CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

- Title of the project activity: "Fuel oil to natural gas switching at Votorantim Cimentos Cubatão".

- Version number of the document: 01.

- Date of the document: 27/december/2005.

A.2. Description of the project activity:

The purpose of the project activity is switching fuel oil to natural gas in the blast furnace slag dryer, at Votorantim Cimentos in the plant of Cubatão, São Paulo, Brazil. This plant produces cement, in the baseline scenario, fuel oil would otherwise continue to be used during the crediting period.

Cement is made by heating limestone with small quantities of other materials, such as clay, to 1,450°C in a kiln. The resulting hard substance, called clinker, is then ground into a powder, in cement mills, with a small amount of gypsum to make the Ordinary Portland Cement (OPC), the first produced type of cement. Other materials can be used in substitution of clinker in the grinding phase of the fabrication, producing the so-called blended cement. Blast furnace slag is one of these alternative materials, resulting in the production of the Portland Blast Furnace Slag cement (PBFS).

The blast furnace slag is a residue of pig iron production similar to sand, that has properties near to clinker and that can be used, under certain conditions, as clinker substitute. In the project activity the slag is used in the grinding phase of cement production chain, i.e. slag replaces clinker in the cement mills avoiding, then, clinker production in the kilns.

It is important to highlight that the cement industry plays a significant role in Climate Change. First because the cement manufacture is an energy intensive process, demanding large amounts of fuel and electricity in the whole process chain. In addition, the chemical process of producing clinker (calcination of limestone) produces non-renewable CO_2. These two factors results in that the cement industry is responsible for a significant portion of global man-made CO_2 emissions. It is estimated that 50% of the cement industry GHG emissions derive from the chemical process, and 40% from burning fuel. The remainder is split between electricity and transport uses.

Knowledgeable of that, back in 1999, worldwide cement industry launched the Cement Sustainability Initiative. Among other reasons, the Initiative was launched in response to international concerns about the role of the cement industry in Climate Change. The objective of the Initiative was to develop studies and to propose an agenda towards the sustainability of the cement industry. In the Climate Change chapter, the agenda proposed some important actions including: innovation in improving the energy efficiency of processes and equipment; switching to lower carbon fuels; using alternative raw materials to reduce limestone use; developing CO_2 capture and sequestration techniques; and taking advantage of market mechanisms such as emissions trading and voluntary initiatives.

Votorantim Cimentos is signatory of the Cement Industry Initiative and started to define strategies in order to meet the Initiative agenda, including the implementation of this project activity.

Grupo Votorantim is among the largest business groups in Brazil. It participates in several markets in the country, including cement, cellulose, paper, aluminum, zinc, nickel, long steel, polypropylene bioriented films, chemical specialties and orange juice. It also has an important share in the financial sector through Banco Votorantim.

In the cement, lime, mortar and concrete businesses, in Brazil and abroad, the group is represented by Votorantim Cimentos. In Brazil, Votorantim Cimentos leads both the cement market and the hydrated and industrial lime markets, and also holds a distinguished position in the mortar market. Abroad, through the operation of St. Marys, it has a 10% share of the Canadian market and about 2% of the U.S. cement market.

The project activity contributes to sustainable development for several reasons:

- Natural gas reduces criteria air pollutants emissions, especially particulate matter, sulphur oxides and carbon monoxide.
- Natural gas use also contributes to the mitigation of greenhouse gases emissions as it is less carbon intensive when compared to other fossil fuels, like fuel oil.
- Furthermore, natural gas is safer than fuel oil in plant operations because it is lighter than air and, in the case of leakage, the gas vanishes rapidly in the atmosphere, decreasing the risk of explosion and blaze.
- Additionally, the transportation of natural gas to the site is safer and more environmentally friendly than fuel oil because it avoids the use of road trucks carrying fuel oil.

A.3. Project participants:

Table 1 - Parties involved in the project activity

Name of Party involved (*) ((host) indicates host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Votorantim Cimentos (private entity)	No
Brazil (host)	Ecoinvest Carbon (private entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: When the PDD is filled in support of a proposed new methodology (forms CDM-NBM and CDM-NMM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

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

São Paulo.

A.4.1.3. City/Town/Community etc:

Cubatão.

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

Project activity is located at:

Votorantim Cimentos – Unidade Cubatão
Rodovia Cônego Domênico Rangoni, s/n – km 62 – Vila Parise
Cubatão - São Paulo
Brazil
Phone: (+55 13) 3361-1187

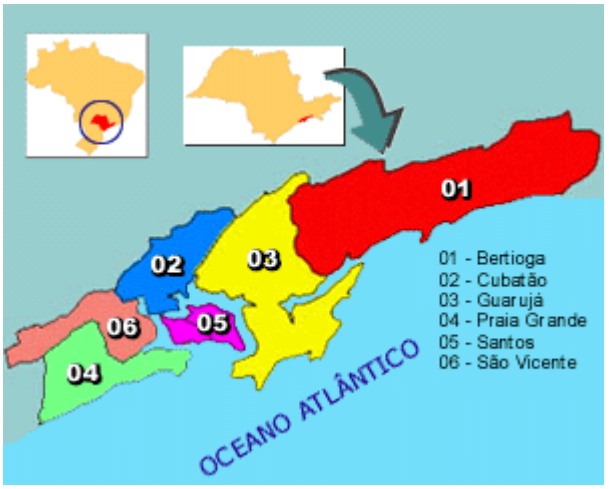

Figure 1 – Location of Cubatão
Source: www.citybrazil.com.br

A.4.2. Category(ies) of project activity:

Votorantim Cimentos project falls under scope number 4 – manufacturing industries.

A.4.3. Technology to be employed by the project activity:

Technology employed by the project is conventional and presents no major changes when compared with other installations of the same type, which burns natural gas in cement dryers.

Blast furnace slag is a residue of pig iron production similar to sand. It has chemical properties that allow it to be used, under certain conditions, as clinker substitute. Before being used to produce cement, the blast furnace slag must be dried in dryers that used fuel oil and with the project starts burning natural gas.

The project activity involved retrofitting of the existing dryer.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The emission reductions of Votorantim Cimentos Cubatão project will be achieved through using natural gas, a fuel with lower carbon emission factor than the previously used fuel, fuel oil. Natural gas is the less carbon intensive from among all fossil fuels. The emissions reductions for Votorantim Cimentos Cubatão project rely on this fact.

Project emissions reductions will be calculated through approved methodology AM0008. Project emissions are the emissions of CO_2, N_2O and CH_4 derived from natural gas burning. Leakage is CH_4 and CO_2 emissions in natural gas production and transportation. Baseline emissions are the emissions of CO_2, N_2O and CH_4 derived from the continued use of fuel oil.

In the absence of the CDM incentives the project activity would not happen and the emissions would be greater than that of the project scenario, because fuel oil would be used instead of natural gas. The additionality assessment conducted in Section B.3 presents with further details the additionality of the project.

There are no national and/or sectoral policies and circumstances that influence the decisions or impose obligations to the proposed project activity. The use of fuel oil and natural gas are not restricted nor demanded by any local legislation. Also, no sectoral policies incentive the use of natural gas or desincentive the use of fuel oil. Therefore, no sectoral policies and circumstances would make the project activity preferred, rather than the baseline scenario. The only national circumstance that foments the new technology is the participation of Brazil in the Kyoto Protocol, which allows the project to benefit from the CDM incentives.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Table 2 accounts for the estimated amount of emissions reduction based on the forecasted natural gas consumption. The crediting period is 7 years, starting in 2004. It is important to note that the effective accomplishment of the emissions reduction will depend on project performance, during the crediting period.

Table 2 – Estimated emission reductions

Years	Annual estimation of emission reductions [tCO_2]
2004	12,000
2005	12,000
2006	12,000
2007	12,000
2008	12,000
2009	12,000
2010	12,000
Total estimated reductions (tCO_2eq)	84,000
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tCO_2eq)	12,000

A.4.5. Public funding of the project activity:

There is no public funding involved in the project activity.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

Approved baseline methodology AM0008 "Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility".

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

AM0008 is subject to the conditions listed below. The project activity meets all of them.

1. The project activity is to switch the industrial fuel currently used in some element processes of a facility from coal and/or petroleum fuels that would otherwise continue to be used during the crediting period, to natural gas.

   Votorantim Cimentos Cubatão project is the switching from fuel oil to natural gas. Fuel oil was used until 2003 in the dryer.

2. The local regulations/programs do not constrain the facility from using coal/petroleum fuels.

   There are/were no regulations and programs, either in the Federal, State or Municipal levels that constrain the facility from using fuel oil, nor policies that foment the use of natural gas instead of other fossil fuels.

3. Use of coal and/or petroleum fuels is less expensive than natural gas per unit of energy in the country and sector.

   Natural gas prices per unit of energy have been higher than fuel oil prices, including at the time when the decision of implementing the project was undertaken.

   The source of natural gas prices is CSPE[1], which is the regulatory commission of energy of the State of São Paulo and is responsible for establishing natural gas prices in the State. The source of fuel oil prices is Votorantim Cimentos Cubatão fuel oil supplier. The information is in the purchasing receipts during the period.

4. The facility would not have major efficiency improvements during the crediting period.

   In fact, no major efficiency improvements will happen to the facility during the crediting period. The project is fuel switching only. There is a minor efficiency difference between fuel oil and natural gas combustion, as expected in any project of fuel switching: This difference cannot be considered as a major efficiency improvement. Detailed calculations are presented in Section B.2.

5. The project activity does not increase the capacity of final outputs and lifetime of the existing facility during the crediting period (i.e. this methodology is applicable up to the end of the lifetime of existing facility if shorter than crediting period).

   The project activity did not increase the lifetime nor the capacity of the existing dryer.

6. The proposed project activity is defined as fuel switching applied to element processes and does not result in integrated process change, except for possible associated changes in other energy use (such as electricity for coal processing) outside the affected element processes, which shall (could) be treated as leakage.

   Project activity will not result in integrated process change. It is a simple substitution of fuel.

[1] CSPE – Comissão de Serviços Públicos de Energia. Natural gas prices – Comgas. Website: www.cspe.sp.gov.br

B.2. Description of how the methodology is applied in the context of the project activity:

Baseline Emissions

Annual baseline emissions *BE*, in [tCO_2], during each year of the crediting period, are calculated according to AM0008:

$$BE_y = \sum_i Q\_F_{i,y} \cdot \left(EF\_F_i\_CO_{2,y} + EF\_F_i\_CH_4 \cdot GWP\_CH_4 + EF\_F_i\_N_2O \cdot GWP\_N_2O\right)$$

In the context of the project activity it becomes:

$$BE = Q\_FO \cdot \left(EF\_FO\_CO_2 + EF\_FO\_CH_4 \cdot GWP\_CH_4 + EF\_FO\_N_2O \cdot GWP\_N_2O\right)$$

where:

Q_FO is the estimated quantity of fuel oil used in the baseline scenario, in each year of the crediting period, measured in [TJ]. *Q_FO* is estimated from the historical efficiency of the dryer and from the consumption of natural gas, measured during the crediting period. The suffix *y*, in the original equation, will be omitted for the sake of simplification.

In order to ensure that the useful heat needed is common in the project and baseline scenarios, *Q_FO* is linked with the consumption of natural gas through the following equation:

$$Q\_FO \cdot h\_FO = Q\_NG \cdot h\_NG \Rightarrow Q\_FO = Q\_NG \cdot \frac{h\_NG}{h\_FO}$$

This equation is necessary to obtain *Q_FO* which is a baseline scenario variable that cannot be measured directly.

? _FO and *? _NG* are the efficiencies of fuel oil and natural gas, respectively.

? _FO and *? _NG* are calculated as the quotient of dry slag produced, in [t], per fuel consumed, in [TJ]. The result is in [t/TJ]:

$$h\_FO = \frac{Q\_ST}{Q\_FO}$$

$$h\_NG = \frac{Q\_ST}{Q\_NG}$$

Where,

Q_ST in [t], *Q_FO* in [TJ] and *Q_NG* in [TJ] are, respectively, the quantities of dry slag produced, fuel oil and natural gas consumed. *?_FO* is determined once, before fuel switching, and *?_NG* is determined once at the early stage of the crediting period.

Additionally, this value is taken as an average value and not as function of the load factor because: (i) the operating pattern of the dryer does not vary much over time. When the dryer is operating, its load factor is approximately fixed. For this reason, the influence of different efficiencies for different load factors is expected to be minor; and (ii) the necessary data to establish the efficiencies as a function of the load factor are not available. Project proponents do not monitor the efficiency of the dryer as function of the load factor and the data from the dryer manufacturer is not available.

EF_FO_CO2 is CO_2 equivalent emission factor per unit of energy of fuel oil in [tCO_2/TJ]. In the case of Votorantim Cimentos project, the only fuel used in the baseline scenario is fuel oil and the emission factor for fuel oil will be considered constant over the crediting period. IPCC default values will be used, since no other reference is available. *EF_FO_CO2* is obtained from the following equation, as recommended by the IPCC in the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories":

$$EF\_FO\_CO_2 = \frac{44}{12} \cdot OXID \cdot EF = \frac{44}{12} \cdot 0.99 \cdot 21.1 = 76.59 \quad tCO_2/TJ$$

EF_FO_CH4 is the IPCC default CH_4 emission factor of fuel oil associated with fuel combustion, measured in [tCH_4/TJ]. *EF_FO_CH4* is obtained from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 3 – Reference Manual, Section 1.4.2.1, Table 1-7, Energy Industries, Oil", where *EF_FO_CH4* = 3 kg/TJ = 0.003 tCH_4/TJ.

EF_FO_ N2O is the IPCC default N_2O emission factor of fuel oil associated with fuel combustion, measured in [tN_2O/TJ]. *EF_FO_ N2O* is obtained from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 3 – Reference Manual, Section 1.4.2.2, Table 1-8, Energy Industries, Oil", where *EF_FO_N2O* = 0.6 kg/TJ = 0.0006 tN_2O/TJ.

GWP_CH4 is the global warming potential of CH_4 set by the IPCC in the "Climate Change 1995: The Science of Climate Change, Table 4, p. 22, 1996" as *GWP_CH4* = 21 tCO_2/tCH_4.

GWP_N2O is the global warming potential of N_2O set by the IPCC in the "Climate Change 1995: The Science of Climate Change, Table 4, p. 22, 1996" as *GWP_N2O* = 310 tCO_2/tN_2O.

Project Emissions

According to AM0008, annual project emissions *PE*, in [tCO_2], during each year of the crediting period is expressed as:

$$PE_y = \sum_i Q\_NG_{i,y} \cdot \left(EF\_NG\_CO_2 + EF\_NG\_CH_4 \cdot GWP\_CH_4 + EF\_NG\_N_2O \cdot GWP\_N_2O\right)$$

In the context of the project activity it becomes:

$$PE = Q\_NG \cdot \left(EF\_NG\_CO_2 + EF\_NG\_CH_4 \cdot GWP\_CH_4 + EF\_NG\_N_2O \cdot GWP\_N_2O\right)$$

where:

Q_NG is the quantity of natural gas used in the project scenario, in each year of the crediting period, for replacing *Q_FO* quantity of fuel oil used in the baseline scenario, measured in [TJ]. *Q_NG* is monitored in each year of the crediting period.

EF_NG_CO2 is the IPCC default CO_2 emission factor per unit of natural gas associated with fuel combustion, in [tCO_2/TJ]. It is obtained from the following equation, as recommended by the IPCC in the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories":

$$EF\_NG\_CO_2 = \frac{44}{12} \cdot OXID \cdot EF = \frac{44}{12} \cdot 0.995 \cdot 15.3 = 55.82 \quad tCO_2/TJ$$

EF_NG_CH4 is the IPCC default CH_4 emission factor of natural gas associated with fuel combustion, measured in [tCH_4/TJ]. It is obtained from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 3 – Reference Manual, Section 1.4.2.1, Table 1-7, Energy Industries, Natural Gas", where *EF_NG_CH4* = 1 kg/TJ = 0.001 tCH_4/TJ.

EF_NG_N2O is the IPCC default N_2O emission factor of natural gas associated with fuel combustion, measured in [tN_2O/TJ]. It is obtained from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 3 – Reference Manual, Section 1.4.2.2, Table 1-8, Energy Industries, Natural Gas", where *EF_NG_CH4* = 0.1 kg/TJ = 0.0001 tN_2O/TJ.

After all, project emissions become:

$$PE = Q\_NG \cdot \left(55.82 + 0.001 \cdot 21 + 0.0001 \cdot 310\right) = 55.87 \cdot Q\_NG \quad [tCO_2]$$

Leakage

AM0008 considers two sources of leakage: fugitive CH_4 emissions from fuel production and CO_2 emissions from fuel transportation. In Votorantim Cimentos project, following the guidance of AM0008, the annual leakage *LE* is expressed as:

$$LE = \left(Q\_NG \cdot FE\_NG\_CH_4 - Q\_FO \cdot FE\_FO\_CH_4\right) \cdot GWP\_CH_4 + Q\_NG \cdot EF\_TF\_NG - Q\_FO \cdot EF\_TF\_FO$$

FE_NG_CH4 and *FE_FO_CH4* are the IPCC default CH_4 emission factor of CH_4 fugitive emissions associated with natural gas and fuel oil production and transportation, in [tCH_4/TJ].

FE_NG_CH4 = 118 $kgCH_4$/TJ = 0.118 tCH_4/TJ, as presented in the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories – Volume 3 – Reference Manual, Section 1.8.5, Table 1-58, Natural gas processing, transport and distribution".

FE_FO_CH4 = 0. Fugitive emissions of CH_4 associated with fuel oil production and transportation will be considered zero. The reason is the lack of specific CH_4 emission factors for the production of fuel oil. This is conservative.

EF_TF_NG and *EF_TF_FO* are CO_2 emission factors for the transportation of natural gas and fuel oil.

EF_TF_NG = 0. Natural gas is transported through pipelines, hence no emissions of CO_2 are attributed due to its transportation. Fugitive emissions of CH_4 are considered in *FE_NG_CH4*.

EF_TF_FO = 0. Fuel oil would be transported through road trucks in the baseline and emissions of CO_2 would occur due to fossil fuel consumption. However, these emissions will not be considered. This is conservative.

Therefore,

$$LE = Q\_NG \cdot 0.118 \cdot 21 = 2.48 \cdot Q\_NG \qquad [tCO_2]$$

Emission Reductions

The annual emission reduction *ER* in each year of the project activity is expressed as

$$ER = BE - PE - LE \qquad [tCO_2]$$

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

Anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the CDM incentives because the scenario would be the continued use of fuel oil in the existing facility. Additionality is assessed as indicated in methodology AM0008:

Step 0 – Preliminary screening based on the starting date of the project activity

Project participants wish to have the crediting period starting prior to the registration of the project activity. For this reasons it is provided below:

(a) Evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity

The implementation of the project activity started on January/2003. The date represents the start of the retrofitting of the installations. Adequate evidence is available at the project site.

(b) Evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

Votorantim Cimentos is signatory of the Cement Industry Initiative and since the beginning of the Initiative the company started to define strategies in order to meet its agenda. Back in 1999 worldwide cement industry launched the Cement Sustainability Initiative. Among other reasons, the Initiative was launched in response to international concerns about the role of the cement industry in Sustainable Development and Climate Change. The objective of the Initiative was to develop studies and to propose a positive agenda towards the sustainability of the cement industry.

In the Climate Change chapter, the agenda proposed some important actions including: innovation in improving the energy efficiency of processes and equipment; switching to lower carbon fuels; using alternative raw materials to reduce limestone use; developing CO_2 capture and sequestration techniques; and taking advantage of market mechanisms such as emissions trading to meet the agenda. The implementation of this project activity is one of the efforts towards the reduction of conventional raw material and reduction of greenhouse gases emissions in the manufacturing process.

Further information on the Cement Sustainability Initiative can be found in the internet website www.wbcsdcement.org.

Regulations/programs related to the project activity

As stated before, there are no regulations/programs, either in the Federal, State or Municipal levels that constrain the facility from using fuel oil, nor policies that foment the use of natural gas instead of other fossil fuels.

Trends of natural and fuel oil consumption in the region and sector

During the 1990's, important changes were introduced in the Brazilian energy sector, aiming to diversify Brazilian energy matrix. In the petroleum and gas sector, the Law # 9478/97, known as Petroleum's Law, started the opening of the natural gas market to the private capital, flexibilizing Petrobras monopoly in the sector.

Since then, private companies became able to act in all activities of the natural gas stream with the objective of developing the sector, which was still very incipient regarding infrastructure to attend markets. The natural gas demand has been presenting an increasing trend in Brazil. The demand passed from 4.2 billion m^3 in 1990 to 7.7 billion m^3 in 1999, involving a cumulated annual rising of 7%. Since the interconnection with Bolivia, the annual consume enlarged 25.1% until arrive at 15.1 billion m^3 in 2002.

According to BEN 2005 (*Balanço Energético Nacional*, national energy data of the Ministry of Mines and Energy), the total final consumption of energy (electricity and fuels) in the cement sector for the past five years was:

Table 3 - Total energy demand evolution in the cement sector (in 10^3 toe)[2]

	2000	2001	2002	2003	2004
Natural gas	49	24	28	14	20
Mineral coal	184	180	135	211	38
Firewood	22	9	0	0	0
Diesel	24	23	25	26	31
Fuel oil	510	229	134	91	22
Electricity	383	375	343	328	323
Vegetal coal	233	211	207	247	284
Petroleum Coke	1.845	2.198	2.125	1.726	1.696
Others	112	132	136	165	234
Total	3.363	3.381	3.132	2.808	2.648

Table 4 - Cement industry consumption (%)

	2000	2001	2002	2003	2004
Mineral coal	5,5	5,3	4,3	7,5	1,5
Fuel oil	15,2	6,8	4,3	3,2	0,8
Electricity	11,4	11,1	10,9	11,7	12,2
Vegetal coal	6,9	6,2	6,6	8,8	10,7
Petroleum Coke	54,9	65,0	67,8	61,5	64,0
Others	6,2	5,5	6,0	7,3	10,7
Total	100	100	100	100	100

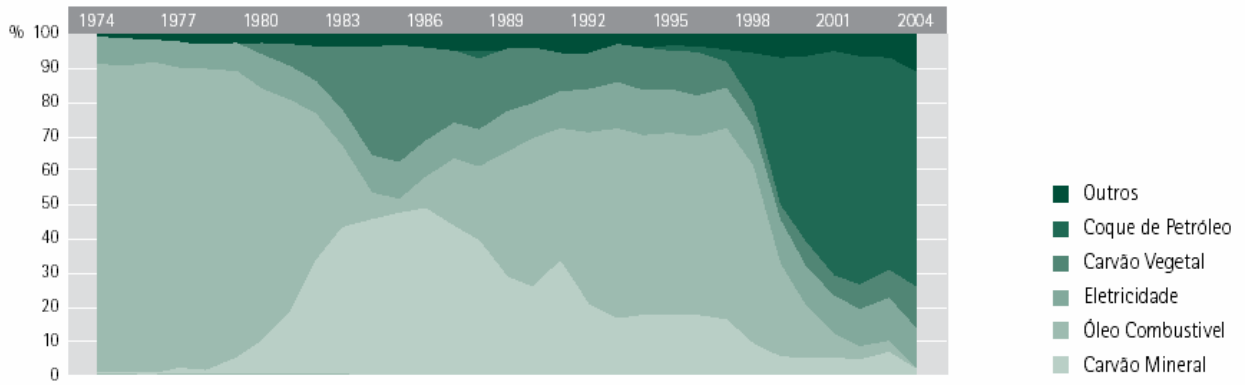

Figure 2 - Cement industry consumption (%)

[2] toe – tonne of oil equivalent (1 toe = 41.87 GJ)

In the same period, the Brazilian cement production was the following:

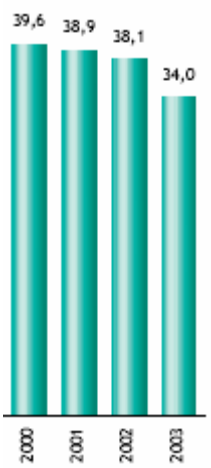

Figure 3 - Brazilian cement production (million ton)
Source: SNIC (http://www.cpcimento.com.br/docs/2003_Apresentacao.pdf)

The numbers above show that consumption of natural gas in the cement sector is inexpressive and it has been decreasing. It can be noted also that there is a decrease in fuel oil demand of the last five years. Certainly, the decrease of energy consumption of energy since 2000 is reflect of stagnation and low investments in infra-structure, back in 1999.

In the most recent five years (2000-2004) the trend in natural gas demand at cement industry has been maintained decreasing, perhaps because of uncertainties in the supplying of natural gas to industrial activities. One major contributor to this fact was the diversion of natural gas to supply electricity generation in thermo power plants after the rationing of electricity in 2001. In the years that followed the rationing the political scenario related with natural gas still remained unclear. In fact, ANP[3] (*Agência Nacional do Petróleo* – Brazilian regulatory agency for petroleum and natural gas) reports some barriers that yet remain to be overcame to further increase the participation of natural gas in the country:

- The policies implemented in the past were not able to reach the integration of the sectors that were to be harmonized among themselves, like natural gas, electricity, petroleum and its derivates. Each of these scopes was developed in parallel and disjointed.

- Competition between natural gas and fuel oil – the reduced price of fuel oil, in especial of the heaviest oils, may represent a barrier to the introduction of natural gas, as the two fuels compete between each other.

[3] Agência Nacional do Petróleo – ANP. Panorama da Indústria do Gás Natural no Brasil. July/2002. Available at www.anp.gov.br e Agência Nacional do Petróleo – ANP. A Indústria do Gás Natural no Brasil. January/2004. Available at www.anp.gov.br.

- Petrobras - the company that historically has the monopoly of the oil and gas production in Brazil is the greatest operator of the sector. In its strategic decisions the company seeks to preserve its markets, jeopardizing the development of other players and companies and the establishment of a real free market. It is legally impossible to split Petrobras or to oblige it to sell its participation in other companies.

- Regulatory mark - there is no unified vision of the regulation to distribution and transport. There is no unified model to the operation of the transactions and competences of the agencies. A prove of that is that the sector still doesn't owns an integral regulatory mark capable of establishing procedures about service conditions, contracts, operations and tariffs. In the same way, the absence of this regulatory mark favored discriminatory actions and consequently conflicts between agents, what increased the uncertainties existents, harming the development of the natural gas market.

- Regulatory uncertainties - there is regulatory inconsistence between Federal and State governments, they are not complementary. There are limits and gaps in the regulatory framework established by Law 9478/97 and other related legislation that create uncertainties in the responsibilities and possibilities of the regulatory agency (ANP) to regulate the market. Examples given by ANP were the indefinition about free access to the grid to other companies and the limits between the Federal regulatory agency and State regulatory agencies responsibilities. This represents the so-called regulatory risks of the natural gas market in Brazil.

- The original system of definition of prices and settlement continue to be motive of conflict. The existence of taxes applied successively to the several stages of the natural gas chain in addition to the different taxes applied in the different States where the natural gas pipeline goes through, represents another problem to the market.

- The existence of conflict with access to the Gasbol (Bolivian-Brazilian natural gas pipeline) evidences its inefficient use, which operates with idler capacity.

Prices of natural gas versus fuel oil

As stated before, natural gas prices have been higher than fuel oil prices, including at the time when the decision of implementing the project was undertaken. The historical prices of natural gas and fuel oil, at the scenario when decision was taken are available under request.

NPV Analysis

The methodology requires that an economic investment analysis, using the net present value (NPV) of the project, is conducted. As the NPV of the project without CERs is negative, project is additional.

The detailed information about the cash flow analysis and NPV calculation is confidential. It is available under request.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

Project boundary encompasses the cement dryer of the Votorantim Cimentos Cubatão facility.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity(ies) determining the baseline:

Date of baseline completion: 27/12/2005.

Contact information:

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SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

Starting date of the project activity (project start-up date): 01/01/2003.

C.1.2. Expected operational lifetime of the project activity:

Expected operational lifetime of the project activity 30 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

Starting date of the crediting period: 01/01/2004.

C.2.1.2. Length of the first crediting period:

The length of the crediting period is 7 years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Approved monitoring methodology AM0008 – "Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility".

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

Approved monitoring methodology AM0008 is subject to the same conditions addressed in Section B.1.1, please refer to that section.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. Q_NG	*Quantity of natural gas consumed in each year of the project activity*	*Monitored in the project activity from purchasing receipts of the local natural gas company and/or field instruments*	*TJ*	*M*	*Monthly*	*100%*	*Electronic and paper*	*Please refer to Section B.2*
2. EF_NG_CO_2	*CO_2 emission factor of natural gas combustion*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCO_2/TJ*	*E (Fixed parameter)*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
3. EF_NG_CH_4	*CH_4 emission factor of natural gas combustion*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCH_4/TJ*	*E (Fixed parameter)*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
4. EF_NG_N_2O	*N_2O emission factor of natural gas combustion*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tN_2O/TJ*	*E (Fixed parameter)*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
5 GWP_CH_4.	*Global Warming Potential for CH_4*	*IPCC in the "Climate Change 1995: The Science of Climate Change"*	*tCO_2/tCH_4*	*E (Fixed parameter)*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
6. GWP_N_2O	*Global Warming Potential for N_2O*	*IPCC in the "Climate Change 1995: The Science of Climate Change"*	*tCO_2/tN_2O*	*E (Fixed parameter)*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Project emissions are calculated as:

$$PE = Q\_NG \cdot \left(EF\_NG\_CO_2 + EF\_NG\_CH_4 \cdot GWP\_CH_4 + EF\_NG\_N_2O \cdot GWP\_N_2O\right)$$

Please, refer to Section B.2 for further information.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
7. Q_FO	*Amount of fuel oil that would be consumed in the baseline, for each year of the project activity. Q_FO is estimated from Q_NG during the crediting period and measured in the year before project starting for ?_FO calculation*	*Calculated by means of efficiencies and natural gas consumption. For ?_FO calculation, Q_FO is measured in the project site, through the purchasing receipts of the fuel oil supplier and/or through local field instruments*	*TJ*	*C, M*	*Monthly*	*100%*	*Electronic*	*Please refer to Section B.2*
8. ?_FO	*Fuel oil efficiency*	*Calculated from Q_FO and Q_ST*	*t/TJ*	*C*	*Once, before project starting*	*100%*	*Electronic*	*Please see Annex 4 and Section B.2*

9. ?_NG	*Natural gas efficiency*	*Calculated from Q_NG and Q_ST*	*t/TJ*	*C*	*Once, at early stage of each crediting period*	*100%*	*Electronic*	*Please see Annex 4 and Section B.2*
10. EF_FO_CO_2	*Emissions factor of CO_2 for fuel oil burning.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCO_2/TJ*	*Fixed parameter*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
11. EF_FO_CH_4	*Emission factor of CH_4 for fuel oil burning.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCH_4/TJ*	*Fixed parameter*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*
12. EF_FO_N_2O	*Emission factor of N_2O for fuel oil burning.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tN_2O/TJ*	*Fixed parameter*	*Once, at validation*	*100%*	*Electronic*	*Please refer to Section B.2*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Baseline emissions are calculated as:

$$BE = Q\_FO \cdot \left(EF\_FO\_CO_2 + EF\_FO\_CH_4 \cdot GWP\_CH_4 + EF\_FO\_N_2O \cdot GWP\_N_2O\right)$$

Please, refer to Section B.2 for further information.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Not applicable	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Not applicable	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
13. FE_NG_CH_4	*CH_4 emission factor of fugitive emissions associated with natural gas*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCH_4/TJ*	*Fixed parameter*	*Once, at validation.*	*100%*	*Electronic*	-
14. FE_FO_CH_4	*CH_4 emission factor of fugitive emissions associated with fuel oil.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCH_4/TJ*	*Fixed parameter*	*Once, at validation.*	*100%*	*Electronic*	-
15. EF_TF_NG	*CO_2 emission factors for the transportation of natural gas.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCO_2/TJ*	*Fixed parameter*	*Once, at validation.*	*100%*	*Electronic*	-
16. EF_TF_FO	*CO_2 emission factors for the transportation of fuel oil.*	*"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories"*	*tCO_2/TJ*	*Fixed parameter*	*Once, at validation.*	*100%*	*Electronic*	-

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Leakage is calculated as:

$$LE = \left(Q\_NG \cdot FE\_NG\_CH_4 - Q\_FO \cdot FE\_FO\_CH_4\right) \cdot GWP\_CH_4 + Q\_NG \cdot EF\_TF\_NG - Q\_FO \cdot EF\_TF\_FO$$

Please, refer to Section B.2 for further information.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Low*	*The natural gas consumed is monitored in normal plant operations that already has QA/QC procedures in place. Purchasing receipts of the local natural gas company are used assure quality of the data.*
2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16	*Low*	*QA/QC procedures are not necessary since these parameters are fixed, obtained from the IPCC.*
7, 8, 9	*Low*	*These variables and parameters are calculated from monitored variables, therefore, QA/QC procedures are derived from the monitored variables.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Project operator and manager is Votorantim Cimentos. Votorantim Cimentos has in place, due to company policies and engineering best practices, a complete set of maintenance and operations procedures, which include the monitoring of process variables, instruments calibration and quality control. For this reason, no major changes in monitoring and QA/QC procedures will be required for the CDM project activity related variables and parameters. The detailed monitoring plan is presented in Annex 4.

D.5 Name of person/entity determining the monitoring methodology:

Contact information:

Ecoinvest Carbon
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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Table 5 – Estimated project emissions

Year	*Q_NG* [TJ]	*PE* [tCO_2]
2004	182	10,010
2005	182	10,010
2006	182	10,010
2007	182	10,010
2008	182	10,010
2009	182	10,010
2010	182	10,010
Total	1,274	70,070

E.2. Estimated leakage:

Table 6 – Estimated leakage

Year	*Q_NG* [TJ]	*LE* [tCO_2]
2004	182	451
2005	182	451
2006	182	451
2007	182	451
2008	182	451
2009	182	451
2010	182	451
Total	1,274	3,157

E.3. The sum of E.1 and E.2 representing the project activity emissions:

From the summation of emissions in Tables 11 and 12, project activity emissions, in [tCO_2], are calculated and presented in Table 13.

Table 7 – Estimated emissions from the project activity plus leakage

Year	*Q_NG* [TJ]	*PE* + *LE* [tCO_2]
2004	182	10,461
2005	182	10,461
2006	182	10,461
2007	182	10,461
2008	182	10,461
2009	182	10,461
2010	182	10,461
Total	1,274	73,227

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Table 8 – Estimated baseline emissions

Year	*Q_NG* [TJ]	*BE* [tCO_2]
2004	182	22,461
2005	182	22,461
2006	182	22,461
2007	182	22,461
2008	182	22,461
2009	182	22,461
2010	182	22,461
Total	1,274	157,227

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

Table 9 – Estimated project emissions reductions

Year	*Q_NG* [TJ]	*ER* [tCO_2]
2004	182	12,000
2005	182	12,000
2006	182	12,000
2007	182	12,000
2008	182	12,000
2009	182	12,000
2010	182	12,000
Total	1,274	84,000

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

Table 10 – Estimated emissions

Year	Estimation of project activity emissions [tCO2]	Estimation of baseline emissions [tCO2]	Estimation of leakage emissions [tCO2]	Estimation of emissions reductions [tCO2]
2004	10,010	22,461	451	12,000
2005	10,010	22,461	451	12,000
2006	10,010	22,461	451	12,000
2007	10,010	22,461	451	12,000
2008	10,010	22,461	451	12,000
2009	10,010	22,461	451	12,000
2010	10,010	22,461	451	12,000
Total	70,070	157,227	3,157	84,000

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Votorantim Cimentos required the environmental licenses for the dryer from the State environmental agency CETESB. The licenses are available under request.

Votorantim Cimentos developed the MCE (*Memorial de Caracterização do Empreendimento*) to obtain the licenses. The MCE is a simplified document that characterizes the projects in terms of its environmental impacts. This document is demanded by the State environmental agency in order to verify if the project activity needs to carry out a more detailed study (RAP – *Relatório Ambiental Preliminar*) to obtain the license. The RAP was not necessary, as the dryer retrofitting presented no major environmental impacts. The MCE is available for further consultation in the project site and with CETESB.

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

No significant environmental impacts are expected for this project activity. The non-requirement of RAP nor EIA/RIMA by the State environmental agency confirms this fact. The verification of project atmospheric emissions, wastewater generation and management and solid residues final disposal was approved by the environmental agency as of the issuance of the license.

Additionally, Votorantim Cimentos Cubatão has emergency preparedness procedures for the whole plant, which includes the natural gas installations and the dryer. The procedures are available at the project site.

Actually, some benefits can be observed after project implementation. The substitution of fuel oil by natural gas reduces emissions of criteria air pollutants (please refer to Section A.2).

SECTION G. Stakeholders' comments

G.1. Brief description of how comments by local stakeholders have been invited and compiled:

Brazilian environmental legislation requests the public announcement and invitation for comments in the event of the environmental license request. The public announcement and public comments request were made in the local state official journal (*Diário Oficial do Estado*) and in the regional newspaper. No objections and comments were raised about the project.

The Brazilian Designated National Authority for the CDM requires the compulsory invitation of selected stakeholders to comment the PDD sent to validation in order to provide the letter of approval. Votorantim and Ecoinvest invited the comments from local stakeholders when validation started.

The invited local stakeholders are listed below:

- City Hall of Cubatão
- City Council of Cubatão
- State Environmental Agency
- Local Environmental Agency
- Local ONG
- State Public Attorney
- FBOMS (Representative of Brazilian Environmental ONGs)

G.2. Summary of the comments received:

So far, no comments were received from local stakeholders.

G.3. Report on how due account was taken of any comments received:

So far, no comments were received from local stakeholders.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the project activity.

Annex 3

BASELINE INFORMATION

All baseline information was presented in Section B. Please, refer to that section.

Annex 4

MONITORING PLAN

Monitoring data is presented in Section D.

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