. Refer to Annex 2. $BE_{kiln,y} = EF_{ff,y} \times BKE \times CLNK_y$ (Equation 7) Where: $BE_{kiln,y}$ Baseline emissions of kiln fuel in year y (tCO_2) $EF_{ff,y}$ Carbon emission factor of kiln fuel in year y (tCO_2/GJ) BKE Baseline kiln economy (GJ/t clinker) $CLNK_y$ Amount of clinker produced in year y (tonne)	Baseline emissions of kiln fuel mix: The baseline emissions from the combustion of the kiln fuel are calculated by multiplying the amount of clinker produced with the emission factor of the fossil fuel (in tCO2/GJ) and the specific kiln energy consumption. $BE_{kiln,y} = BKE \times CLNK_y \times EF_{mix}$, (Equation 7) Where: BKE – Baseline specific kiln energy consumption, GJ/t (of clinker). Data from the Annex 2 of the PDD Version 2.1 dated 02/02/2007.; $CLNK_y$ – Amount of clinker produced in period y, t EF_{mix} – Carbon dioxide emission factor of kiln fuel mix, tCO_2/GJ. The necessity to take into account the fuel mix consumed by the kilns both in the baseline scenario and the project scenario. The kilns both in the baseline and project scenarios consume a mixture of coal (main fuel) and natural gas (auxiliary fuel) and this needs to be transparently incorporated into the revised monitoring plan and emission reduction calculations.

No in PDD.	Carbon dioxide emission factor of kiln fuel mix: The emission factor of the fossil fuel mix in the kilns (coal and natural gas) can be calculated as a weighted average emission factor of coal and natural gas. Also, as the shares of the fuels may be different between the baseline and the project scenario the share of coal in the baseline fuel mix is taken as the average of the actual measurements of the two years of operation of the baseline wet kilns (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln. $EF_{mix} = W_{BL,coal} \times EF_{coal} + (1 - W_{BL,coal}) \times EF_{NG}$, (Equation 8) Where: $W_{BL,coal}$ – Baseline share of coal in the fuel mix of the kilns, fraction. This value has been calculated as average by taking the actual measurements of the two years of operation of the baseline wet kilns (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln.
Electricity consumption raw milling and kiln The baseline emissions from the consumption of electricity of raw milling and the kilns are calculated by multiplying the amount of clinker produced with the grid electricity baseline and the baseline electricity consumption. The grid electricity baseline $EF_{el,y}$ is based on the standardised electricity baseline of the Dutch Ministry of Economic Affairs. The baseline electricity consumption $BELE_{rwmkln}$ has been established by extrapolating historic measured consumption. Due to wear out of the equipments, the specific electric consumption will increase in the baseline scenario. Therefore, taking a fixed value instead is conservative. Only measurement in the year 2005 has been used as, due to investment in a more efficient compressor system, power consumption in 2005 was lower than previous years. Therefore taking measurement of 2005 only is conservative. Refer to Annex 2. $BE_{rwmkln,y} = EF_{el,y} \times BELE_{rwmkln} \times CLNK_y$ (Equation 8) Where: $BE_{rwmkln,y}$ Baseline emissions of electricity consumption of raw milling and kilns in year y (tCO_2) $EF_{el,y}$ Carbon emission factor of Ukrainian grid in year y (tCO_2/MWh) $BELE_{rwmkln}$ Baseline electricity consumption of raw milling and kiln (MWh/t clinker) $CLNK_y$ Amount of clinker produced in year y (tonne of clinker)	Baseline emissions from electricity consumption of raw milling and kiln: $BE_{rwmkln,y} = SEC_{BL,rwmkln} \times CLNK_y \times EF_{el,y}$, (Equation 9) Where: $SEC_{BL,rwmkln}$ – Baseline specific electricity consumption of raw milling and kiln, MWh/t (of clinker). Draws on the list of standard variables contained in appendix B to the Guidance.

<table>
<tr>
<td>Electricity consumption coal mill

In the baseline scenario the coal mill would have to mill more coal than compared to the project scenario for the same amount of produced clinker. Therefore the baseline emissions are calculated by monitoring the actual electricity consumption of the coal mill and multiply it with the quotient of the baseline kiln economy and the project kiln economy.

$$BE_{coalmill,y} = \frac{BKE}{PKE_y} \times EF_{el,y} \times EL_{coalmill,y}$$
(Equation 9)
Where:
$BE_{coalmill,y}$ Baseline emissions of electricity consumption of the coal mill in year y (tCO2)
BKE Baseline kiln economy (GJ/t clinker)
PKE_y Project kiln economy per tonne of clinker in year y (GJ/t clinker)
$EF_{el,y}$ Carbon emission factor of Ukrainian grid in year y (tCO_2/MWh)
$EL_{coalmill,y}$ Electricity consumption of coal mill in year y (MWh)</td>
<td>Baseline emissions of electricity consumption of coal mill:
$BE_{coalmill,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times \frac{EC_{coalmill,y}}{FC_{coal,y}} \times EF_{el,y}$, (Equation 10)
Where:
$W_{BL,coal}$ – Baseline share of coal in the fuel mix of the kilns, fraction. This value has been calculated as average by taking the actual measurements of the two years of operation of the baseline wet kilns (2009 and 2010), which is after commissioning of the coal mill, and before commissioning of the dry kiln;
BKE – Baseline specific kiln energy consumption, GJ/t (of clinker). Data from the Annex 2 of the PDD Version 2.1 dated 02/02/2007.;
$CLNK_y$ – Amount of clinker produced in period y, t
$NCV_{coal,y}$ – Net Calorific Value of coal in period y, GJ/t;
$EC_{coalmill,y}$ – Electricity consumption of coal mill in period y, MWh.
$FC_{coal,y}$ – Coal consumption by the kilns in period y, t;
$EF_{el,y}$ – Indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052, in period y, tCO_2/MWh;

The baseline emissions of electricity consumption of the coal mill are calculated by multiplying the baseline consumption of coal by the actual specific electricity consumption of the coal mill and relevant emission factor. The actual specific electricity consumption of the coal mill is calculated by dividing the electricity consumption of coal mill in relevant period by the coal consumption by the kilns in the same period. The baseline consumption of coal is calculated as the baseline energy demand of the kiln covered by coal (baseline share of coal in the fuel mix of the kilns multiplied by the baseline kiln efficiency and then multiplied by the amount of clinker produced) divided by the Net Calorific Value of coal.</td>
</tr>
<tr>
<td>Project kiln economy per tonne of clinker
$$PKE_y = \frac{FF_{kiln,y} \times NCV_{ff,y}}{CLNK_y}$$
(Equation 10)
Where:
PKE_y Project kiln economy in year y (GJ/t clinker)
$FF_{kiln,y}$ Quantity of fossil fuel burnt in kiln in year y (tonne)
$NCV_{ff,y}$ Net calorific value of fossil fuel burnt in kiln in year y (GJ/tonne)
$CLNK_y$ Amount of clinker produced in year y (tonne of clinker)</td>
<td>As part of Equation 10</td>
</tr>
</table>

Heat generator of coal mill

In the baseline scenario no exhaust gases of the dry kiln can be utilised as a source of energy. Therefore in the baseline scenario a heat generator will be installed fuelled by natural gas. The heat generator will start operating with the commissioning of the coal mill in autumn 2006 and will continue to operate under the baseline scenario. The baseline specific fuel consumption of the heat generator $BFF_{heatgen}$ will be established by taking the measured values of the years 2007 and 2008. Refer to annex 2.

$$BE_{heatgen,y} = FF_{kiln,y} \times BFF_{heatgen} \times EF_{ng,y} \times NCV_{ng,y}$$

(Equation 11)

Where:

$BE_{heatgen,y}$	Baseline emissions of heat generator in year y (tCO_2)
$FF_{kiln,y}$	Quantity of fossil fuel burnt in kiln in year y (tonne)
$BFF_{heatgen}$	Baseline specific fuel consumption of heat generator (1000 Nm^3/tonne coal)
$EF_{ng,y}$	Carbon emission factor natural gas in year y (tCO_2/GJ)
$NCV_{ng,y}$	Net calorific value of natural gas in year y (GJ/1000 Nm^3)

Baseline emissions of natural gas consumption of coal mill heat generator:

The baseline emissions of natural gas consumption of coal mill heat generator are calculated by multiplying the baseline consumption of coal by the baseline specific natural gas consumption of the coal mill heat generator and Net Calorific Value of the natural gas and relevant emission factor. The baseline consumption of coal is calculated as the baseline energy demand of the kiln covered by coal (baseline share of coal in the fuel mix of the kilns multiplied by the baseline kiln efficiency and then multiplied by the amount of clinker produced) divided by the Net Calorific Value of coal.

$$BE_{heatgen,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}} \times SFC_{BL,NG,heatgen} \times NCV_{NG,y} \times EF_{NG},$$

(Equation 11)

Where:

$SFC_{BL,NG,heatgen}$ – Baseline specific natural gas consumption of the coal mill heat generator, m^3/t (of coal);

$NCV_{NG,y}$ – Net Calorific Value of natural gas in period y, GJ/m^3;

EF_{NG} – Carbon dioxide emission factor for the combustion of natural gas, tCO_2/GJ;

The necessity to take into account the consumption of coal for drying of clinker in the kiln is different for wet and dry processes leads to replace $FF_{kiln,y}$ (Quantity of fossil fuel burnt in kiln in year y (tonne) in PDD) to consumption of coal which would occurs in baseline scenario during production of the same amount clinker as in the project scenario is calculated by the following formula:

$$FC_{coal,BL,y} = \frac{W_{BL,coal} \times BKE \times CLNK_y}{NCV_{coal,y}}$$

were:

$W_{BL,coal}$ – Baseline share of coal in the fuel mix of the kilns, fraction;

BKE – Baseline specific kiln energy (from fuel mix combustion) consumption, GJ/t (of clinker);

$CLNK_y$ – Amount of clinker produced in period y, t

$NCV_{coal,y}$ – Net Calorific Value of coal in period y, GJ/t;

Quantity of clinker produced during a year

The amount of clinker produced is measured from kiln feed measurement. $CLNK_y$ is calculated using the data on cement sales minus mineral components added, with a correction for a change in the clinker stocks at the end of a calendar year corrected for purchased and sold clinker. The quantity of clinker is calculated by using the following formula:

$$CLNK_y = CEM_y - MIN_y + CLNK_{stkend,y} - CLNK_{stkbgn,y} - CLNK_{purchased,y} + CLNK_{sold,y}$$

(Equation 12)

Where:

$CLNK_y$	amount of clinker produced in year y (tonne)
CEM_y	amount of cement produced in year y (tonne)
MIN_y	amount of mineral additives used in cement production in year y (tonne)
$CLNK_{stkend,y}$	amount of clinker stocks at the end of year y (tonne)
$CLNK_{stkbgn,y}$	amount of clinker stocks at the beginning of year y (tonne)
$CLNK_{purchased,y}$	amount of clinker purchased in year y (tonne)
$CLNK_{sold,y}$	amount of clinker sold in year y (tonne)

The amount of mineral additives used during a year MIN_y is calculated using the data on mineral additives purchased and the surveyed clinker stocks in the beginning and the end of a year. One exception is made for limestone as the purchased limestone is used both for clinker production and as a mineral component. The amount of limestone added as a mineral component will therefore be measured by taking regular samples of the cement. Please refer to section D.2 for a detailed description how the different values will be measured.

$$MIN_y = PRMIN_y - MIN_{stkend,y} + MIN_{stkbgn,y} + LMST_y$$

(Equation 13)

Where:

MIN_y	amount of mineral additives used in cement production in year y (tonne)
$PRMIN_y$	amount of mineral additives purchased in year y (tonne)
$MIN_{stkend,y}$	amount of mineral additives stocks at the end of year y (tonne)
$MIN_{stkbgn,y}$	amount of mineral additives stocks at the beginning of year y (tonne)
$LMST_y$	amount of limestone added in year y (tonne)

The amount of cement produced during a year is measured by cement mill feed, but not accurately enough for the purpose of monitoring the emissions of GHG. Therefore CEM_y is measured by using the

Amount of clinker produced in period

$CLNK_y$

Amount of clinker produced in period y calculated continuously by multiplying special transition coefficient by raw meal consumption in the kiln feed management system. Summarized monthly by calculation. Direct input from company records and reports.

data on cement sales as this provides to most accurate measurement. As produced cement is not necessarily immediatly sold, the figure will be corrected for a change in the cement stocks at the end of a year. $CEM_y = SLS_y - CEM_{stkend,y} + CEM_{stkbgn,y}$ (Equation 14) Where: CEM_y amount of cement produced in year y (tonne) SLS_y cement sales in year y (tonne) $CEM_{stkend,y}$ cement stocks at the end of year y (tonne) $CEM_{stkbeg,y}$ cement stocks in the beginning of year y (tonne)	