



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1. Title of the project activity:**

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Wind farm extension project for Lafarge's cement plant in Tétouan

A.2. Description of the project activity:

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Lafarge Ciments is the first cement manufacturer in Morocco to install a wind farm to produce electrical energy from a renewable energy namely wind. The project aims at reinforcing Lafarge development activities to secure its cement plants with electricity.

The existing wind farm is installed near Lafarge's Tétouan cement plant. It has been registered as CDM project in 2005 under reference number 0042. Lafarge cement is undertaking an extension project of the existing wind farm by installing eleven new turbines having a nominal unit capacity of 2 MW. The extension project activity which is located in the north of the cement plant site (see Figure 2) will be completely independent from the existing wind farm. The 22 MW extension project will have its own collecting post, two dedicated 20 kV transport lines and specific meters. The electricity produced by the new wind farm, estimated at 77 GWh/year, will be used either in the nearby cement plant or transported through the national grid for use in other Lafarge's industrial plants connected to the grid.

The electrical energy produced by the project activity will substitute electricity currently supplied by the national grid managed the public utility: Office National d'Electricité (ONE) and thus result in reductions of Green House Gases (GHG) emissions associated with the fossil fuel dominated power plants feeding the national grid.

Using a new and renewable local source of energy, the project will contribute as well to the decrease of the country's dependence vis-à-vis the importation of fossil fuels and will help create directly and indirectly new jobs. As such, the project activity is expected to contribute to the development of wind energy in Morocco and hence to help achieve the objectives of Morocco's national strategy for renewable energy development. Generally speaking, the project's contribution to Morocco's sustainable development can be summarized by the following benefits:

- Diversification of the national supply of energy;
- Local development of renewable energy use in an international context of high fossil energy prices ;
- Reduction of the country's imports in hard currency by the use of wind power instead of electricity mainly produced from imported coal, natural gas or oil products ;
- Reduction of GHG emissions in accordance with the objectives of the UNFCCC ;
- Contribution to the development of national and foreign investments in the energy sector;



- Clean technology transfer and local capacity building in wind electricity generation and optimal use of wind energy in an heavy industry ;
- Creation of stable qualified jobs.

A.3. Project participants:

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Name of Party involved ((host) indicates a 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)
Morocco (host Party)	Lafarge Ciments (Private entity)	No

Contact information is provided in Annex 1

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:**

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A.4.1.1. Host Party(ies):

>> Morocco

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

>> Province of Tétouan

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

>> Saddina commune

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

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The site of location of the future wind farm is the rural commune of Saddina (Tetouan Province) at the north east side of the cement plant. The following Table 1 gives the Lambert coordinates of the future wind turbines. Figure 2 represents a map of the location of the new wind farm with the turbines represented by circles with the three blades inside.

**Table 1: Heights and Lambert Coordinates of the turbines**

Turbine	Height (m)	X	Y
G4'	67	497 616	556 861
G6'	67	497 125	557 182
G7'	67	496 743	557 259
G9'	67	496 395	557 709
G11'	67	496 227	557 288
TIII_1	60	497 830	557 058
TIII_2	60	497 657	557 251
TIII_3	60	496 987	556 974
TIII_4	60	496 043	557 735
TIII_5	60	496 360	557 970
TIII_6	60	496 995	557 713

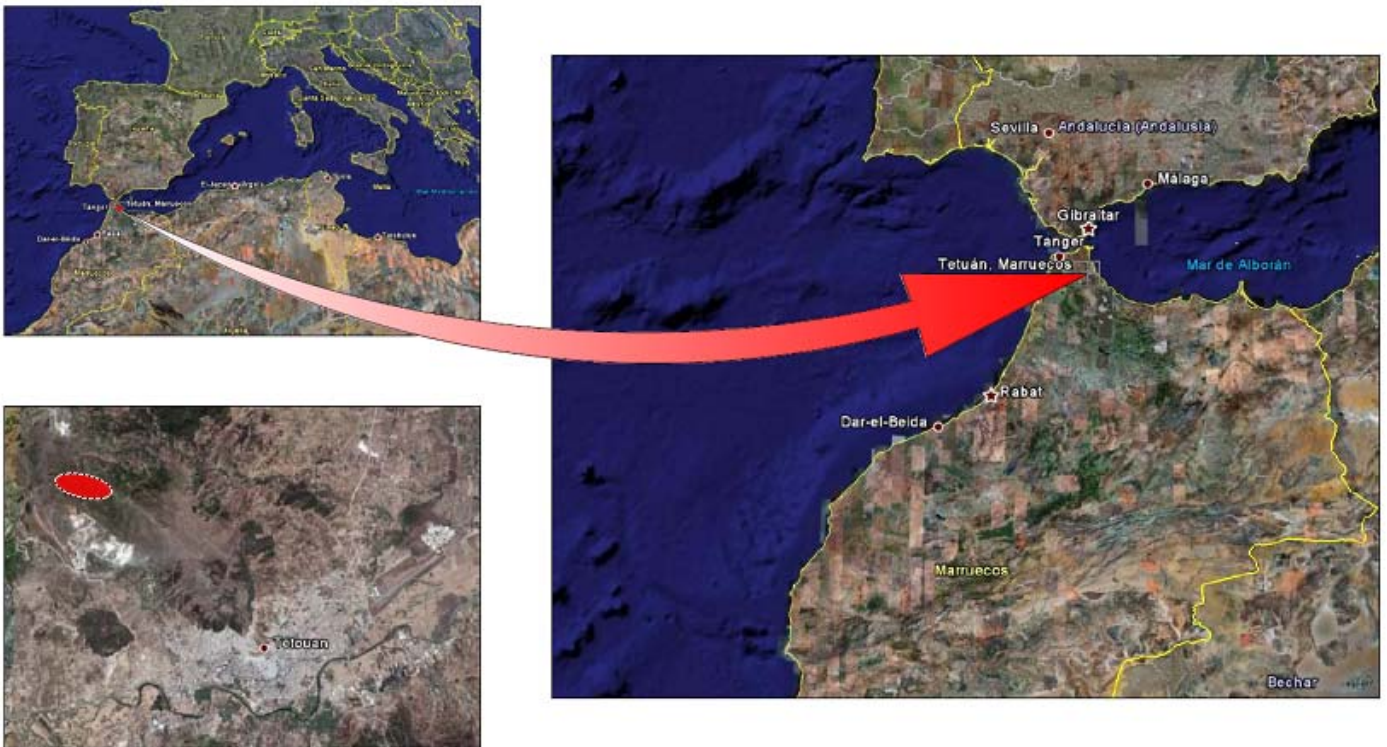


Figure 1: Localisation of the project activity

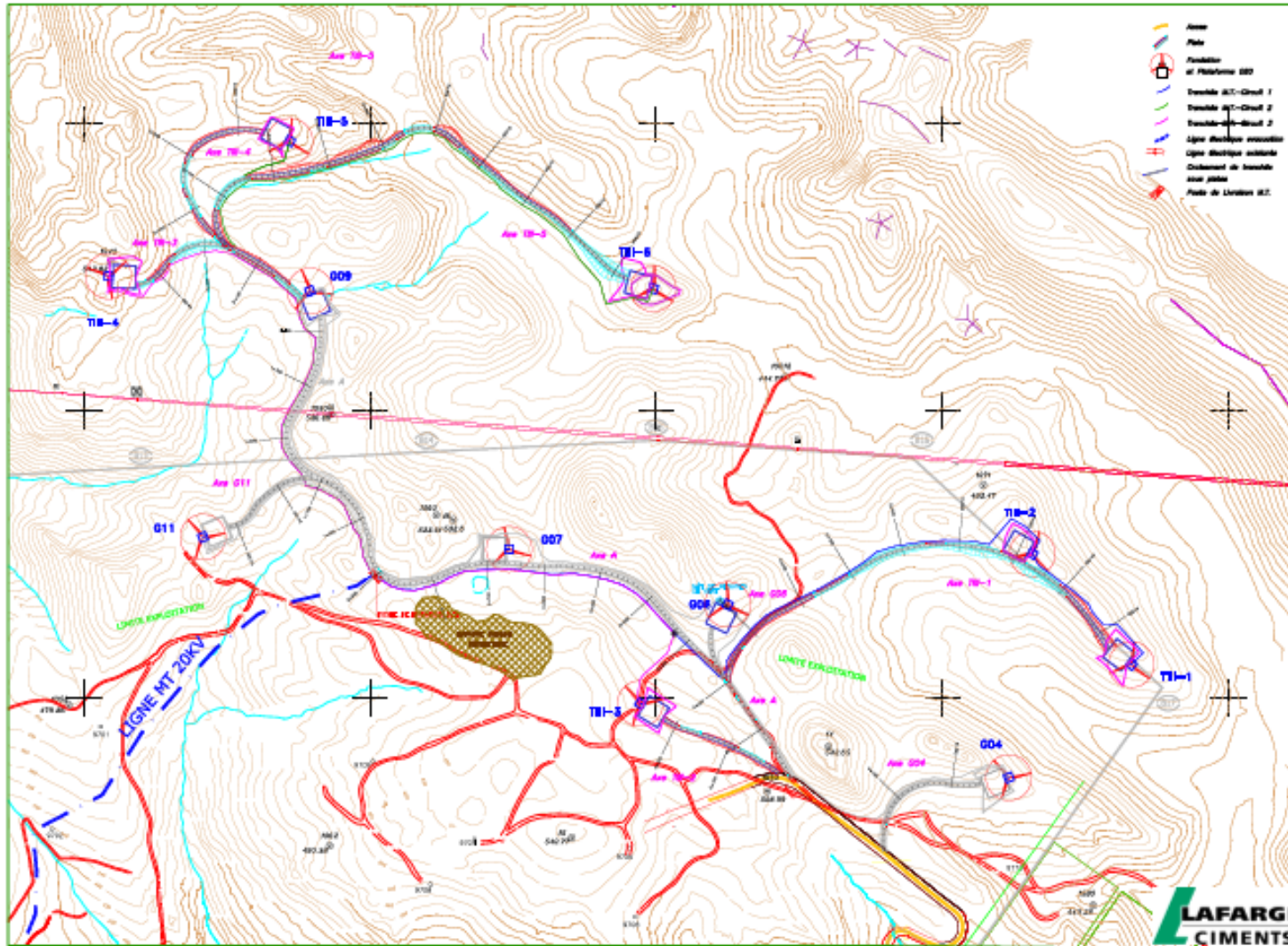


Figure 2: Localisation of the turbines of the new wind farm

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

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Grid connected power generation. Sectoral scope 1: Energy Industries

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

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The new Tetouan Wind farm project has an installed nominal capacity of 22 MW. It uses a renewable source of energy, namely wind energy to produce electricity. This technology is considered a clean technology since there is no gas emissions associated with the energy generation. Wind electricity generation is now accepted worldwide. It is an environment friendly alternative to the production of electricity from non-renewable sources such as fossils' fuels.

The new Tetouan wind farm is equipped with eleven 2 MW wind turbines using state of the art technology. They are manufactured by GAMESA EOLICA from Spain which was ranked fourth worldwide in 2003 in the design, manufacturing and installation of wind turbines. GAMESA wind turbines are widely used in Spain, France, Germany and other countries. The 2 MW GAMESA wind turbine has an excellent reliability record in other countries. The 2 MW turbines are relatively large units that have not yet been used in Morocco.

The main technical characteristics of the project's turbines are summarized below::

- ✓ 11 G80-2.0 MW turbines.
- ✓ Each turbine is equipped with three blades rotors weighting 38.6 metric tons and a diameter of 80 m corresponding to a rotating velocity between 9 and 19 tr/min. Each blade has a length of 39 m and a weight of 6.5 metric tons.
- ✓ 5 turbines G (from the 11) have a tower height of 67 m and a total weight of 145 tons
- ✓ 6 TIII turbines (from the 11) have a tower height of 60 m and a total weight of 127 tons.
- ✓ 690 V/ 20 KV transformers integrated in each turbine nacelle support frame.
- ✓ Systems of automatic control of the blade speed connected to a computer.
- ✓ Two 20 KV Electric transport lines connected to the supply post.
- ✓ Optical fiber network for communication and control.

**Table 2: Technical performances of the turbines**

Wind turbines	Raw Productions	Track losses	Unavailability losses (5%)	Electrical losses (2%)	Net production	Capacity factor
	GWh	GWh	GWh	GWh	GWh	%
G4'	8,064	0,145	0,396	0,151	7,372	42,1%
G6'	8,560	0,265	0,415	0,158	7,722	44,1%
G7'	8,561	0,300	0,413	0,157	7,691	43,9%
G9'	9,053	0,045	0,450	0,171	8,387	47,9%
G11'	8,814	0,238	0,429	0,163	7,984	45,6%
THH_1	6,242	0,587	0,283	0,113	5,259	30,0%
THH_2	6,827	0,335	0,325	0,130	6,037	34,5%
THH_3	7,369	0,796	0,329	0,131	6,113	34,9%
THH_4	8,851	0,682	0,409	0,163	7,597	43,4%
THH_5	7,208	0,159	0,353	0,141	6,555	37,4%
THH_6	7,120	0,335	0,339	0,136	6,310	36,0%
Average	7,879	0,353	0,376	0,147	7,003	40,0%
Total	86,669	3,885	4,141	1,614	77,029	-
Hours equivalent	3 939,5	176,6	188,2	73,4	3 501,3	-
Capacity factor	45,0%	-	-	-	40,0%	-

Sources: Technical reports GD022550 and GD041475, Gamesa, 2007&2008

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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The electricity produced from the wind turbines will replace the electricity supplied by the national managed by the public utility Office National d'Electricité (ONE).

By using the electricity generated from the wind park, the project activity eliminates the GHGs emissions which would have been emitted otherwise by the grid dominated by fossil fuel based power plants, had the project not taken place. The project's activity contributes as well to the reduction of local pollution associated with SO₂ and NO_x emissions of thermal power plants.

According to the baseline study presented in part B of this report, the wind farm will reduce, during its first 7 years' crediting period, the GHGs emissions of about 406 511 tons of equivalent CO₂, that is an average of 58 073 tons of CO₂ equivalent per year.

**Table 3: Annual estimation reductions over the crediting period**

Year	Annual estimation of emission reductions in tons of CO₂e
2010	58 073
2011	58 073
2012	58 073
2013	58 073
2014	58 073
2015	58 073
2016	58 073
Total estimated reductions	406 511
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tons of CO₂e)	58 073

A.4.5. Public funding of the project activity:

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The funding of the wind farm project is completely ensured by Lafarge Ciments. The project activity does not involve any public funding.

SECTION B. Application of a baseline and monitoring methodology**B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

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ACM0002 (version 9): Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources.

The Tool for the Demonstration and Assessment of Additionality is the version 5.2.
The Tool to Calculate the Emission Factor for an Electricity System is the version 1.1.

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

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The proposed project can meet the applicability criteria of the baseline and monitoring methodology (ACM0002), therefore, the methodology is applicable to the proposed project.

- The proposed project is a grid-connected zero-emission renewable power generation activity from wind source;
- The proposed project is not an activity that involves switching from fossil fuels to renewable energy at the proposed project site.
- The power grid which the proposed project is to be connected to is the national public grid clearly identified and most information on the characteristics of this grid is publicly available.
- The additionality of the proposed project can be verified using “Tools for the demonstration and assessment of additionality” requested by the baseline methodology ACM0002.

B.3. Description of the sources and gases included in the project boundary:

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	Source	Gas	Included?	Justification/Explanation
Baseline	Fossil fuels	CO ₂	Yes	Major emission sources
	Fired power plants	CH ₄	No	Excluded for simplification (conservative)
		N ₂ O	No	Excluded for simplification (conservative)
Project Activity	On-site fuel combustion to the project activity	CO ₂	No	Excluded (a clean energy project)
		CH ₄	No	Excluded (clean energy project)
		N ₂ O	No	Excluded (clean energy project)

According to the methodology (ACM0002), a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. The proposed project is within the boundary of the national power grid of ONE.

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

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To provide the same power output or services comparable with the proposed CDM project activity, there would be the following alternatives:

- a) Supply of equivalent annual power output by the Grid where the proposed project is connected;
- b) The proposed project not undertaken as a CDM project activity;
- c) Construction of a power plant using other source of renewable energy with equivalent amount of installed capacity or equivalent amount of annual electricity output; and
- d) Construction of a fossil fuel power plant with equivalent amount of installed capacity or annual electricity output.

The alternative **b)** is unrealistic because the investment analysis in section B.5. Step 2 will show that the proposed project without CER revenues is not economically viable.

The alternative **c)** is also unrealistic. First, the hydro power is unrealistic because of the lack of exploitable rivers in the proposed project area. Secondly, the technology of Solar PV is still not well developed and will cost much more than the wind technology for the same power output. Thirdly, there is no established biomass power plant with an installed capacity of 22 MW in Morocco, the same capacity as the proposed project. Furthermore, the proposed project owner has an experience in wind power generation (the first wind farm of 10.2 MW near the same site) and has no experience and capacity to develop other renewable energy power plants. In addition, all renewable energy projects in the north of Morocco where the wind farm is to be located are all from wind due to very favourable wind conditions (average of 8 m/s) in north Morocco.

The alternative **d)** could be possible, since it is possible for a private operator to invest in a thermal power station for its own use provided the capacity is less than the limit of 50 MW fixed by the Moroccan Law 16.08. But the project owner has not the experience running a thermal power plant that requires a full operational and maintenance professionals with high and specialized technical capacity. Moreover the project owner has already registered a wind farm project activity near the same site. Hence the alternative **d)** is considered unrealistic for the project participant.

In conclusion, the only practical and feasible baseline scenario is the alternative **a)**.

B.5. 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 (assessment and demonstration of additionality):



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The additionality of the proposed project is demonstrated and assessed by the approved Tool for the Demonstration and Assessment of Additionality (version 5.2) according to the following steps:

Step1. Identification of alternatives to the project activity consistent with current laws and regulations.

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:

In absence of the proposed project, reasonable and credible alternatives that are in accordance with current laws and regulations include:

- a) Supply of equivalent annual power output by the Grid where the proposed project is connected;
- b) The proposed project not undertaken as a CDM project activity;
- c) Construction of a power plant using other source of renewable energy with equivalent amount of installed capacity or equivalent amount of annual electricity output; and
- d) Construction of a fossil fuel power plant with equivalent amount of installed capacity or annual electricity output.

As discussed in previous section B4, the only practical and feasible baseline scenario is the alternative **a**).

Step1b. Consistency with mandatory laws and regulations:

The applicable legal and regulatory requirement for the proposed project include laws, governmental regulations, local regulations, departmental rules and disciplines related to electricity and environment protection.

All the alternatives comply with the laws and regulatory requirements for electricity generation in Morocco.

Step2. Investment analysis.

The purpose of this step is to determine whether the proposed project activity is economically or financially less attractive than other alternatives without an additional funding that may be



derived from the CDM project activities. The investment analysis was conducted in the following steps:

Sub-step 2a. Determine appropriate analysis method

The three analysis methods suggested by the Tool for the Demonstration and Assessment of Additionality are simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III). Since the proposed project will earn revenues from not only the CDM but also savings on the current electricity bill, the simple cost analysis method is not appropriate. Investment comparative analysis method is only applicable to the case that alternative baseline scenario is similar to the proposed project, so that comparative analysis can be conducted. The alternative baseline scenario of the proposed project is the national power grid rather than a new investment project. Therefore option II is not an appropriate method either. The proposed project will use benchmark analysis method based on both project EVA (Economic Value Added) and project IRR (Internal Rate Return).

Sub-step 2b –Apply benchmark analysis (Option III)

Lafarge ciments uses the Lafarge Group financial benchmark for its investment projects in Morocco. Lafarge Group applies a double financial benchmark on both the EVA and the IRR consisting of: i) the cumulative EVA must be positive and ii) IRR must exceed 12% in order for the project to be financially viable.

This financial benchmark has been used by Lafarge for its investment projects by Lafarge Ciments.

Since the project IRR without CDM revenues is less than the IRR benchmark of 12% as shown below, the benchmark financial analysis can be limited to the IRR.

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

The basic parameters for calculation of the IRR of the project are shown in the following table:



Table 4 : Financial parameters

Parameters	Unit	Value	Data source
Installed capacity	MW	22	Feasibility Study
Total annual output	MWh	77 000	Feasibility Study
Annual output to be transferred to Bouskoura Plant	MWh	10 384	Lafarge Ciments
Tetouan Plant's electricity cost	Dh/MWh	694,6	ONE tariff – 2008 electricity bills
Bouskoura Plant	Dh/MWh	644,7	ONE tariff - 2008 electricity bills
Energy price inflation	%	2	Lafarge Ciments
Total investment	MDh	386,51	Feasibility Study
O&M cost (from 2010)	MDh	6,32	Feasibility Study
Maintenance inflation	%	3	Lafarge Ciments
Income tax	%	30	National tax regulation
Project lifetime	Years	25	
Crediting period	Years	21	

In accordance with the benchmark analysis (Option III), the proposed project will not be considered as financially attractive if its financial indicator IRR is lower than Lafarge's IRR benchmark of 12%.

Without the CDM revenue, the project has an IRR of 8.1% which is lower than the benchmark rate of 12%. Thus the proposed project is not financially attractive to the investors.

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

The purpose of the sensitivity analysis is to examine whether the conclusion regarding the financial viability of the proposed project is sound and tenable with those reasonable variations in the assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive or is unlikely to be financially attractive.

The following key parameters have been selected as sensitive elements to test the financial attractiveness for the proposed project:

- (1) Static total investments
- (2) Electricity tariff
- (3) O&M cost

The effect of changes in the static total investments, electricity tariff and O&M cost on the Internal Rate Return (IRR) has been examined. Assuming these three parameters to change within the range of (-10% +10%), then the outcomes of IRR sensitivities is presented in the following table and graphic.

Table 5: Sensitivity of project IRR (%) to different financial parameters

Parameters	Fluctuations		
	-10%	0	10%
Electricity tariff	6,5	8,1	9,6
O&M cost	8,3	8,1	7,9
Static investment	9,4	8,1	6,9

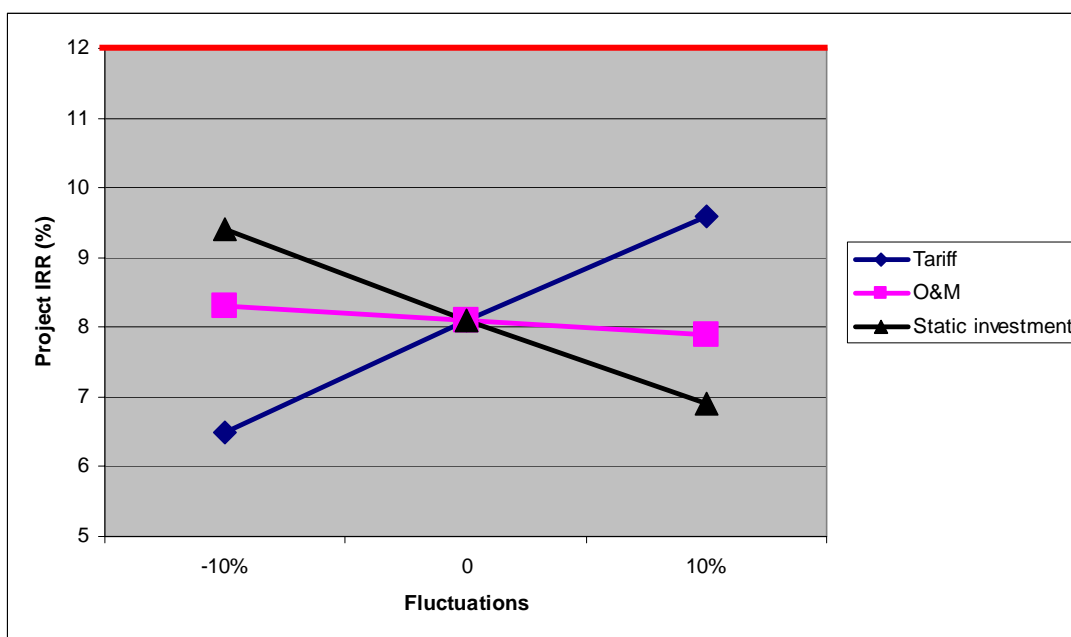


Figure 3: Sensitivity of project IRR to different financial parameters

As shown in the previous Table and Figure the project IRR varies in the range of 6,5% to 9,6% when the above three financial indicators fluctuated within the range from -10% to +10%. The sensitivity analysis even with $\pm 10\%$ variations of the financial key parameters, the project IRR is still lower than the Lafarge Ciments benchmark of 12%. Thus without CDM revenues, the proposed project is not financially attractive.

**Step 4. Common practice analysis.*****Sub-step 4a. Analyze other activities similar to the proposed project activity:***

With regard to the widespread usual practices, it is worth mentioning that in Morocco the predominant practice of electricity supply for industrial plants is the national ONE grid.

With the implementation of the previous project near the same site, the Lafarge Tetouan cement plant is the first cement plant, not only in Morocco but also in the world, to be directly supplied by wind renewable energy.

The following Table shows the wind farms developed and under development in Morocco.

Table 6: Wind farm development in Morocco

Project	Capacity	Project status	CDM status
Koudia El Beida (IPP)	50 MW	On production since 2000	Not developed as a CDM project
Essaouira	60 MW	2007	Registered
Lafarge Ciments	10 MW	2005	Registered
Laayoune CIMAR	10 MW	Under development	Under development
Haouma Nareva	60 MW	Under development	Under development
Tanger Wind Farm ONE	140 MW	On construction	Under development
Tarfaya IPP	300 MW	In the bidding process	CDM revenues considered in the IPP bidding documents.

Sub-step 4b. Discuss any similar options that are occurring:

Morocco signed the Kyoto Protocol in 2002. The Koudia El Beida project was not eligible to CDM at the time of its implementation.

All the other wind projects in Morocco are either registered or under CDM development.

In conclusion, the proposed project is additional and the project owner considered applying for CDM project before the construction of the proposed project.

**B.6. Emission reductions:****B.6.1. Explanation of methodological choices:**

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According to the ACM0002, the Tool to Calculate the Emission Factor for an Electricity System (version 1.1) is applied to calculate the combined margin emission factor. This section describes how the emission factor (EFy) of the Lafarge wind power project has been determined based on the instructions for calculating the emission factors of the operating margin (OM) and build margin (BM).

Step 1 – Calculation of the Operating Margin emission factor (OM)

The Tool to Calculate the Emission Factor for an Electricity System provides four options to determine the operating margin. For the proposed project activity, option (a) (simple OM) has been chosen. This is because undertaking a dispatch data analysis (the preferred methodological option) cannot be done at a reasonable cost, since the data is not readily available from the relevant authorities and ONE. The simple OM can be used in the case of the proposed project activity since low-cost/must-run sources constitute less than 50% of the total grid. The simple OM emission factor has been calculated based on a 3-year vintage (2006-2008). The OM is calculated as the generation-weighted emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants. Low-operating cost and must run power plants include typically hydro, low cost biomass and geothermal. The OM is calculated as follows (Option A), using a 3-year average:

$$EF_{OM, simple, y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO_2, i, y}}{\sum_m EG_{m,y}}$$

Where

- $EF_{OM, simple, y}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)
- $FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power plant / unit m in year y (mass or volume unit)
- $NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
- $EF_{CO_2, i, y}$ = CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ)
- $EG_{m,y}$ = Net electricity generated and delivered to the grid by power plant / unit m in year y (MWh)
- m = All power plants/units serving the grid in year y except low-cost/must-run power plants / units



- i = All fossil fuel types combusted in power plant / unit m in year y
- y = The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option).

In terms of the Moroccan electricity sector the 3-year vintage OM was calculated using the data of all operational power fossil fuel fired plants providing electricity to the grid for the years 2006, 2007 and 2008. The data of the plants used in the Operating Margin calculation were provided by ONE. They are presented in Annex 3.

Step 2 – Calculation of the Build Margin (BM)

The Tool to Calculate the Emission Factor for an Electricity System allows project participants to choose between two given options for calculating the Build Margin for the project: (1) calculate the build margin emission factor based the set of five power units that have been built most recently, or (2) Consider the set of power capacity additions in the electricity system that comprises 20% of the system generation (in MWh) and that have been built most recently. Option 2 has been used for the computation of the BM emission factor.

During 2008, the most recent year for which the data is available, the total electricity generation of the six most recent power plants that account of more than 20% of the total electricity generation, has been established at 8 416.69 GWh, This represents 35.3% of the overall electricity generated by all power plants in 2008. An overview of the data on the electricity generation and fuel consumptions of the power plants is presented in Annex 3.

The Build Margin emissions factor (BM) is calculated as the generation-weighted average emission factor of the most recently built plants, using the following formula:

$$EF_{BM,y} = \frac{\sum_{i,m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where

- $EF_{BM,y}$ = Build margin CO2 emission factor in year y (tCO2/MWh)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
- $EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)
- m = Power units included in the build margin
- y = Most recent historical year for which power generation data is available

**Step 3 - Calculation of the baseline emissions factor**

The final step in applying the consolidated methodology for the baseline determination of the Lafarge's wind farm extension project is to calculate the baseline emission factor. This has been calculated as the weighted average of the emissions factor of the OM and the BM. The formula that has been used to calculate this weighted average emission factor is as follows:

$$EF_{CM,y} = EF_{OM,y} \times w_{OM} + EF_{BM,y} \times w_{BM}$$

Where

- $EF_{BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)
- $EF_{OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh)
- w_{OM} = Weighting of operating margin emissions factor (%)
- w_{BM} = Weighting of build margin emissions factor (%)

The default values of weighted factors are:

$$w_{OM} = 0.75 \quad w_{BM} = 0.25$$

The official ONE data for the fuels NCV and the latest default values recommended in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for the fuels emissions factors were used to derive the OM and the BM emission factors of the grid.

The results of the EF calculation are presented in annex 3 and summarized below:

Désignation	EF in tCO2/MWh
« Operating Margin » (OM)	
2006	0,8250
2007	0,7658
2008	0,7242
Average OM on 2006-2008	0,7717
« Build Margin » (BM) 2008	0,7018
Combined Margin (weighted average OM and BM)	0,7542



As per the latest version of the “Tool to calculate the emission factor for an electricity system”, version 1.1; in terms of the grid EF, the project participants have chosen option 1 of the tool consisting of *for the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.*

Project emissions

According to the baseline methodology ACM0002, the GHG emission of a wind farm project can be neglected. For the Tétouan wind farm extension project, it is expected that electricity from the grid will be used in the site for lighting and control equipment. Although, the expected electricity import from the grid is negligible, it will be monitored and taken into account in the emission reductions evaluation.

Leakage emissions

According to the consolidated baseline methodology ACM0002, the main indirect emissions potentially giving rise to leakage in the context of electric sector projects result from activities such as power plant construction, fuel handling (mining, processing, and transportation), and land inundation (for hydroelectric projects). The project developer does not need to consider such indirect emissions when applying the methodology. Therefore the Project can take no account of such leakages, $L_y = 0$ tCO₂e.

Emission reductions

The project activity will generate GHG emission reductions by avoiding CO₂ emissions from electricity generation by fossil fuel power plants. The emission reduction (ER_y) during a given year y is calculated as follows:

$$ER_y = BE_y - PE_y - L_y$$

Where

- ER_y = Emission reductions in year y (t CO₂e/yr)
- BE_y = Baseline emissions in year y (t CO₂e/yr)
- PE_y = Project emissions in year y (t CO₂/yr)
- LE_y = Leakage emissions in year y (t CO₂/yr)

**B.6.2. Data and parameters that are available at validation:**

Data / Parameter:	EF _{OM}
Data unit:	tCO ₂ / MWh
Description:	Operating Margin Emission Factor
Source of data used:	ONE (Office National de l'Electricité – Public utility)
Value applied:	0,7716
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculations based on the Tool to Calculate the Emission Factor for an Electricity System (version 1.1)
Any comment:	

Data / Parameter:	EF _{BM}
Data unit:	tCO ₂ / MWh
Description:	Build Margin Emission Factor
Source of data used:	ONE (Office National de l'Electricité – Public utility)
Value applied:	0,7018
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculations based on the Tool to Calculate the Emission Factor for an Electricity System (version 1.1)
Any comment:	

Data / Parameter:	EF _{CM}
Data unit:	tCO ₂ / MWh
Description:	Combined Margin Emission Factor
Source of data used:	Computed from EF _{OM} and EF _{BM}
Value applied:	0,7542
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculations based on the Tool to Calculate the Emission Factor for an Electricity System (version 1.1)
Any comment:	



Data / Parameter:	NCVi
Data unit:	GJ/T
Description:	Net calorific value (energy content) per mass or volume unit of fuel <i>i</i>
Source of data used:	Official Statistical book Annuaire des Statistiques - 2007 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the Tool to Calculate the Emission Factor for an Electricity System (version 1.1), the national specific value shall be used preferentially
Any comment:	

Data / Parameter:	EF _{CO₂,i}
Data unit:	tCO ₂ /TJ
Description:	Carbon emission factor per unit of energy of the fuel <i>i</i>
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

>>

As described in B.6, the emission reductions of the proposed project are calculated as follows:

Baseline emissions

Annual generation of the wind farm is estimated at 77 000 MWh.

The calculation equation is as follows:

$$BE_y = 77\,000 \text{ MWh/year} * 0.7542 \text{ tCO}_2/\text{MWh} = 58\,073 \text{ tCO}_2/\text{year}$$



Project emissions

It is expected that the project activity will import a negligible amount of electricity for lighting and control equipment needs. As per the baseline of methodology ACM0002, the wind project's electricity consumption can be considered negligible for the ex-ante computations purposes. However the actual project electricity consumption will be monitored and taken into account in the ex-post emission reductions evaluation.

$$PE_y = EP_y \times EF_{CM} = 0 \times 0,7542 = 0$$

Where:

- PE_y = Project emissions in year y (t CO₂e/yr)
- EP_y = Electricity imported from the grid in year y (MWh/yr)
- EF_{CM} = Combined Margin emission factor (t CO₂e/MWh)

Leakage

According to the baseline methodology ACM0002, the leakage of the proposed project is not considered,

$$LP_y = 0$$

Project Emission Reductions

Net emission reductions of the proposed project = Total baseline emissions – Total project emissions

The total annual baseline emissions are **58 073 tCO₂ a year**.

The total annual project emissions are **0 tCO₂**.

Thus the proposed project activity is expected to achieve **406 511 tCO₂e** of net emission reductions during the first 7-year crediting period.

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

>>

Year	Estimation of project activity emissions (in tons of CO ₂ e)	Estimation of baseline reductions (in tons of CO ₂ e)	Estimation of leakage (in tons of CO ₂ e)	Estimation of overall reductions (in tons of CO ₂ e)
2010	0	58 073	0	58 073
2011	0	58 073	0	58 073
2012	0	58 073	0	58 073
2013	0	58 073	0	58 073
2014	0	58 073	0	58 073
2015	0	58 073	0	58 073
2016	0	58 073	0	14 329
Total	0	406 511	0	406 511

B.7. Application of the monitoring methodology and description of the monitoring plan:**B.7.1 Data and parameters monitored:**

Data / Parameter:	EGy
Data unit:	MWh
Description:	Electricity produced by the wind farm extension
Source of data to be used:	Double Electricity meters readings at project boundary
Value of data applied for the purpose of calculating expected emission reductions in section B.5	77 000 MWh/year
Description of measurement methods and procedures to be applied:	Hourly measurements and monthly recording
QA/QC procedures to be applied:	Electricity supplied by the project activity to the plant or the grid. Double metering check.
Any comment:	



Data / Parameter:	EPy
Data unit:	MWh
Description:	Electricity supplied by the grid consumed in the site boundary
Source of data to be used:	Electricity meter reading at project boundary
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 MWh
Description of measurement methods and procedures to be applied:	Readings will be measured hourly and monthly recorded
QA/QC procedures to be applied:	Electricity imported from the grid. Double check by accounting receipts established by ONE
Any comment:	

B.7.2. Description of the monitoring plan:

>>

a) The aim of the monitoring plan

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

b) The data which needs to be monitored

Two main parameters will be subject to an ex-post monitoring:

- ✓ The electricity supplied to the plant and the power grid
- ✓ The electricity imported from the grid for the site local electricity needs.

The baseline emission factor: fixed on ex-ante calculation and need not to be monitored every year as per the latest version of the "Tool to calculate the emission factor for an electricity system", version 1.1

c) Application of the monitoring plan



According to the baseline study, the key parameter of the emissions' reductions evaluation is the net electricity supplied to grid by the wind farm. The recommended monitoring methodology is based on a specific and continuous measure of the electricity supplied to plant/grid and the electricity imported from the grid.

The proposed electricity imports/exports metering system is depicted in annex 4. The generated electricity is to be transported through two independent 20KV lines to the grid and the cement plant. Each line is to be equipped at the site substation with highly accurate bidirectional electricity meter to monitor the electricity produced by the connected wind turbines. The meters will be duplicated to check data reliability and avoid gaps in data monitoring in case of meter failure. The exported electricity by the project activity will be derived as the sum of the meters readings of the two lines.

An additional meter will be installed at the substation for the monitoring of the electricity imports for the auxiliaries energy needs.

The meters readings of both the supplied and imported electricity will be recorded at the same time every 24h. The meters reading data will be processed and stored electronically in a computer system with regular backup copy on a digital basis complemented by printed versions of the monthly electricity reports. The monitoring equipment will be initially maintained by the wind park supplier during three years. Subsequently, the maintenance of this monitoring equipment will be done by Lafarge itself or given to a local subcontractor.

The monitoring structure consist in a staff familiar with computers and data treatment, taking into account the fact that the staff of the cement plant is already using similar monitoring system for the initial wind farm and most sophisticated computing equipment for the permanent conduct and supervision of this new cement plant. Staff members will be designated for data collection and management and monthly monitoring reports will be established. The responsible entity for monitoring is Lafarge Tétouan plant management.

The monitoring procedure will include, in particular: (i) staff organisation with job descriptions, (ii) instructions for data transfer and record handling protocols, and (iii) calibration checking procedures for the measuring equipment. An internal audit procedure will ensure the quality control and will check the reliability and security of the monitoring. Following these audits, corrective actions will be decided, if necessary. All the data will be archived until two years after the end of the crediting period.

The monitoring procedure will be defined in a monitoring manual that include, in particular: (i) staff organisation with job descriptions, (ii) instructions for data transfer and record handling protocols, and (iii) calibration checking procedures for the measuring equipment.

**B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):**

>>

Date of completion of Baseline Study: 13/04/2009

Name of person/entity determining the baseline: Dr. Abdelmourhit Lahbabi – ADS Maroc

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:**

>> March 2008

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

>> 25 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:**>> January 1st 2010**C.2.1.2. Length of the first crediting period:**

>> 7 years

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

>> N.A.

C.2.2.2. Length:

>> N.A.

**SECTION D. Environmental impacts**

>>

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

>>

D.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:

Despite the fact that the wind farm projects are not subject to an environmental impact assessment according to the Morocco EIA law N°12-03, Lafarge Ciments has carried an EIA for the project¹. This assessment has examined the possible impacts of the project's activities on the environment during both the construction and operational phases. More specifically the following impacts have been analyzed:

- ✓ Impacts on the biodiversity during the construction period;
- ✓ Impacts on the birds migration during the operational period;
- ✓ Impacts on the landscape ;
- ✓ Noise generation

The EIA has shown that the environmental impacts of the project activities are insignificant during the operational phase. The impacts of the project construction phase on the environment have been assessed as low, local and transitory. Adequate mitigation measures and good practices procedures for the construction yard have been recommended in the EIA.

SECTION E. Stakeholders' comments

>>

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

Lafarge Ciments organized a workshop February 4, 2009 on the project activities with concerned stakeholders including local authorities, population elected bodies, experts, local associations, etc. In total 41 stakeholders attended this workshop.

¹ EIA of Lafarge's Wind Farm extension project.- ADS Maroc – June 2008.

**E.2. Summary of the comments received:**

>>

The debate started following the presentations focused on the national renewable energy policies, achievements and prospects of the CDM in Morocco and on the project technical characteristics, operational activities, implementation phases and its CDM development. The results of the project's environmental impacts were also presented during the workshop. Participants were invited to express their views and ask questions or to request clarifications to the workshop presenters.

One of the key interventions was the speech made by the Président of the Commune elected body who praised Lafarge Ciments for its local investment projects, for the creation of job opportunities for the community and for its sponsoring and financial contribution to various local social activities.

The main elements discussed and the questions raised during the workshop are summarized below:

- ✓ Several participants thanked Lafarge for its leading social development activities for the community, for its environment protection projects and for the communication on the project and its CDM development.
- ✓ A question was raised on why limit the capacity to 22 MW while the legal framework authorizes 50 MW.
- ✓ A request was made to use part of the electricity produced for the lighting needs of the community.
- ✓ A comment was made on the necessity of public authorities to develop renewable energy training program and research and development projects in the universities and engineering schools.
- ✓ A participant asked why not develop solar projects in Morocco similar the wind projects currently under development.
- ✓ Why the wind farm extension project is using 2 MW turbines instead of the currently available 5 MW turbines.
- ✓ Why in the EIA presentation, the project's impacts on water resources and air quality were not mentioned.
- ✓ A recommendation was made as to edit the project presentation brochure in Arabic as well as French.

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

At the end of the discussion and questions session, the Lafarge's Ciments representatives thanks the participants for their remarks and comments and provided the following answers to the questions raised:

- ✓ Lafarge Ciments could have developed a 50 MW wind farm project, but the project faces an investment barrier (high cost) and a very limited profitability even considering the CDM additional revenues.
- ✓ For using the produced electricity for the community lighting needs, Lafarge Ciments explained this is not possible for legal reasons (only public utilities are allowed to provide electricity to end users) as well as technical reasons (necessity to transform the electricity to low voltage). The Lafarge representative stressed the fact that the cement company is already contributing to various development community projects and can consider the community new financial assistance requests
- ✓ The representative of the Centre de Développement des Energies Renouvelables (CDER), the public institution in charge of RE development in Morocco, explained that under the current technical and financial international conditions, the Wind energy is more competitive for high capacity electricity generation. Solar is widely used in Morocco for rural electrification of isolated villages.
- ✓ As for using 5 MW turbines, the Lafarge's representative explained that the project's feasibility study recommended using 2MW turbine. Also 5MW turbines requires high capacity cranes that are not available locally.
- ✓ Concerning the EIA presentation, Lafarge's representative explained that the study has been done on the impacts of the wind farm and that others EIA have been done for the cement plant at different stages of its development. In any case the impacts of the extension wind farm project are considered insignificant.
- ✓ The Lafarge's Ciments informed the participant that the project's brochure will be as requested, translated to Arabic.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	LAFARGE CEMENTS
Street/P.O.Box:	6, Route de Mecque (California), Quartier les crêtes, Boite postale 7234.
Building:	-
City:	Casablanca
State/Region:	-
Postcode/ZIP:	20151
Country:	Morocco
Telephone:	+ (212) 5 22 52 49 72/80
FAX:	+ (212) 5 22 50 65 70
E-Mail:	siham.anoua@lafarge-maroc.lafarge.com
URL:	www.lafarge.ma
Represented by:	Mrs Siham Anoua
Title:	-
Salutation:	Mrs
Last name:	Anoua*
Middle name:	-
First name:	Siham
Department:	-
Mobile:	-
Direct FAX:	+ (212) 5 22 50 65 70
Direct tel:	+ (212) 5 22 52 49 72/80
Personal e-mail:	siham.anoua@lafarge-maroc.lafarge.com



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for this project activity.



Annex 3

BASELINE INFORMATION



Table A1: Calculation of OM factor for 2006

Title			Consumption					Natural gas t	Electricity generation (MWh)	Emissions	
			Imported Coal (t)	Local Coal (t)	Pet Coke (t)	Heavy oil (t)	Gasoil (t)		MWh	Total (ton CO2/yr)	Specific CO2 emission (tonCO2/MWh)
Coal Type Power plant	JLEC		3 888 948.00						10 472 653.00	10 161 613,45	0,9703
	Mohammedia #1		677 417.00						1 559 967.00	1 770 054,45	1,1347
	Jerada		330 269.00		122 648.00	1 772.00			869 093.00	1 257 126,36	1,4465
Fuel oil Type Power plant	Mohammedia #2				338 187.00				1 317 080.00	1 051 633,87	0,7985
	Kénitra				240 649.00				808 485.00	748 327,52	0,9256
	Mohammedia TG (33MW)				33 393.00	3 094.00			96 098.00	113 698,03	1,1831
	Tan Tan TG (33MW)				37 802.00	1 122.00			102 280.00	121 124,97	1,1842
	Tit Mellil TG (33MW)				65 577.00	2 527.00			187 900.00	211 971,49	1,1281
	Tétouan TG (33MW)				18 836.00	1 830.00			57 414.00	64 403,78	1,1217
	Agadir TG (20 MW)				330.00	37.00			808.00	1 144,07	1,4159
	Tanger TG (20 MW)				315.00	11.00			598.00	1 014,58	1,6966
	Tétouan TG (20 MW)										
	Laayoune TG				5 100.00				24 144.00	15 859,07	0,6569
Laayoune TG II											
Dakhla TG				9 372.00				41 943.00	29 143,38	0,6948	
Gasoil type	Total Micro Diesel plants						980.00		2 970	3 122,57	1,0514
Natural gas	Tahaddarat							334 182	2 512 333.00	899 885,29	0,3582
Total Renewable	Total		4 896 634			751 333	9 601	334 182	18 053 766	0,00	0,0000
			5 019 282								
Total									19 938 866	16 450 123	0,8250



Table A2: Calculation of OM factor for 2007

Title Power plant		Consumption					Natural gas t	Electricity generation (MWh)	Emissions	
		Imported Coal (t)	Local Coal (t)	Pet Coke (t)	Heavy oil (t)	Gasoil (t)		MWh	Total (ton CO2/yr)	Specific CO2 emission (tonCO2/MWh)
Coal Type Power plant	JLEC	3 794 685,87						10 016 392,00	9 915 311,54	0,9899
	Mohammedia #1	664 045,00						1 547 659,00	1 735 114,12	1,1211
	Jerada	325 466,00	57 413,00	90 461,00	1 772,00			892 449,00	1 274 849,53	1,4285
Fuel oil Type Power plant	Mohammedia #2				368 484,00			1 448 578,00	1 145 846,10	0,7910
	Kénitra				251 489,00			869 166,00	782 035,83	0,8998
	Mohammedia TG (33MW)				20 864,00	325,00		58 820,00	65 914,71	1,1206
	Tan Tan TG (33MW)				5 808,00	846,00		17 792,00	20 756,30	1,1666
	Tit Mellil TG (33MW)				53 304,00	1 029,00		149 993,00	169 034,02	1,1269
	Tétouan TG (33MW)				17 104,00	283,00		48 314,00	54 088,70	1,1195
	Agadir TG (20 MW)				2 643,00	83,00		6 350,00	8 483,19	1,3359
	Tanger TG (20 MW)				1 297,00	38,00		3 231,00	4 154,26	1,2858
	Tétouan TG (20 MW)									
	Laayoune TG				3 299,00			15 027,00	10 258,64	0,6827
	Laayoune TG II					32 822,00		97 159,00	104 580,74	1,0764
Dakhla TG				9 013,00			43 899,00	28 027,03	0,6384	
Gasoil type	Total Micro Diesel plants					1 732,00		3 296	5 518,67	1,6744
Natural gas	Tahaddarat						402 610	2 822 944,00	1 084 148,21	0,3840
	Total									
Total Renewable	Total	4 784 197			735 077	37 158	402 610	18 041 069	0,00	0,0000
	Total	4 932 071								
Total								21 427 269	16 408 122	0,7658



Table A3: Calculation of OM factor for 2008

Title		Consumption					Electricity generation (MWh)	Emissions		
		Imported Coal (t)	Local Coal (t)	Pet Coke (t)	Heavy oil (t)	Gasoil (t)		Natural gas t	MWh	Total (ton CO2/yr)
Coal Type Power plant	JLEC	3 658 978,90						10 022 801,00	9 560 716,48	0,9539
	Mohammedia #1	351 227,00						823 853,00	917 737,40	1,1140
	Jerada	393 870,00		72 165,00	2 097,00			815 132,00	1264354,999	1,5511
Fuel oil Type Power plant	Mohammedia #2				423 863,00			1 684 874,00	1 318 053,88	0,7823
	Kénitra				467 962,00			1 637 969,00	1 455 185,12	0,8884
	Mohammedia TG (33MW)				31 914,00	643,00		85 927,00	101 289,28	1,1788
	Tan Tan TG (33MW)								0,00	#DIV/0!
	Tit Mellil TG (33MW)				99 496,00	1 217,00		276 833,00	313 272,72	1,1316
	Tétouan TG (33MW)				33 844,00	504,00		94 081,00	106 847,96	1,1357
	Agadir TG (20 MW)				7 857,00	122,00		18 497,00	24 821,03	1,3419
	Tanger TG (20 MW)				2 133,00	85,00		5 292,00	6 903,66	1,3045
	Tétouan TG (20 MW)				4 861	217,00		11 855,00	15 807,30	1,3334
	Laayoune TG				1 778,00	214		8 311,00	6 210,78	0,7473
	Laayoune TG II				18 340	68 906,00		246 841,00	276 585,66	1,1205
	Dakhla TG				8 221,00			45 523,00	25 564,21	0,5616
Gasoil type	Total Micro Diesel plants					2 852,00		3 460	9 087,33	2,6264
Natural gas	Tahaddarat						408 954	2 867 423,00	1 101 230,31	0,3840
	Total									
Total Renewable	Total	4 404 076			1 102 366	74 760	408 954	18 648 672	0,00	0,0000
	Total	4 476 241								
Total								22 789 810	16 503 668	0,7242



Table A4: Fuel data base

Fuel Type	Net Calorific Value		Emission factor	
	kcal/kg	GJ/T	t CO ₂ /TJ	t CO ₂ /T
Natural Gas		48,000	56,10	2,693
Imported coal	6 600	27,621	94,6	2,613
Local coal	5 600	23,436	98,3	2,304
Pet coke		32,5	97,5	3,169
Heavy fuel oil	9 600	40,176	77,4	3,110
Gasoil		43	74,1	3,186
References	Annuaire des statistiques 2007	2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 1, Table 1.2 Volume 2 ; Table 2.2		

Table A5: Calculation of OM factor (2006-2008)

Electricity generation by OM plants		CO ₂ emissions by OM plants		
2006	19 938 866	2006	16 450 123	0,8250
2007	21 427 269	2007	16 408 122	0,7658
2008	22 789 810	2008	16 503 668	0,7242
Total	64 155 945	Total	49 361 913	0,7717

**Table A6: Calculation of BM factor of the National grid**

	Plant name	Technology	year operation	Fuel	MWh in 2008	% total Production	Accumalted %	% of total selected	CEF	Result
1	Tahaddart	Combined Cycle	2005	Natural Gas	2 867 423	12%	12%	34,07%	0,384049	0,13084
2	STEP Afourer	Small hydro STEP	2004	Hydro	443 657	2%	14%	5,27%	0,000000	0,00000
3	El Hansali	Small hydro Hansali	2003	Hydro	38 063	0%	14%	0,45%	0,000000	0,00000
4	Ait Messoud	Small hydro Ait Messoud	2003	Hydro	10 626	0%	14%	0,13%	0,000000	0,00000
5	Eddakhla	TAG Ad Dakhla	2002	Fuel	45 523	0%	14%	0,54%	0,561567	0,00304
6	JLEC (3 and 4)	Steam power: Jorf Units 3&	2000	Coal	5 011 401	21%	35,2%	59,54%	0,953897	0,56796
Total					8 416 693			100%	BM Factor	0,7018

Total electricity supplied to the grid in 2007				23 858 591	
The power plant capacity additions in the electricity system that comprise 20% of the system generation and that have been built most recently	8 416 693			35,28%	Selected
The five power plants that have been built most recently	3 405 292			14,27%	

The Essaouira wind project is not included since it has been registered as CDM project



Annex 4

MONITORING INFORMATION

ELECTRICITY METERING SYSTEM

