Revised Monitoring Plan

Project Title

Graneros Plant Fuel Switching project

Project Participant

Nestlé Chile S.A.

UNFCCC Reference No.

UNFCCC Ref. No. 0024

Date: 24th April 2008

D. Monitoring methodology and plan

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

The project activity uses an already existing monitoring methodology (AM0008 – Version 01), which has been approved and made publicly available by the CDM Executive Board.

The methodology is designated: "***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:

The Monitoring and Verification Plan describes the procedures for data collection, and auditing required for the project, in order to determine and verify emissions reductions achieved by the project. This project will require only very straightforward collection of data, described below, most of which is already collected routinely by the staff of Nestlé's Graneros Plant, where the proposed CDM project is to be implemented.

The approved methodology AM0008 Version 01 is applicable to a project activity, which is to switch the industrial fuel currently used in some element processes of a facility to natural gas from coal and/or petroleum fuels that would otherwise continue to be used during the crediting period under the following conditions:

- The local regulations/programs do not constrain the facility from using coal/petroleum fuels;
- Use of coal and/or petroleum fuels is less expensive than natural gas per unit of energy in the country and sector;
- The facility would not have major efficiency improvements during the crediting period;
- 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), and
- 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.

The proposed project activity consists of switching the fuel used in some element processes of a facility (coal) to natural gas and meets the applicability criteria of the approved methodology AM0008 Version 01:

The local regulations/programs did not constrain the facility from using coal fuels and coal is less expensive than natural gas in Chile's Region VI. Coal cost US$ 2.55 per million Btu (HHV, higher heating value) compared to US$ 3.50 per million Btu (HHV) for natural gas. Moreover, the continued use of coal does not require investments to convert burners and associated equipment from coal and other fuels to natural gas.

The facility would not have major efficiency improvements and the project activity does not increase the capacity of final outputs and lifetime of the existing facility during the crediting period.

Moreover, the proposed project activity is a fuel switching applied to element processes and does not result in integrated process change.

As stated above, the project activity under consideration meets all applicability conditions of the methodology. This justifies the appropriateness of the choice of the methodology in view of the project activity

D.3. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

The monitoring methodology involves monitoring of the followings:

- For fuel switching part, CO_2 emission factors (these values are fixed throughout the crediting period) are calculated or referred from some statistical document like IPCC Good Practice Guidance on greenhouse gases (GHG) Inventory and Uncertainty Management ex-ante in the Project Design Document. The GHG emission factors are those per unit of caloric value (e.g., Joule, kcal, etc.) times caloric content per physical unit (e.g., ton, liter, m^3, etc.) with suitable oxidization factors specified in the IPCC Guidelines. Local statistical data are preferable to some aggregated (mean) default values;

- For each element process, the fuel efficiency is measured *ex-ante* before switching the fuel as a function of load factor[1]. On the other hand, natural gas efficiency (also a function of load factor) is measured at an early stage after implementation of the project.

- Applicability concerning the local regulations are checked at the renewable of the crediting period;

- If project participants choose to use a renewable crediting period, at each renewal the project participants should assess the additionality of the project activity (in accordance with the approved baseline methodology AM0008) and should in particular monitor the following parameters:
  a) The price differential between coal and gas in the host country. Prices are monitored, so that changes in price differentials can be seen.
  b) Share of imported versus domestic coal, and the actual emission factor characteristic of coal and gas consumed in the host country.

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[1] The methodology AM0008 calls for combustion efficiency to be measured as a function of the load factor measured ex-ante before fuel switching. However, the methodology (AM0008, version 1) was published on 15 June 2004, while the conversion to natural gas had been completed several months earlier. AM0008 is based on NM0016, presented by MGM International together with a draft PDD in August 2003. The NM0016 did not include a requirement for measuring efficiency as a function of the load factor, and no such measurements were conducted prior to fuel conversion. The only data available correspond to full load efficiency measurements. These ex-ante efficiency data were reported in the August 2004 version of the PDD which was validated and registered.

For non-CO_2 GHG emissions part associated with fuel combustion and fugitive, IPCC default parameters can be used for the emission factors because such parts are minor;

For CO_2 emission part associated with fuel transportation, are directly monitored for project scenario and calculated with suitable assumptions for baseline scenario. The emission factors are those of the IPCC default value.

[Note] If the project participant can demonstrate that some segment of emission reductions ERy (such as a term in the leakage, e.g., CO2 emissions from fuel transportation) is negligibly small (e.g., such a part is demonstrated to be much smaller (<10−1) than the uncertainty level of the most contributing part in ERy), the parameters associated with the segment do not need to be monitored.

If the project participant can demonstrate that some element process consumes less energy than 5% of total consumption and its time variance is negligible small, fixed values (monitoring is once) or less frequent monitoring can be applied, or such effects can be neglected as a conservative estimation.

According to the monitoring methodology the parameters to be monitored are the following:

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
1. MFC_{NG}	Heat	Quantity of natural gas used (PS)	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
1.1. $MFC_{NG\ (LOSS)}$	Heat	Quantity of natural gas used in LOSS	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
1.2. $MFC_{NG\ (NEI\ 23)}$	Heat	Quantity of natural gas used in NEI 23	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
1.3. $MFC_{NG\ (NEI\ 24)}$	Heat	Quantity of natural gas used in NEI 24	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
1.4. $MFC_{NG\ (NAS\ 1)}$	Heat	Quantity of natural gas used in NAS 1	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
1.5. $MFC_{NG\ (NAS\ 2)}$	Heat	Quantity of natural gas used in NAS 2	Joule or Kcal	m	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Converted from physical quantity (e.g., m^3), if needed, using conversion factor (e.g, kcal/m^3) provided by local supplier.
2. MFC_{Coal}	Heat	Quantity of coal used (BS)	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Σn, operation pattern Qn_Fi,y
2.1. $MFC_{Coal\ (LOSS)}$	Heat	Quantity of coal used in LOOS	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Qn_NGy X (n_n_NG/n_n_Fi) This value is monitored by operation pattern at the process n.
2.2. $MFC_{Coal\ (NEI\ 23)}$	Heat	Quantity of coal used in NEI 23	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Qn_NGy X (n_n_NG/n_n_Fi) This value is monitored by operation pattern at the process n.

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
2.3. $MFC_{Coal\ (NEI\ 24)}$	Heat	Quantity of coal used in NEI 24	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Qn_NGy X (n_n_NG/n_n_Fi) This value is monitored by operation pattern at the process *n*.
2.4. $MFC_{Coal\ (NAS\ 1)}$	Heat	Quantity of coal used in NAS 1	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Qn_NGy X (n_n_NG/n_n_Fi) This value is monitored by operation pattern at the process *n*.
2.5. $MFC_{Coal\ (NAS\ 2)}$	Heat	Quantity of coal used in NAS 2	Joule or Kcal	c	Monthly	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Calculated as Qn_NGy X (n_n_NG/n_n_Fi) This value is monitored by operation pattern at the process *n*.
3.1. $\eta_{NG\ (LOOS)}$	Fuel Efficiency	Fuel efficiency of natural gas used in LOOS	%	m	Once at the early stage of the project	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Not a single value but a pattern (function) of "load factor" at the process n. Preferable to draw a graph as a function of load factor. The measurement should be repeated for each process n with several load factors in order to get the curve of η n with statistical significance.
3.2. $\eta_{NG\ (NEI\ 23)}$	Fuel Efficiency	Fuel efficiency of natural gas used in NEI 23	%	m	Once at the early stage of the project	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Not a single value but a pattern (function) of "load factor" at the process n. Preferable to draw a graph as a function of load factor. The measurement should be repeated for each process n with several load factors in order to get the curve of η n with statistical significance.
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3.4. $\eta_{NG\ (NAS\ 1)}$	Fuel Efficiency	Fuel efficiency of natural gas used in NAS 1	%	m	Once at the early stage of the project	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Not a single value but a pattern (function) of "load factor" at the process n. Preferable to draw a graph as a function of load factor. The measurement should be repeated for each process n with several load factors in order to get the curve of η n with statistical significance.

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
3.5. $\eta_{NG\ (NAS\ 2)}$	Fuel Efficiency	Fuel efficiency of natural gas used in NAS 2	%	m	Once at the early stage of the project	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Not a single value but a pattern (function) of "load factor" at the process n. Preferable to draw a graph as a function of load factor. The measurement should be repeated for each process n with several load factors in order to get the curve of η n with statistical significance.
4.1. $\eta_{COAL\ (LOOS)}$	Fuel Efficiency	Fuel efficiency of coal used in LOOS	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	
4.2. $\eta_{COAL\ (NEI\ 23)}$	Fuel Efficiency	Fuel efficiency of coal used in NEI 23	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	
4.3. $\eta_{COAL\ (NEI\ 24)}$	Fuel Efficiency	Fuel efficiency of coal used in NEI 24	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	
4.4. $\eta_{COAL\ (NAS\ 1)}$	Fuel Efficiency	Fuel efficiency of coal used in NAS 1	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	
4.5. $\eta_{COAL\ (NAS\ 2)}$	Fuel Efficiency	Fuel efficiency of coal used in NAS 2	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	
5. Load Factor	Load Factor	Load Factor of operation pattern at process	%	m	One before fuel switch	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Plural values of load factor are measured for "pre-set" operation patterns (such as normal operation, start-up, shut-down, holiday operation, etc.)
6. L Reg	Local Regulation	Local regulation constraint	-	checked	At the renewal of the crediting period	100%	Paper (field record) Electronic (spreadsheet)	Project lifetime	Does local regulation allow to utilize the coal fuel? If not, the project is no longer additional.

(PS) and (BS) are for the parameters in Project scenario and Baseline Scenario, respectively

Data collected by Graneros' staff in order to monitor the emissions from the baseline and project activity are shown in the following table.

#	Data variable	Data unit	Recording frequency	Comment
1	Volume of natural gas consumed (*MFC_{NG}*)	m^3	Month	The data on natural gas consumption are obtained from direct measurements of natural gas consumed by each element process (meters installed at each boiler and furnace). The volume measured is multiplied automatically by an adjustment factor (which correct for temperature and pressure to bring it to 15°C and 1 atmosphere) and then by the heating value of natural gas (provided by the supplier) in order to obtain the fuel energy.
2	Efficiency of principal equipment (3 boilers and 2 furnaces) (η)	%	Once for the crediting period.	The methodology AM0008 requires that, for each element process n, the fuel efficiency η_Fi be measured ex-ante before switching the fuel. While the methodology requires efficiency to be measured as a function of load factor, the methodology was approved (June 2004) AFTER the project was initiated, and only full load efficiency is available prior to project implementation. On the other hand, η_NG (as function of load factor) was measured at an early stage, after project implementation, and is considered fixed along the first crediting period.
3	Fuel prices (coal and natural gas)	$/unit	At end of crediting period	Fuel prices need to be recorded only in case project life extends beyond one crediting period, requiring renewal of validation

Non GHG-related data:

- Nestlé's internal health record: the company would monitor occupational health in order to detect if the project were substantially improving the health condition of its employees. This program would be based on internal health records; and records of absenteeism due to sickness. (Not to be considered for emission reduction calculations.)
- In addition, the company would aim at maintaining its existing internal programs related to social and environmental quality, which also serve as indicators of the company's commitment to social and environmental quality. Nestlé's Environmental Minimum Technical Requirements (NEMTR) is part of the Nestlé Environmental Management System (NEMS). Annex 8 of the PDD showed the main sustainability indicators used in this project. These are not relevant to emissions reduction calculations.

Data were to be archived until two years after the end of the crediting period.

Additionally, the following table shows the fixed values used in calculation of emission reductions.

Natural Gas		
Parameter	**Value**	**Source**
Lower heating value CV_{NG}	Value provided by the supplier.	For natural gas in Chile. Value provided by the supplier.
CO_2 emissions factor (combustion) EF_{NG}	56.1 kg/GJ	Ref. 1, Table 1-1 p. 1.13. Natural gas (dry): 15.3 t C/TJ lower heating value basis. X 44/12 = 56.1 t CO_2/TJ.
CH_4 emissions factor (natural gas production, pipeline and distribution leaks) MLR	0.3 kg/GJ	Natural gas production = 0,07 kg/GJ. Ref. 1, Table 1-64 p 1.131. 39590 to 96000 kg/PJ of gas produced. An average value of 70000 kg/PJ is considered here. gas pipeline and distribution leaks = 0,23 kg/GJ. Ref. 1, Table 1-64 p. 1.131. 116610 to 340000 k
CH_4 emissions factor (combustion) MEF_{NG}	1.4 kg/TJ	Ref. 1, Table I-16 p. 1.54. Natural gas boiler.
Global Warming Potential (CH_4) GWP (CH_4)	21	Ref. 2, for methane this was 21 for the First Commitment Period of the Kyoto Protocol.
N_2O emissions factor (combustion) NEF_{NG}	2.3 kg/TJ	Ref. 1, Table I-19 p. 1.57. Natural gas boiler.
Global Warming Potential GWP (N_2O)	310	Ref. 2, for nitrous oxide this was 310 for the First Commitment Period of the Kyoto Protocol.
Coal		
Parameter	**Value**	**Source**
Lower heating value CV_{COAL}	6790 kcal/kg	Ref. 1, Table 1-2, p. 1.16, Chile Hard coal (imports)
CO_2 emissions factor (combustion) EF_{COAL}	94.6 kg/GJ	Ref. 1 Table 1-1 p. 1.13, Other Bit coal: 25.8 t C/TJ lower heating value basis. X 44/12 = 94.6 t CO_2/TJ.
Coal transport CO_2 emissions $E_{transport}$	22.1 kg /t coal	See details in PDD.
CH_4 emissions factor (combustion) MEF_{COAL}	1 kg/TJ	Ref. 1, Table 1-16, p. 1.54. Bituminous spreader stokers.
Global Warming Potential (CH_4) GWP (CH_4)	21	Ref. 2, for methane this was 21.
N_2O emissions factor (combustion) NEF_{COAL}	1.6 kg/TJ	Ref. 1, Table 1.15, p. 1.53. Bituminous spreader stokers for utility boilers. (Value for industrial boilers not available.)
Global Warming Potential GWP (N_2O)	310	Ref. 2, for nitrous oxide this was 310.

References

1. IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996).
2. According to Article 5, section 3 of the Kyoto Protocol, GWP value is as agreed on at COP3.

The monitoring methodology followed in the PDD described the procedure and equations for calculating project and baseline emissions from monitored data. For this specific project, the methodology was applied through a spreadsheet model. The staff responsible for project monitoring was to complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides the total GHG emission reductions achieved through the project.

The models contain a series of worksheets with different functions:

Main data entry sheet:

Name of sheet	**Function**
Fuel Consumption	Most of the input data is entered in this sheet. Data to be input include *monthly* fuel consumption for each major fuel using equipment following project implementation and the heating value of natural gas (provide by the supplier). Since AM0008 does not allow for the use of fuels other than natural gas following project implementation, the periods during which any other fuel was used, and emissions reductions for these periods were excluded from the determination of project and baseline emissions, and emissions reductions. *All other worksheets show annual values.*

Calculation sheets:

Name of sheet	**Function**
Natural gas-NEI 24 boiler Natural gas-NEI 23 boiler Natural gas-LOSS boiler Natural gas-NAS furnace No1 Natural gas-NAS furnace No 2	These worksheets are calculation sheets based principally on monthly natural gas consumption data input in the first sheet (see above). The only additional data input in these sheets relate to a single value of combustion efficiency.
Coal-Bsdynamic	These worksheets are calculation sheets to determine the consumption of these fuels that would have occurred in the absence of the project activity. These are determined in a dynamic manner from fuel consumption data following project implementation. (See methodology for details.)

Result sheet:

Name of sheet	**Function**
Emiss. Red.	This final worksheet summarizes baseline and project emissions, and determines emissions reductions, all on an annual basis.

All worksheets except the main data input sheet also list any fixed parameters (emissions factors, heating value, GWP, etc.) required for the calculations, and references for these values.

A color-coded key is used to facilitate data input. The key for the code is as follows:

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display key result lines as calculated by the model.

D.4. Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not included in the project boundary, and identification if and how data will be collected and archived on these emission sources.

Electricity consumption at the project site is responsible for indirect emissions of CO_2 at power plants based on fossil fuels. However, electricity consumption is not affected by project activity, which involves fuel shifting for boilers and furnaces used to generate heat. Thus we do not expect electricity consumption or associated emissions to be affected by the project activity. Thus, such emissions are not considered.

D.5. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHG within the project boundary and identification if and how such data will be collected and archived.

The baseline emissions are determined in a dynamic manner from monitored values. All data needed for determining this dynamic baseline are listed above in section D.3. Thus, no additional data are needed to define the baseline.

D.6. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored *(data items in tables contained in section D.3., D.4. and D.5 above, as applicable)*

Nestlé Chile S.A. has a series of internal procedures with respect to quality control. Nestlé Chile S.A. will use these procedures to ensure that data collected for the project are subject to the most rigid quality control procedures.

The quality control (QC) and quality assurance (QA) procedures implemented are the following.

Data	**QA/QC procedures**
1. Volume of natural gas consumed (MFC_{NG})	A procedure was prepared for calibration and reading of natural gas meters. It was defined that the meters will be verified each 5 years (frequency suggested by the meter manufacturer and confirmed with natural gas supplier). The total consumption of the plant is measured in the Metrogas metering station (installed in the plant entrance). This information (total volume) will be used for corroboration (to verify if the sum of the volume measured by each meter is consistent with (i.e. lower than) the total consumption measured by Metrogas). Note that only major equipments are considered within the project, and the consumption of this equipment is less than the total natural gas consumption. In case of failure of any of meters installed to measure fuel consumption of the boilers and furnaces, the procedure "Instrucción Operacional Corrección en medidores Digitales" (based on Dresser "MCUT" software) shall be used to obtain the volume of natural gas.
2. Efficiency of principal equipments (3 boilers and 2 furnaces) (η)	These data will be directly used for calculation of emissions reductions. The natural gas combustion efficiency was measured at an early stage of the crediting period in order to get a curve with statistical significance where the efficiency is a function of load factor. The measurement and calculation of the combustion efficiency was carried out using two calibrated instrument (Testo and Bacharach) that provide the results automatically and then, used for calculation of emissions reductions. On the other hand, as part of a Nestle internal monitoring procedure, combustion efficiency is measured periodically. The results are recorded in an Excel workbook. These results are recorded in an Excel chart. The boiler and furnace operators are in charge of loading the data into the Excel charts, in the computer located in the boiler room. . There is a copy of this chart in the computer of the Technical Chief of the Factory, as well as a printed copy duly signed by the operators that carried out the measurements and by the Technical Chief of the Factory.
3. Fuel prices (coal, diesel, LPG, natural gas)	These data will be required for revalidation of project and determine baseline and additionality at end of each crediting period.

D.7 Name of person/entity determining the monitoring methodology:

Date of completion: 27/3/2008

Rocío Rodriguez MGM International SRL

Junín 1655, 1º B

C1113AAQ, Buenos Aires, Argentina

Tel./Fax: (54 11) 5219-1230/32

e-mail: rrodriguez@mgminter.com

Rocío Rodriguez is not project participants.