CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
VERSION 03 - IN EFFECT AS OF: 22 DECEMBER 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Title: RAMSA – Biogas recovery and electricity generation from M'zar Wastewater treatment plant, Morocco
Version: 1
Date: December 18, 2008

A.2. Description of the small-scale project activity:

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Summary:
The proposed project activity involves the recovery of biogas and the electricity generation from existing lagoons in the M'zar wastewater treatment plant, Agadir, Morocco.
Currently no legislation is in place in Morocco that governs the capture of methane in wastewater treatment plants and as a result, the 9 open lagoons emit methane freely into the atmosphere. A significant amount of methane emissions will be captured.
The recovery system will be installed in 3 steps (3 lagoons per year). The electricity generating sets will be installed at the beginning of 1^{st} step. The total installed capacity will not exceed 15MW (two sets of 0.8 MW each are to be installed).
The proposed project activity is made of two components: component 1 Biogas recovery and component 2 Electricity generation.

The proposed project activity represents an abatement of 253,693 tCO_2 over the first seven years period.

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	Régie Autonome Multi-Services d'Agadir (RAMSA, «Établissement Public à caractère industriel et Commercial »)	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

>>
Morocco

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

>>
Souss Massa Draa province

A.4.1.3. City/Town/Community etc:

>>
Agadir

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

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This project is located in the greater Agadir, 20 km from the town centre of Agadir.

The Autonomous Multi Services Public Corporation of Agadir, the RAMSA (Régie Autonome Multi Services d'Agadir), is responsible for the project.

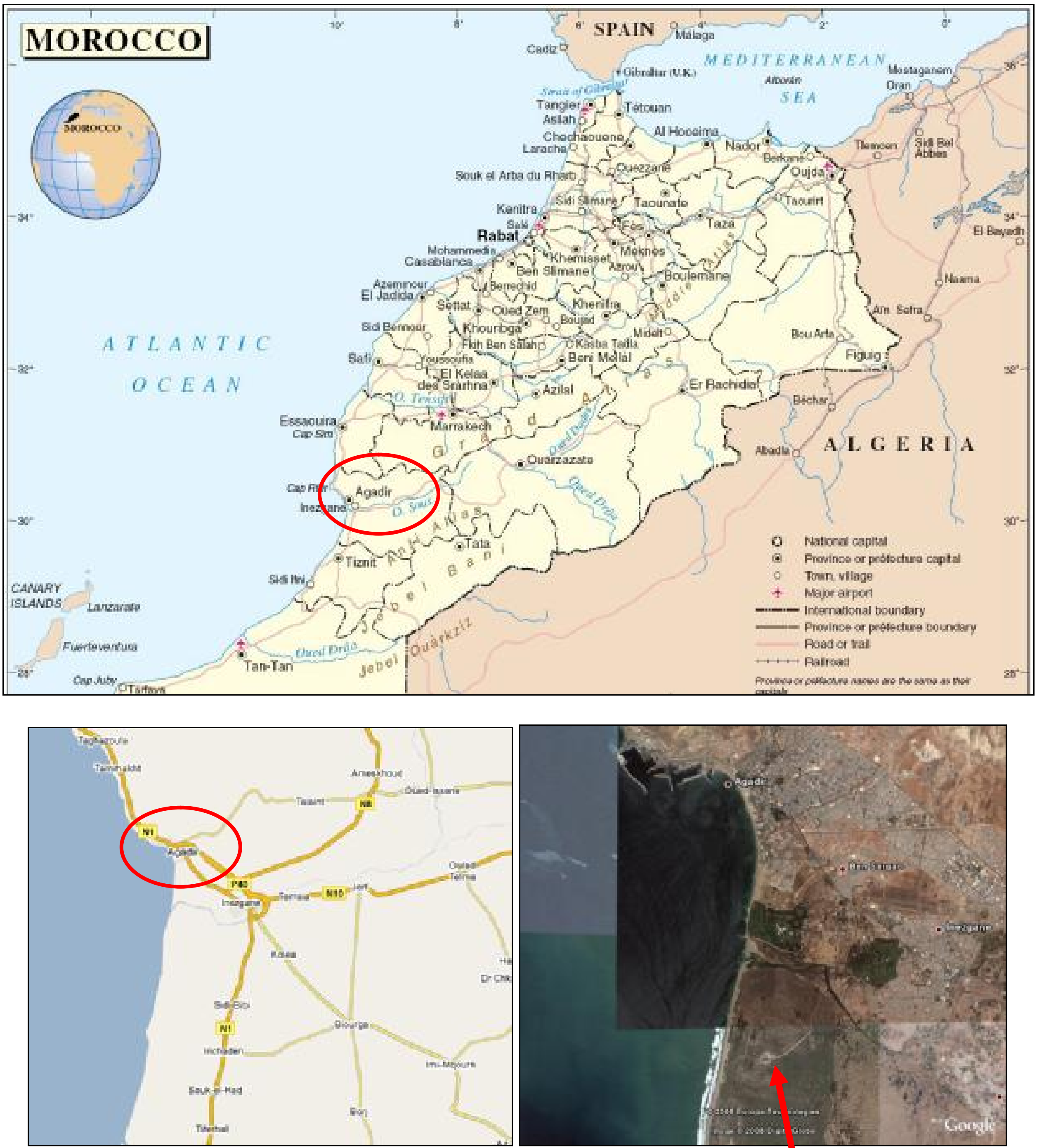

Figure 1 : Location of the project activity

Precise coordinates of the project are 30°20'00'' N; 09°35'52 W.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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The project activity combines two components:

Component	Type	Category
1	III (Other project activities)	III.H. – Methane Recovery in Wastewater Treatment (Version 10_Scope 13_10 October 2008)
2	I (Renewable energy projects)	I.D. – Grid connected renewable electricity generation (Version 13_Scope 01_14 dec 2007)

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions (in tCO_2e)
2009	7 208
2010	25 037
2011	44 470
2012	46 028
2013	47 640
2014	49 309
2015	51 036
Total estimated emission reductions (tCO_2e)	270 728
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tCO_2e)	38 675

Note that the increase in emission reductions is due to the progressive implementation of the biogas recovery system on the 9 existing lagoons (3 lagoons equipped the 1st year, 6 the 2nd year and 9 after).

A.4.4. Public funding of the small-scale project activity:

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There is no public funding of this project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

As highlighted in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- with the same project participants;
- in the same project category and technology/measure;
- registered within the previous 2 years;
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

RAMSA confirms that there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity in the same category and technology/measure, registered within the previous 2 years and whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

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

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Title:

Component	Title	Category
1	Methane recovery in wastewater treatment	AMS III.H
2	Grid connected renewable electricity generation	AMS I.D

B.2 Justification of the choice of the project category:

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Justification of Methodology III.H choice	
Eligibility conditions	
Conditions (as mentioned in methodology III.H)	Compliance
This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options[1]: *[...]* *(iv) Introduction of methane recovery and combustion to an existing anaerobic wastewater treatment system such as anaerobic reactor, lagoon, septic tank or an on site industrial plant[1]* *[...].* *[1] Under this methodology anaerobic lagoons are considered ponds deeper than 2 meters, without aeration, ambient temperature above 15°C, at least during part of the year, on a monthly average basis, and with a volumetric loading rate of Chemical Oxygen Demand above 0.1 kg COD.m-3.day-1. The residence time of the non-soluble part of the organic matter in anaerobic lagoons shall be at least 30 days.*	The project comprises the gradual implementation of geomembranes over the 9 existing lagoons (currently operating in anaerobic conditions), purification system and combustion equipments. The 9 existing lagoons are open type, with a depth of at least 3m (from 3.24m to 5.59m), without aeration. The ambient temperature is above 15°C, at least during part of the year. The volumetric loading rate of Chemical Oxygen Demand is more than 2 kg COD.m^{-3}. The residence time of the non-soluble part of the organic matter of around 4 years. Therefore, the project complies with the eligibility condition.
The recovered methane from the above measures may also be utilized for the following applications instead of combustion/flaring: *(a) Thermal or electrical energy generation directly;* *[...].*	The recovered biogas will be burnt to generate electricity. Therefore, the project complies with the eligibility condition.
If the recovered methane is used for project activities covered under paragraph 2 (a), that component of the project activity can use a corresponding category under type I.	The component 2 is based on the methodology I.D. Therefore, the project complies with the eligibility condition.

[1] Other technologies in table 6.3 of Chapter 6: Wastewater Treatment and Discharge of 2006 IPCC Guidelines for National Greenhouse Gas Inventories are included.

Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO2 equivalent annually from all type III components of the project activity.	Emissions reductions calculation (cf. section A.4.3) for the III.H component of this bundled project indicates that the project complies with the eligibility condition.

Justification of Methodology I.D choice	
Eligibility conditions	
Conditions (as mentioned in methodology I.D)	Compliance
Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	The component 2 of this project consists of renewable biogas energy generating sets of less than 2 MW in total (two sets of 0.8 MW each). Therefore, this project complies with the eligibility condition.

B.3. Description of the project boundary:

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Component	Project boundaries
1	Project boundaries are delimited by: 1. the 9 existing settling lagoons 2. the new equipments installed on the 9 existing lagoons (geomembranes, combusting equipments, etc.).
2	The project boundary is the physical, geographical site of the methane combustion facility.

Component 1

Implementation of the project activity will affect certain sections of the treatment systems while others remain unaffected. The treatment systems not affected by the project activity, i.e. sections operating in the project scenario under the same operational conditions as in the baseline scenario are the following:

- wastewater network,
- pumping stations,
- sludge treatment and final disposal.

The lagoons that will be covered with biogas recovery by the project activity, but continue to operate with the same qty. of feed inflow, volume (retention time), and temperature (heating) as in the baseline scenario, will be considered as not affected i.e. the methane generation potential remains unaltered, as mentioned in the footnote 5 page 3/23 of the methodology III.H, version 10: “The covering of lagoons and the installation of biogas recovery equipment may result in changes in the operational conditions (such as temperature, COD removal, etc.) of an anaerobic treatment system. These changes are considered small and hence not accounted for under this methodology."

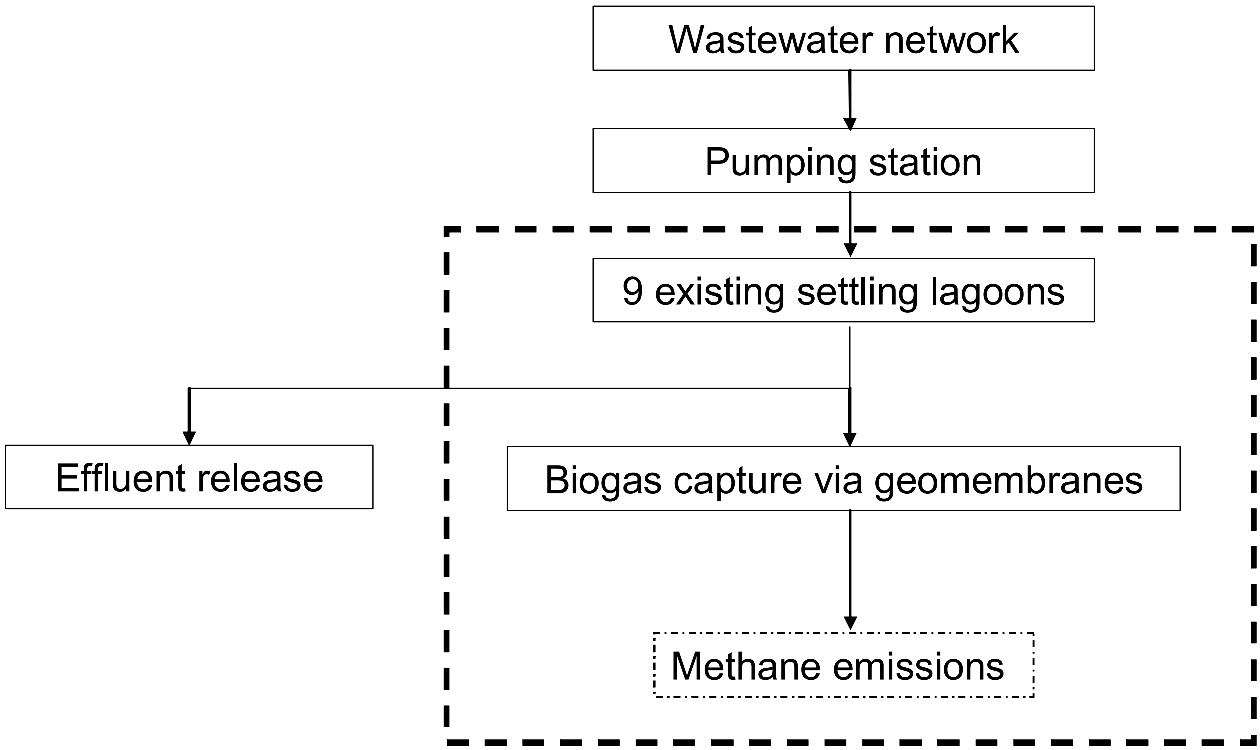

Figure 2 : Project boundary, III.H component

All the equipments consuming power in the baseline will work under the same conditions in the project activity. The electrical consumption of the new equipments in the project activity (gas analyzer, etc.) are treated in the component 2 below.

Component 2

The figure below shows the schematic representation of the project boundary. The project boundary encompasses the methane combustion in generating sets which is implemented on the physical, geographical site of Agadir M'Zar wastewater treatment plant. The estimated production of the generating sets is about 61 GWh over the first seven years period.

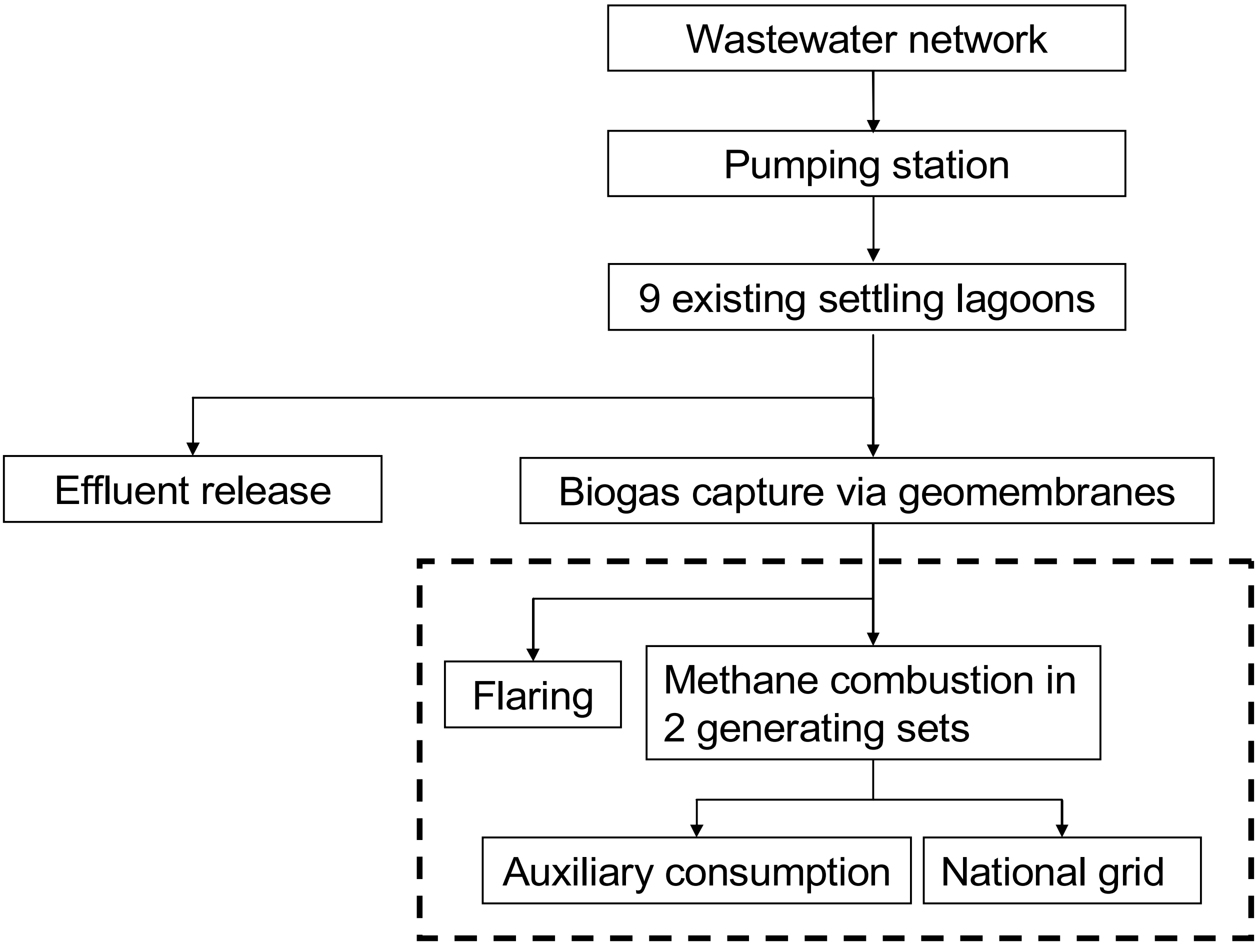

Figure 3 : Project boundary, I.D component

The system boundary concerning the electricity supplied to the grid, displacing more carbon intensive electricity, is the national grid of Morocco. The operation (and central dispatch) of the interconnected system is the sole responsibility of the Office National de l'Electricité (ONE). Emissions related to the facilities and power plants within the national grid will serve as our boundary and baseline.
The electricity consumed by the pumping stations and existing equipments in the M'zar wastewater treatment plant comes from the national grid. In the project activity, these consumptions will also come from the grid. This way, the difference between the baseline and the project activity will be the electricity produced (minus the auxiliary consumption).

B.4. Description of baseline and its development:

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Component 1

The baseline emission scenario consists of the existing anaerobic wastewater without methane recovery and combustion units. The lagoons are open type, with a depth of at least 3m (from 3,24m to 5,59m) and a residence time of the sludges of around 4 years. The methane is released into the atmosphere in an uncontrolled manner.

$$BE_y = BE_{power,y} + BE_{s,treatment,y} + BE_{ww,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$$ **Equation 1**

Where:

- BE_y = Baseline emissions in year "y"(tCO_2e)
- $BE_{power,y}$ = Baseline emissions from electricity or fuel consumption in year *y* (tCO_2e).

The electrical consumption being identical for both the baseline and the project activity, this term is negligible (cf. §B.3).

$$BE_{power,y} = 0$$ **Equation 2**

- $BE_{ww,treatment,y}$ = Baseline emissions of the wastewater treatment systems affected by the project activity in year y (tCO_2e)

$$BE_{ww,treatment,y} = \sum_i \left(Q_{ww,i,y} \times COD_{removed,i,y} \times MCF_{ww,treatment,BL,i} \times B_{o,ww} \times UF_{bl} \times GWP\_CH4 \right)$$

Equation 3

Where:

- $Q_{y,i,ww}$ = Volume of wastewater treated in baseline wastewater treatment i in the year y (m^3)
- $COD_{removed,i,y}$ = Chemical oxygen demand removed by baseline treatment system i in year y measured as the difference between inflow COD and the outflow COD in system *i* ($tonnes/m^3$)
- $MCF_{ww,treatment,bl,i}$ = Methane correction factor for baseline wastewater treatment system i (MCF values as per table III.H.1)
- i = Index for baseline wastewater system
- $B_{o,ww}$ = Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 $kgCH_4$/kg COD)
- UF_{bl} = Model correction factor to account for model uncertainties (0.94)
- GWP_CH4 = Global warming potential for methane (value of 21)

All the lagoons work under the same conditions (same COD_{in} and same COD_{out}). In the baseline, there is no distinction between the several 9 existing lagoons.

Thus,

$$BE_{ww,treatment,y} = Q_{ww,y} \times COD_{removed,y} \times MCF_{ww,treatment,BL} \times B_{o,ww} \times UF_{bl} \times GWP\_CH4$$

Equation 4

- $BE_{s,treatment,y}$ = Baseline emissions of the sludge treatment systems affected by the project activity in year y (tCO_2e).

The sludge treatment being identical for both the baseline and the project activity, this term is negligible (cf. §B.3).

$$BE_{s,treatment,y} = 0$$ **Equation 5**

- $BE_{ww,discharge,y}$ = Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e).

The treated wastewater discharged into the sea being identical for both the baseline and the project activity, this term is negligible (cf. §B.3).

$BE_{s,treatment,y} = 0$ **Equation 6**

- $BE_{s,final,y}$ = Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e).

The final sludge produced being identical for both the baseline and the project activity, this term is negligible (cf. §B.3).

$BE_{s,final,y} = 0$ **Equation 7**

Hence:

$BE_y = Q_{ww,y} \times COD_{removed,y} \times MCF_{ww,treatment,BL} \times B_{o,ww} \times UF_{bl} \times GWP\_CH4$ **Equation 8**

As precised in section 17 of methodology III.H version 10, all parameters (including COD removal efficiency and volume of wastewater treated per year) are calculated using historical data.

Component 2:
The baseline scenario is the production of electricity from the existing current power plants in Morocco.

As per Baseline Methodology I.D. (Version 13_Scope01_14 December 2007), the baseline for emission reductions related to the production of electricity (measured in kg CO_2e/kWh) should be calculated in a transparent and conservative manner as:

(a) The average of the "approximate operating margin" and the "build margin", where:

(i) The "approximate operating margin" is the weighted average emissions (in kg CO_2e/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

(ii) The "build margin" is the weighted average emissions (in kg CO_2e/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

OR,

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix.

Option (a): The average of the "approximate operating margin" and the "build margin" is selected. It is calculated as follows:

STEP 1. Calculate the Operating Margin emission factor(s) ($EF_{OM,y}$)

The OM emission factor ($EF_{OM,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving the system, not including hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

$$EF_{OM,y} = \frac{\sum_{i,j}\left(F_{i,j,y} \times COEF_{i,j}\right)}{\sum_{j} GEN_{j,y}}$$ **Equation 9**

Where:

- $F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year *y*, *j* refers to the power sources delivering electricity to the grid, and including imports to the grid,
- $COEF_{i,j\,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2e / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year y, and
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The CO_2 emission coefficient $COEF_i$ is defined as:

$$COEF_i = NCV_i \times EF_{CO2,i} \times OXID_i$$ **Equation 10**

Where:

- NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*,
- $OXID_i$ is the oxidation factor of the fuel *i* (see page 1.29 in the 1996 Revised IPCC Guidelines for default values),
- $EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values. 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 2001, 2002 and 2003. The data of the plants used in the Operating Margin are provided in the tables presented in Annex 3. Imports from Algeria and Spain have been taken into account. They form between 10 and 12 % of the total electricity produced in the years 2001, 2002 and 2003 (see Annex 3). These imports have been taken into account using an emission factor of 0 t CO_2e/MWh.

STEP 2. Calculate the Build Margin emission factor ($EF_{BM,y}$) as the generation-weighted average emission factor (tCO_2e/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$ **Equation 11**

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above for plants *m*. The sample group *m* consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

For Morocco, both options lead to the same sample group of power plants. The total of the 5 most recently built power plants have an installed capacity of 833 MW, which is equal to 22% of the overall installed capacity. An overview of the data on the performance of the 5 selected power plants is presented in Annex 3.

STEP 3. Calculate the baseline emission factor *EF_y* as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = w_{Om} \times EF_{OM,y} + w_{BM} \times EF_{BM,y}$$ **Equation 12**

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2e/MWh.

Relevant data related to years 2001, 2002 and 2003 have been collected from the National Utility (Office national de l'Electricité, ONE). They are presented as along with relevant calculations of operating margin and build margin EF in Annex 3.
Thus, operating margin EF_{OM} is 0.734 tCO_2e/MWh, build margin EF_{BM} is 0.752 tCO_2e/MWh, and Combined margin EF is 0.743 tCO_2e/MWh.

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 small-scale CDM project activity:

Currently no legislation is in place governing the capture of biogas emissions in the wastewater treatment industry in Morocco. As a result, the open lagoons emit methane freely into the atmosphere. As will be demonstrated below, the project presents a new technology for the recovery of biogas in wastewater treatment plants and electricity generation. Under current system requirements for RAMSA's wastewater treatment plant, implementing the project is unprofitable without CDM revenue.

ADDITIONALITY

Project additionality is demonstrated through the use of the Tool for the demonstration and assessment of additionality", as proposed in the Executive Board's 16th meeting.

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

The project is only expected to start operation after validation of the PDD and registration of the project as CDM. In any case, as it will be demonstrated in the following steps, CDM revenue has been considered from the early stages of development of the project, and it is an integral part of the financial package of the project.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

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

There are two possible alternative options for RAMSA:
Option A: To develop the project as currently specified by BRLi without securing CDM revenue

Option B: To continue with RAMSA's wastewater treatment plant as it is currently designed, i.e. with the operation of an open anaerobic system without the capture of the biogas.

Sub-step 1b. Enforcement of applicable laws and regulations

In Morocco, there is no legislation regarding biogas recovery from wastewater treatment plants.
Therefore, all the alternatives to the project outlined in Step 1a are in compliance with applicable laws and regulations.

Step 2. Investment analysis
N.B.: All the related data is detailed in Annex 5.

Sub-step 2a. Determine appropriate analysis method

The most appropriate analytical option is to perform an investment comparison of the project activity.
Therefore, Option II is selected.

Sub-step 2b. – Option II. Apply investment comparison analysis

The most common analytical option for RAMSA to evaluate the project's feasibility is Net Present Value (NPV). NPV calculations were central to the project's evaluation within RAMSA.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):
Parameters and calculation tables are shown in Annex 3.
The financial comparison is based on documentation provided by RAMSA and projections from the engineering department BRLi.

Table 1: Comparative financial indicators for alternative options

Option	Description	Investment	NPV (10 years)
A	Develop project activity without CDM revenue	k€ 4,414	k€ -645
B	Continue with RAMSA's current system design	k€ 0	k€ 0

Option B (continuing with RAMSA's current facility) will not require any additional investments nor operating costs.
The figures show that developing the project without CDM revenue (option A) is not profitable compared to continuing with current operation (option B).

Table 2: Comparative financial indicators total project

Description	NPV (10 years)
Continue with RAMSA's current system design	k€ 0
Develop project activity with electricity revenues	k€ -645
Develop project activity with electricity & CDM revenue	k€ 1,386

Options are compared on the basis of the Net Present Value (NPV). Though the project activity covers a seven years crediting period (only seven years of carbon revenues), the NPV analysis is based on a period of 10 years. This period is typical for RAMSA's investment decisions making process.

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

The following sensitivity analysis is performed for the project:
1. Decrease in project development costs by 10% and is presented in the following table.

Table 3: Sensitivity analysis

Decrease in project development costs by 10%	
Description	NPV (10 years)
Continue with RAMSA's current system design	k€ 0
Develop project activity with electricity revenues	k€ -282
Develop project activity with electricity & CDM revenue	k€ 1,749

The project remains financially unattractive compared to continuing with the current design even if total investment costs are reduced by a significant 10%. The project can therefore not be considered financially attractive without securing CDM revenue.

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

As has been shown in Step 2 above, the project activity experiences a negative NPV without the inclusion of CDM revenue. The project's high investment costs coupled with risks due to the use of a new technology will leave the most likely option as simply continuing with the facility's current status quo of operation.

In addition to this investment barrier, the following barriers are identified for the implementation of the project:

1. Barrier due to prevailing practice:
The project (capture system and 2x0.8 MW generating sets) is the first of its kind in Morocco. Never before has a wastewater treatment project in Morocco been implemented that uses geomembranes for the capture of biogas at this scale. A pilot project was developed by the RAMSA in Ben Sergao. The size of this pilot (750m^3/day of effluent) is clearly much smaller than the project activity (around 40,000m^3/day of effluent).

2. Technological barrier:
In Morocco, there is a lack of local skilled personnel to operate the biogas generating sets. Indeed, this technology implies the mastery of several points: corrosion, H_2S effect on motor, measuring equipments, flaring equipments, grid connection, etc. Thus, local technicians will be trained within RAMSA to operate the units. Recruiting and outsourcing the first years are seriously considered.

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The barriers show that without the CDM revenue the wastewater treatment cycle of RAMSA would be operating at its current design. Project feasibility and financing for the project activity would be impossible without CDM revenue. Also the other non-financial barriers are valid for the project activity only. The only option therefore would be to continue with business as usual at M'zar wastewater treatment plant.

STEP 4. COMMON PRACTICE ANALYSIS

Sub-step 4a. Analyze other activities similar to the proposed project activity:

As indicated previously, this project activity is the "first of its kind" in Morocco. No project activity relating to biogas capture from wastewater for electricity generation purposes has been developed in the country so far at this scale. Only a limited number of pilots projects (Ben Sergao, for example) have been tested in this field in Morocco.

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

There are no similar options that are occurring.

Step 5. Impact of CDM registration

CDM revenue contributes to the project to a great extent. Without it, the project will not be implemented. If carbon credits are secured, assuming an average price of €15 per tCO_2e, the following investment evaluation is realised:

Table 4: Financial analysis of project

Description	Investment	NPV (10 years)
Develop project activity as CDM project	k€ 4,414	k€ 1,386

With CDM revenues, an NPV of k€ 1,386 is expected. This presents a level of return that is acceptable to RAMSA.
Without CDM revenue, the project will not be able to satisfy RAMSA's investing requirements.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Component 1

The ex-ante emission reductions for the methane recovery are calculated as per AMS-III.H. Emission reductions shall be estimated *ex ante* in the PDD using the formulas provided in the baseline, project and leakage emissions sections, as follows:

$$ER_{y,exante} = BE_{y,exante} - \left(PE_{y,exante} + LE_{y,exante}\right) \quad \textbf{Equation 13}$$

Where:

- $ER_{y,ex\ ante}$ = *Ex ante* emission reduction in year *y* (tCO2e)
- $LE_{y,ex\ ante}$ = *Ex ante* leakage emissions in year *y* (tCO2e)
- $PE_{y,ex\ ante}$ = *Ex ante* project emissions in year *y* (tCO2e)
- $BE_{y,ex\ ante}$ = *Ex ante* baseline emissions in year *y* (tCO2e)

Regarding *ex-post* emissions reductions, as mentioned in §31 p13/23 of the III.H methodology, it is possible that the project activity involves wastewater and sludge treatment systems with higher methane conversion factors (MCF) or with higher efficiency than the treatment systems used in the baseline situation. Therefore the emission reductions achieved by the project activity is limited to the *ex post* calculated baseline emissions minus project emissions using the actual monitored data for the project activity. The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex-post} = \min\left(\left(BE_{y,ex-post} - PE_{y,ex-post} - LE_{y,ex-post}\right), \left(MD_y - PE_{power,y} - PE_{biomass,y} - LE_{y,ex-post}\right)\right)$$

Equation 14

Where:

- $ER_{y,ex\ post}$ = Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
- $BE_{y,ex\ post}$ = Baseline emissions calculated using ex post monitored values
- $PE_{y,ex\ post}$ = Project emissions calculated using ex post monitored values
- MD_y = Methane captured and destroyed/gainfully used by the project activity in the year y (tCO_2e). In case of flaring/fuelling it shall be measured using the conditions of the flaring process.

$$MD_y = BG_{burnt,y} \times \%CH4 \times D_{CH4} \times \eta_{flare} \times GWP\_CH4$$

Equation 15

Where:

- $BG_{burnt,y}$ = Biogas[2] flared/combusted in year y (m^3)
- %CH4 = Methane content in the biogas in the year y (mass fraction)
- D_{CH4} = Density of methane at the temperature and pressure of the biogas in the year y (tonnes/m^3)
- η_{flare} = Flare efficiency in year y (fraction)

Component 2

The site is already connected to the grid as the electricity consumed is taken from the grid. The electricity produced will be either consumed by new equipments ("Auxiliary consumption") or sent to the grid. Only the electricity delivered to the grid will be considered in the emissions reduction calculation.

The consumption of existing equipments is left out of the boundaries of the project. The explanation supporting this assumption is that even if existing equipments consume electricity generated from biogas, without the project activity, that electricity would have been taken from the grid and CO_2 would have been emitted in the connected power plants.

[2] Biogas volume and methane content measurements shall be on the same basis (wet or dry).

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

Data / Parameter:	COD_{in}
Data unit:	mgO_2/l
Description:	Chemical oxygen demand of the wastewater entering the lagoons
Source of data used:	RAMSA (cf. Annex 3)
Value applied:	1,708.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Average of measurements realized from 03/08/2005 to 13/12/2007
Any comment:	

Data / Parameter:	COD_{out}
Data unit:	mgO_2/l
Description:	Chemical oxygen demand of the wastewater going out of the lagoons
Source of data used:	RAMSA (cf. Annex 3)
Value applied:	784
Justification of the choice of data or description of measurement methods and procedures actually applied :	Average of measurements realized from 30/08/2005 to 13/12/2007
Any comment:	

Data / Parameter:	$Q_{hour,ww}$
Data unit:	$m^3/hour$
Description:	Volume of wastewater entering the lagoons per hour
Source of data used:	RAMSA (cf. Annex 3)
Value applied:	1,517.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Average of measurements realized from 30/07/2005 to 14/12/2007
Any comment:	

Data / Parameter:	N_{hour}
Data unit:	Hour/year
Description:	Number of hour of availability of the generation system per year
Source of data used:	Default value
Value applied:	8,232
Justification of the choice of data or description of measurement methods and procedures actually applied :	Hypothesis of 2 weeks per year of unavailability
Any comment:	

Data / Parameter:	UF_{bl}
Data unit:	-
Description:	Model correction factor to account for meodel uncertainties
Source of data used:	Default value
Value applied:	0.94
Justification of the choice of data or description of measurement methods and procedures actually applied :	Methodology III.H. – Methane Recovery in Wastewater Treatment (Version 10_Scope 13_10 October 2008)
Any comment:	

Data / Parameter:	$B_{o,ww}$
Data unit:	kg $_{CH4}$/kg $_{COD}$
Description:	Methane generation capacity of the treated wastewater
Source of data used:	Default value
Value applied:	0.21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Methodology III.H. – Methane Recovery in Wastewater Treatment (Version 10_Scope 13_10 October 2008)
Any comment:	

Data / Parameter:	$MCF_{ww,treatment}$
Data unit:	-
Description:	Methane correction factor for the anaerobic wastewater treatment system
Source of data used:	Default value
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	Methodology III.H. – Methane Recovery in Wastewater Treatment (Version 10_Scope 13_10 October 2008), MCF values in table III.H.1 (anaerobic deep lagoons deeper than 2m)[3]
Any comment:	

Data / Parameter:	GWP_CH4
Data unit:	kg $_{CO2}$/kg $_{CH4}$
Description:	Global warming potential for methane
Source of data used:	Default value
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Methodology III.H. – Methane Recovery in Wastewater Treatment (Version 10_Scope 13_10 October 2008)
Any comment:	

Data / Parameter:	**EF**
Data unit:	tCO_2e/MWh
Description:	Electricity emission factor
Source of data used:	ONE
Value applied:	0.743
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as per Baseline Methodology I.D. (Version 13_Scope01_14 December 2007)

[3] Cf. AMS-III.H, Table III.H.1

B.6.3 Ex-ante calculation of emission reductions:

>>

Component 1

A. Ex-ante formulae related to the baseline:

$$BE_y = Q_{ww,y} \times COD_{removed,y} \times MCF_{ww,treatment,BL} \times B_{o,ww} \times UF_{bl} \times GWP\_CH4$$ **Equation 8**

Cf. § B.4for more details

B. Ex-ante formulae related to the project activity direct emissions:

$$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE$$

Equation 16

Where:

- PE_y = Project activity emissions in the year "y" (tCO_2e)
- $PE_{power,y}$ = Emissions from electricity or diesel consumption in the year "y"
- $PE_{ww,treatment,y}$= Methane emissions from wastewater treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (tCO_2e).
- $PE_{s,treatment,y}$ = Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year *y* (tCO_2e).
- $PE_{y,ww,discharge}$ = Methane emissions from degradable organic carbon in treated wastewater in year *y* (tCO_2e).
- $PE_{s,final,y}$ = Methane emissions from anaerobic decay of the final sludge produced in year y (tCO_2e).
- $PE_{fugitive,y}$ = Methane emissions from biogas release in capture systems in year y, calculated as per paragraph 26 (tCO_2e)
- $PE_{flaring,y}$ = Methane emissions due to incomplete flaring in year y as per the "Tool to determine project emissions from flaring gases containing methane"(tCO_2e)
- $PE_{biomass,y}$= Methane emissions from biomass stored under anaerobic conditions.

Taken into consideration the project characteristics (§B.3):

- **$PE_{power,y}$ = 0 Equation 17**

The consumption of electricity is the same in the project activity and in the baseline. The electricity generation is treated in the bundled PDD "RAMSA - Grid connected renewable electricity generation from biogas recovered at RAMSA's M'zar Wastewater treatment plan, Morocco".
Therefore this term is negligible.

- **$PE_{ww,treatment,y}$= 0 Equation 18**

These emissions shall be calculated as per formula 2 in paragraph 20, using an uncertainty factor of 1.06 and data applicable to the project situation ($MCF_{ww,treatment,PJ,k}$ and $COD_{removed,PJ,k,y}$) and with the following changed definition of parameters:
$MCF_{ww,treatment,PJ,k}$ Methane correction factor for project wastewater treatment

system *k* (MCF values as per table III.H.1.)
$COD_{,removed,PJ,k,y}$ Chemical oxygen demand removed by project wastewater treatment system k in year *y* (tonnes/m3), measured as the difference between inflow COD and the outflow COD in system *k*

$$PE_{ww,treatment,y} = \sum_k \left(Q_{ww,k,y} \times COD_{removed,k,PJ,y} \times MCF_{ww,treatment,PJ,k} \times B_{o,ww} \times UF_{PJ} \times GWP\_CH4\right)$$

Equation 19

Where:

- $Q_{y,k,ww}$ = Volume of wastewater treated in baseline wastewater treatment k in the year y (m^3)
- $COD_{removed,k,PJ,y}$ = Chemical oxygen demand removed by project activity treatment system k in year y measured as the difference between inflow COD and the outflow COD in system k (tonnes/m^3). This parameters is equal that in the baseline as the same lagoons are used under similar conditions (cf. §B.3)
- $MCF_{ww,treatment,PJ,k}$ = Methane correction factor for project activity wastewater treatment system k (MCF values as per table III.H.1, equal that in the baseline as the same lagoons are used)
- k = Index for project activity wastewater system
- $B_{o,ww}$ = Methane producing capacity of the wastewater (IPCC lower value for domestic wastewater of 0.21 kgCH_4/kg COD)
- UF_{PJ} = Model correction factor to account for model uncertainties (1.06)

Geomembranes will be installed in three steps: 3 lagoons the 1st year, 3 more the 2nd year and the remaining 3 the 3rd year.
Thus, for the 1st year:

$$PE_{ww,treatment,y} = Q_{ww,y} \times COD_{removed,y} \times MCF_{ww,treatment,PJ} \times B_{o,ww} \times UF_{PJ} \times GWP\_CH4 \times 66\%$$

Equation 20

For the 2nd year:

$$PE_{ww,treatment,y} = Q_{ww,y} \times COD_{removed,y} \times MCF_{ww,treatment,PJ} \times B_{o,ww} \times UF_{PJ} \times GWP\_CH4 \times 33\%$$

Equation 21
For the remaining years:

$$PE_{ww,treatment,y} = 0$$ **Equation 22**

- $PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$ **Equation 23**

Where:

- **$PE_{fugitive,ww,y}$** = Fugitive emissions through capture and flare inefficiencies in the anaerobic wastewater treatment in the year “y”
- **$PE_{fugitive,s,y}$** = Fugitive emissions through capture and flare inefficiencies in the anaerobic sludge treatment in the year “y”. The characteristics of sludge are the same in the project activity and in the baseline. Therefore this term is negligible.

$PE_{fugitive,s,y} = 0$ **Equation 24**

And:

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) \times MEP_{y,ww,treatment} \times GWH\_CH4$$ **Equation 25**

Where:

- CFE_{ww} = Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (a default value of 0.9 shall be used)
- $MEP_{y,ww,treatment}$ = Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year "y" (tonnes)

$$MEP_{y,ww,treatment} = Q_{y,ww} \times B_{o,ww} \times UF_{PJ} \times \sum_{j} COD_{y,removed,PJ,j} \times MCF_{ww,treatment,PJ,j}$$ **Equation 26**

- **$PE_{s,treatment,y}$ = $PE_{s,final,y}$ = 0 Equation 27**

The characteristics of sludge are the same in the project activity and in the baseline where the sludge is used for soil application.
Therefore this term is negligible.

- **$PE_{y,discharge}$= 0 Equation 28**

The characteristics of the treated wastewater (after the anaerobic lagoons) discharged in the sea are the same in the project activity and in the baseline.

- **$PE_{biomass,y}$ = 0 Equation 29**

This component is not relevant for this project activity

- $$PE_{flaring,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP\_CH4}{1000}$$ **Equation 30**

Where:

- $TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour h (kg/h)
- $\eta_{flare,h}$ = Flare efficiency in hour h

This component is calculated using the "Tool to determine project emissions from flaring gases containing methane".
The expected system of flaring is an open flare. The methane desctruction efficiency is approached with default values:
• 0% if the flame is not detected for more than 20 minutes during the hour *h*.
• 50%, if the flare is detected for more than 20 minutes during the hour *h*.

The following paragraphs explain the calculation that lead to the previous equation.

STEP 1. Determination of the mass flow rate of the residual gas that is flared
The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h}$$ **Equation 31**

Where:

Variable	SI Unit	Description
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour *h*
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the

		hour *h*

and:

$$\rho_{RG,n,h} = \frac{p_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$$ **Equation 32**

Where:

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour *h*
p_n	Pa	Atmospheric pressure at normal conditions (101 325)
R_u	$Pa.m^3/kmol.K$	Universal ideal gas constant (8.314)
$MM_{RG,h}$	Kg/kmol	Molecular mass of the residual gas in hour *h*
Tn	K	Temperature at normal conditions (273.15)

and:

$$MM_{RG,h} = \sum_i \left(fv_{i,h} \times MM_i \right)$$ **Equation 33**

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	Kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
MM_i	kg/kmol	Molecular mass of residual gas component *i*
I		The components CH4, CO, CO2, O2,H2, N2

As a simplified approach, we will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

The mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, are determined as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \times AM_j \times NA_{j,i}}{MM_{RG,h}}$$ **Equation 34**

Where:

Variable	SI Unit	Description
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in hour *h*
$fv_{i,h}$	-	Volumetric fraction of component *i* in the residual gas in the hour *h*
AM_j	kg/kmol	Atomic mass of element *j*
$NA_{j,i}$	-	Number of atoms of element *j* in component *i*
$MM_{RG,h}$	Kg/kmol	Molecular mass of the residual gas in hour *h*
MM_i	kg/kmol	Molecular mass of residual gas component *i*
j		The elements carbon, hydrogen, oxygen and nitrogen

i		The components CH_4, CO, CO_2, O_2,H_2, N_2

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).
It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60ºC), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$$TM_{RG,h} = FV_{CH4,RG,h} \times fv_{RG,h} \times \rho_{CH4,n} \quad \textbf{Equation 35}$$

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to fvi,RG,h where *i* refers to methane).
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

STEP 6. Determination of the hourly flare efficiency

The determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature), the type of flare used (open or enclosed) and, in case of enclosed flares, the approach selected by project participants to determine the flare efficiency (default value or continuous monitoring).

The expected system of flaring is an open flare, the flare efficiency in the hour *h* ($\eta_{flare,h}$) is:
• 0% if the flame is not detected for more than 20 minutes during the hour *h*.
• 50%, if the flare is detected for more than 20 minutes during the hour *h*.

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour *h*, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as follows:

$$PE_{flaring,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP\_CH4}{1000}$$

Where:

Variable	SI Unit	Description
$PE_{flare,y}$	tCO_2e	Project emissions from flaring of the residual gas stream in year *y*
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$	-	Flare efficiency in hour *h*
GWP_CH4	tCO_2e/tCH_4	Global Warming Potential of methane valid for the commitment period

Hence, for the 1st year:

$$PE_y = (1 - CFE_{ww} + 66\%) \times MEP_{y,ww,treatment} \times GWH\_CH4 + \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP\_CH4}{1000}$$

Equation 36

For the 2nd year:

$$PE_y = (1 - CFE_{ww} + 33\%) \times MEP_{y,ww,treatment} \times GWH\_CH4 + \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP\_CH4}{1000}$$

Equation 37

For the remaining years:

$$PE_y = (1 - CFE_{ww}) \times MEP_{y,ww,treatment} \times GWH\_CH4 + \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP\_CH4}{1000}$$

Equation 38

Leakage

The used technology is not equipment transferred from another activity and the existing equipment is not transferred to another activity. Thus, leakage effects at the site of the other activity are not to be considered and estimated.

$LE_y = 0$ **Equation 39**

Component 2

For the detail of the ex-ante calculation of emission reductions, see § B.4.

For the project activity, the emissions related to the project operations are zero as the electricity is generated from a renewable source. The emission reductions of the M'zar Wastewater treatment plant project are therefore equal to the baseline emissions.

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

>>

Years	Project activity emissions (tCO2e)	Baseline emissions (tCO2e)	Leakage (tCO2e)	Overall emission reductions (tCO2e)	Cumulated emission reductions (tCO2e)
2009	33 279	40 487	0	7 208	7 208
2010	20 148	45 185	0	25 037	32 246
2011	4 739	49 209	0	44 470	76 716
2012	4 905	50 933	0	46 028	122 743
2013	5 077	52 717	0	47 640	170 383
2014	5 255	54 564	0	49 309	219 692
2015	5 439	56 475	0	51 036	270 728

Average per year (tCO2e)	38 675

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Component 1

Data / Parameter:	Q_{fuel}
Data unit:	m^3/year
Description:	Volume of biogas sent to generating sets
Source of data to be used:	Gas flow meter
Value of data	
Description of measurement methods and procedures to be applied:	This figure will be monitored by a continuous gas flow meter installed on-site. Data will be recorded daily.
QA/QC procedures to be applied:	Meter calibration is to be conducted once per annum
Any comment:	

Data / Parameter:	$\%_{CH4}$
Data unit:	%
Description:	Methane content of the biogas
Source of data to be used:	Gas analyzer
Value of data	
Description of measurement methods and procedures to be applied:	The methane content of the combusted gas will be analyzed with quarterly samples by a portable gas analyzer.
QA/QC procedures to be applied:	In the event that the methane content of the quarterly samples varies significantly, monthly samples will be taken.
Any comment:	

Data / Parameter:	T_{biogas}
Data unit:	°C
Description:	Temperature of the captured biogas
Source of data to be used:	Gas analyzer
Value of data	
Description of measurement methods and procedures to be applied:	The temperature of the captured biogas will be analyzed with quarterly samples by the gas analyzer.
QA/QC procedures to be applied:	In the event that the methane content of the quarterly samples varies significantly, monthly samples will be taken.
Any comment:	

Data / Parameter:	p_{biogas}
Data unit:	Atm
Description:	Pressure of the captured biogas
Source of data to be used:	Gas analyzer
Value of data	
Description of measurement methods and procedures to be applied:	The pressure of the captured biogas will be analyzed with quarterly samples by the gas analyzer.
QA/QC procedures to be applied:	In the event that the methane content of the quarterly samples varies significantly, monthly samples will be taken.
Any comment:	

In the event that there is more biogas produced than what power generation requires or in any emergency, the Project has a provision for an optional flare installation.

Data / Parameter:	$fv_{i,h}$
Data unit:	-
Description:	Volumetric fraction of component *i* in the residual gas in the hour *h* where *i* = CH4, CO, CO2, O2,H2, N2
Source of data:	Measurements by project participants using a continuous gas analyser
Measurement procedures:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60 ºC
Monitoring frequency:	Continuously. Values to be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N2.

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data:	Measurements by project participants using a flow meter
Measurement procedures:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of volumetric fraction of all components in the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 ºC
Monitoring frequency:	Continuously. Values to be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	T_{flare} Data unit:
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare
Source of data:	Measurements by project participants
Measurement procedures:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating
Monitoring frequency:	Continuously.

QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter:	$\eta_{flare,h}$
Data unit:	%
Description:	The fraction of methane destroyed in the hour h. The flare efficiency is defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process.
Source of data to be used:	Default value
Value of data	0% or 50%
Description of measurement methods and procedures to be applied:	Continuous check of compliance with the manufacturer's specification of the flare device (temperature, biogas flow rate) will be done. • 0% if the flame is not detected for more than 20 minutes during the hour *h.* • 50%, if the flare is detected for more than 20 minutes during the hour
QA/QC procedures to be applied:	Maintenance of the flare is to be conducted once a year to ensure optimal operation.
Any comment:	

Data / Parameter:	Q_{flare}
Data unit:	m^3/year
Description:	Volume of biogas sent to the flare
Source of data to be used:	Gas flow meter
Value of data	
Description of measurement methods and procedures to be applied:	This figure will be monitored by a continuous gas flow meter installed on-site. Data will be recorded daily.
QA/QC procedures to be applied:	Meter calibration is to be conducted once per annum
Any comment:	

Data / Parameter:	T_{flare}
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	Measurements by project participants
Measurement procedures:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burnt and that the flare is operating.

Monitoring frequency	Continuously.
QA/QC procedures to be applied:	Thermocouples should be replaced or calibrated every year.
Any comment:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Component 2

Data / Parameter:	$E_{delivered}$
Data unit:	GWh/year
Description:	Produced electricity delivered to the grid
Source of data to be used:	RAMSA
Value of data	8,000
Description of measurement methods and procedures to be applied:	Electricity meter
QA/QC procedures to be applied:	The electricity meter will go under maintenance/calibration subject to appropriate industry standards. Double check with the receipt of sales will be made.
Any comment:	

Data / Parameter:	**EF**
Data unit:	tCO_2/MWh
Description:	Emission factor of the Moroccan grid
Source of data to be used:	Weighted sum of OM and BM emission factors. Provided by the national utility (ONE)
Value of data	0.743
Description of measurement methods and procedures to be applied:	Cf. Annex 3
QA/QC procedures to be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

>>

A monitoring team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the monitoring plan and monitoring protocol.

An operator of the system and power plant facility will be trained on equipment operation, data recording, reporting, operation, maintenance and emergency procedures. He will be in charge of checking for leaks and of the logging of data. A CDM project manager will consolidate all of the data monthly to be inputted in a monitoring workbook. RAMSA will keep electronic copies and paper copies for back-up purposes. The records are to be kept for 2 years longer than the crediting period.

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

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Date of completing the final draft of this baseline and monitoring methodology section: December 18, 2008 by Alexis Gazzo, alexis.gazzo@fr.ey.com.

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:

>>

01/01/2009

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

>>

21 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:

>>

01/01/2009

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

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C.2.2.2. Length:

>>

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SECTION D. Environmental impacts

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D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

In relation to the baseline scenario no negative environmental impacts will arise as a result of the project activity.

Component 1

The project will capture the methane that is currently emitted in the atmosphere. Its impact on the environment is positive. Namely the project activity will help:

- Eliminate the emissions of a high global warming gas (methane) ;
- Mitigate of the current bad odors resulting from the biogas emissions.

Component 2

The implementation of the project activity will allow the use of the methane captured in the waste water treatment plant and electricity generation from a renewable source. The project activity will offset the use of national grid electricity that would have been produced primarily from fossil fuel combustion. Thus, the project activity will have a positive impact on the environment.

The negative impacts of the methane combustion on the environment are considered insignificant.

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:

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Impacts are not considered significant.

SECTION E. Stakeholders' comments

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

>>

A consultation workshop on the project activity was held on October 30th, 2008 with concerned stakeholders including local public authorities and ministerial departments, experts, local environmental and development associations, university professors, government officials, RAMSA technical staff, etc. The objective of the workshop was to inform the concerned stakeholders on the project activities and to gather and discuss their comments and recommendations.

Official invitations were sent by fax and a follow up was done by phone by RAMSA. Overall more than forty participants attended the workshop, including:

- A representative of the DNA (Ms Ouafae Bouchouata)

- The Director General of RAMSA and some of his technical staff and assistants (M. FOUTOUHI Mohamed)
- Representative of the local associations: Life Sciences and Earth Association,
- Representative of Afoulki Lkhir Association
- Representatives of the following institutions:
    - Wilaya of Agadir
    - Inezgane Ait Melloul Prefecture
    - Faculty of Life Sciences of Agadir
    - National Office of Drinking Water (ONEP)
    - Basin Water Agency of Souss Massa
    - Water and Forest Office
    - Various departments of the Ministry of Interior

During the workshop, presentations were held on the context of the project (National Plan for Wastewater Treatment; Renewable sources and use of biogas in Morocco; CDM activities in Morocco), its planned activities and associated CDM development process.

E.2. Summary of the comments received:

>>

All workshop participants enthusiastically contributed to the discussions on the project activity and raised various queries which were appropriately answered to.

Most of the questions asked were about the CDM process and development in general and the CDM development for project itself.

Representatives of ONEP and the Basin Water Agency of Souss Massa were both very enthusiastic about the project activity and congratulated RAMSA for implementing this project.

The representative of the Water and Forest Office suggested that the revenues from this CDM project should also benefit to the site and infrastructure improvement.

The representative of a local association asked about the possibility of CDM development for the community development activities that they are currently implementing in Agadir.

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

>>

The RAMSA director thanked all the participants for their interest in the project and the support they've shown to the RAMSA. The Director recalled the contribution of RAMSA in the development of the site by investing on a medium voltage line for the electrification of the area. He also recalled the close cooperation with the Faculty of Sciences of Agadir, since the creation of the wastewater treatment plant, by providing equipment and subsidizing environmental studies on the Oued Souss estuary.

The CDM expert present at the workshop gave additional information on the CDM development and information on how the CDM programmatic approach could provide a good opportunity for local development associations active in small scale community development activities.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	RAMSA
Street/P.O.Box:	Rue du 18 novembre, BP 754
Building:	
City:	Agadir
State/Region:	Souss Massa Draa Province
Postfix/ZIP:	Q.I., 80 000
Country:	Morocco
Telephone:	028 22 30 30
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E-Mail:	Regie_ramsa@menara.ma
URL:	
Represented by:	Mohamed Foutouhi
Title:	Director
Salutation:	
Last Name:	Foutouhi
Middle Name:	
First Name:	Mohamed
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	m_foutouhi@yahoo.fr

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for this project.

ANNEX 3

BASELINE INFORMATION
Component 1

Moyenne	1517,9
Ecart type	763,7

Date	période	Débit moyen temporaire l/s	débit moyen en m3/h
20/09/2007	10h	3272	3272
20/05/2006	16:00-17:00	895	3222
18/05/2006	13:00-14:00	893	3214,8
19/05/2006	22:00-23:00	887	3193,2
20/05/2006	14:00-15:00	881	3171,6
19/05/2006	13:00-14:00	868	3124,8
20/05/2006	12:00-13:00	866	3117,6
18/05/2006	14:00-15:00	856	3081,6
20/05/2006	11:00-12:00	855	3078
19/05/2006	21:00-22:00	851	3063,6
21/05/2006	12:00-13:00	851	3063,6
10/12/2005	15Hà16h	842	3031,2
18/05/2006	12:00-13:00	827	2977,2
20/05/2006	13:00-14:00	822	2959,2
20/05/2006	17:0018:00	819	2948,4
19/05/2006	14:00-15:00	813	2926,8
21/05/2006	14:00-15:00	813	2926,8
19/05/2006	12:00-13:00	812	2923,2
21/05/2006	15:00-16:00	797	2869,2
18/05/2006	23:00-24:00	790	2844
19/05/2006	15:00-16:00	788	2836,8
18/05/2006	00:00-01:00	785	2826
10/12/2005	17hà18h	783	2818,8
18/05/2006	17:0018:00	782	2815,2

Extract of the wastewater flow entering average calculation

EAUX BRUTES

PARAMETRES	unités	27/07/2007	10/08/2007	24/08/2007	03/09/2007	20/09/2007
T°C	°C		28	27	26	28.6
pH		7,55	7,11	7	7.11	7.04
Conductivité	µs/cm	2910	340	5520	5600	4240
Turbidité	NTU		4090	450	680	410
MES	mg/l	640	780	801	1030	1410
DCO	mg d'O2/l	833	915	1020	1105	1340
DBO_5	mg d'O2/l	850	851	790	949	1059
NTK	mg d' N/l	84	144	171	160.8	166
Ammonium	mg/l	81	73	71	72	90
Nitrites	mg/l	0	0	0.05	0.06	0.00
Nitrates	mg/l	0	0	0.45	0.98	0.14
Orthophosphates	mg/l	16,5	15,6	20,8	19	17.4
Phosphore total	mg/l	25	21,5	28.6	22,5	26.9
Bicarbonates	mg/l	502,8	571.20	510	576.0	780
Calcium	mg/l	113,4	79,04	185	680.8	107
Magnesium	mg/l	54,8	42,45	42	50.7	53,6
Sodium	mg/l		670	657,8	120	524,4
Potassium	mg/l		55.1	53,7	67	49,14
Sulfates	mg/l	232	206	185	104,9	225
Chlorures	mg/l	504	715,6	945	1080.00	864

Moyenne	1708,9
Ecart type	604,6

Extract of the COD in average calculation

EAUX DECANTEES

PARAMETRES	unités	27/07/2007	10/08/2007	24/08/2007	03/09/2007
T°C	°C		28.5	27	26
pH		7,38	7,31	7,25	7.42
Conductivité	µs/cm	2520	3840	4770	4570
Turbidité	NTU		221	230	296
MES	mg/l	420	380	480	560
DCO	mg d'O2/l	685	458	580	528
DBO_5	mg d'O2/l	434	174	416	129
NTK	mg de N/l	142,8	116	165	162.4
Ammonium	mg/l	94	89	77	78
Nitrites	mg/l	0	0	0,02	0.032
Nitrates	mg/l	0	0	0,51	1.02
Orthophosphates	mg/l	18	15,1	19,1	22,2
Phosphore total	mg/l	27	21	26,9	25,6
Bicarbonates	mg/l	540	618.80	598	672.40
Calcium	mg/l	115,7	108	193,75	588.8
Magnesium	mg/l	56,5	48,02	45	53.8
Sodium	mg/l		596	586	161
Potassium	mg/l		59	49,2	59
Sulfates	mg/l	232	64,4	93,6	95
Chlorures	mg/l	792	706	765	864.00

Moyenne	784
Ecart type	125

Extract of the COD out average calculation

Component 2

1. OPERATING MARGIN

Power stations	Fuel	Production (MWh/year)			Fuel consumption (tons)			Fuel		
		2001	2002	2003	2001	2002	2003	VCN *a)*	FECC1 *b)*	FECC2 *c)*
Jerada	Coal	636 455	708 176	880 094	340 994	358 494	436 821	-	-	-
Mohammedia	Coal	1 372 383	1 423 242	1 495 510	556 849	588 932	630 277	-	-	-
Jorf Lasfar	Coal	9 041 585	9 386 881	9 375 155	3 272 748	3 370 411	3 272 748	-	-	-
Jerada	Oil	-	-	-	3 199	2 772	1 397	40,19	20,00	73,33
Mohammedia TG	Oil	621 556	904 111	1 070 937	161 799	237 513	275 364	40,19	20,00	73,33
Kenitra	Oil	361 996	521 920	753 133	105 255	151 725	221 052	40,19	20,00	73,33
Tantan	Oil	9 145	12 100	15 202	3 258	4 238	5 510	40,19	20,00	73,33
Tit Mellil	Oil	27 723	39 593	29 454	9 411	13 440	9 709	40,19	20,00	73,33
Tetouan	Oil	11 587	21 931	22 233	4 000	7 062	7 554	40,19	20,00	73,33
Agadir	Oil	627	409	983	245	168	444	40,19	20,00	73,33
Tanger	Oil	2 315	83	527	434	23	228	40,19	20,00	73,33
Laayoune	Oil	20 679	8 907	6 039	3 960	1 529	1 061	40,19	20,00	73,33
Dakhla	Oil	-	25 846	30 373	-	3 513	6 952	40,19	20,00	73,33
Distribution factories	Diesel	35 102	40 233	46 376	9 025	6 755	4 373	43,33	20,20	74,07
Mohammedia TG	Diesel	-	26	66	120	129	108	43,33	20,20	74,07
Tan Tan	Diesel	-	-	-	75	126	163	43,33	20,20	74,07
Tit Mellil	Diesel	-	-	-	193	224	269	43,33	20,20	74,07
Tetouan	Diesel	-	-	-	175	147	95	43,33	20,20	74,07
Agadir	Diesel	-	-	-	7	22	14	43,33	20,20	74,07
Tanger	Diesel	-	-	-	55	15	25	43,33	20,20	74,07
Laayoune	Diesel	-	-	-	742	576	377	43,33	20,20	74,07
Import	-	1 698 568	1 533 380	1 582 047	-	-	-	-	-	-
TOTAL	-	**13 839 721**	**14 626 838**	**15 308 129**						

a) Fuel Net Calorific value in TJ/kT (IPCC 1996)

b) Fuel Carbone Emission Factor in tC/TJ (IPCC 1996)
c) Fuel Carbone Emission Factor in tCO2/TJ (IPCC 1996), FECC2 = FECC1 x 44 / 12

Power stations	Emissions of CO2 (tons)			CEF (ton CO2 / MWh)			WCEF *d)* (en t CO2 / MWh)		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
Jerada	-	-	-	1,123	1,123	1,123	0,052	0,054	0,065
Mohammedia	-	-	-	0,938	0,938	0,938	0,093	0,091	0,092
Jorf Lasfar	-	-	-	0,788	0,788	0,788	0,515	0,506	0,483
Jerada	-	-	-	-	-	-	-	-	-
Mohammedia TG	476 865	700 014	811 571	0,767	0,774	0,758	0,034	0,048	0,053
Kenitra	310 215	447 174	651 499	0,857	0,857	0,865	0,022	0,031	0,043
Tantan	9 602	12 491	16 239	1,050	1,032	1,068	0,001	0,001	0,001
Tit Mellil	27 737	39 611	28 615	1,000	1,000	0,972	0,002	0,003	0,002
Tetouan	11 789	20 814	22 264	1,017	0,949	1,001	0,001	0,001	0,001
Agadir	722	495	1 309	1,152	1,211	1,331	0,000	0,000	0,000
Tanger	1 279	68	672	0,553	0,817	1,275	0,000	0,000	0,000
Laayoune	11 730	4 506	3 127	0,567	0,506	0,518	0,001	0,000	0,000
Ed Dakhla	-	10 354	20 489	-	0,401	0,675	-	0,001	0,001
Distribution factories	28 964	21 679	14 034	0,825	0,539	0,303	0,002	0,001	0,001
Mohammedia TG	-	414	347	-	15,923	5,252	-	0,000	0,000
Tan Tan	-	-	-	-	-	-	-	-	-
Tit Mellil	-	-	-	-	-	-	-	-	-
Tetouan	-	-	-	-	-	-	-	-	-
Agadir	-	-	-	-	-	-	-	-	-
Tanger	-	-	-	-	-	-	-	-	-
Laayoune	-	-	-	-	-	-	-	-	-
Import	-	-	-	0,000	0,000	0,000	0,000	0,000	0,000
TOTAL							**0,723**	**0,737**	**0,741**

Average :	**0,734**

d) Carbon Emission Factor of the power station weighted by production.

2. BUILD MARGIN

Power station	Operating date	Capacity MW	Added capacity MW	Added capacity %
AHMED EL HANSALI	2003	92,0	92,0	2,4
AIT MESSAOUD	2003	6,4	98,4	2,6
DAKHLA	2002	21,0	119,4	3,1
ABDELKHALEK TORRES	2000	54,0	173,4	4,5
JORF LASFAR	2000	660,0	833,4	21,8
AL WAHDA	1998	240,0	1073,4	28,0
TETOUAN 33	1995	99,0	1172,4	30,6
TIT MELLIL	1994	198,0	1370,4	35,8
ALLAL EL FASSI	1994	240,0	1610,4	42,1
SEFROU	1994	0,6	1611,0	42,1
MOHAMMEDIA GAZ	1992	99,0	1710,0	44,7
TAN TAN	1992	99,0	1809,0	47,3
HASSAN 1ER	1991	67,0	1876,0	49,0
LAAYOUNE DIESEL	1989	21,0	1897,0	49,6
MOHAMMEDIA CHARBON	1986	600,0	2497,0	65,2
LALLA TAKERKOUST	1985	12,0	2509,0	65,6
AL MASSIRA	1980	128,0	2637,0	68,9
KENITRA	1979	300,0	2937,0	76,7
OUED EL MAKHAZINE	1979	36,0	2973,0	77,7
IDRISS 1ER	1978	40,6	3013,6	78,7
AGADIR	1977	40,0	3053,6	79,8
TANGER	1977	40,0	3093,6	80,8
TETOUAN	1977	40,0	3133,6	81,9
CASABLANCA	1975	120,0	3253,6	85,0
MOULAY YOUSSEF	1974	24,0	3277,6	85,6
MANSOUR ED DAHBI	1973	10,0	3287,6	85,9
JERADA	1972	165,0	3452,6	90,2
BOU AREG	1969	6,4	3459,0	90,4

EL KANSERA	1967	14,4	3473,4	90,8
MOHAMMED EL KHAMIS	1967	23,2	3496,6	91,4
TANGER DIESEL	1958	6,4	3503,0	91,5
AFOURER	1955	93,6	3596,6	94,0
BINE EL OUIDANE	1954	135,0	3731,6	97,5
TAURART	1951	2,0	3733,6	97,6
DAOURAT	1950	17,0	3750,6	98,0
IMFOUT	1949	31,2	3781,8	98,8
LAU	1942	14,1	3795,9	99,2
KASBA ZIDANIA	1936	7,1	3803,0	99,4
FES AVAL	1934	2,0	3805,0	99,4
SIDI SAID MAACHOU	1929	20,8	3825,8	100,0
TAZA	1929	0,6	3826,4	100,0
MEKNES	1925	0,6	3827,0	100,0

Most recent 5 power stations or 20% capacity

Power station	Fuel	Production MWh 2003	CEF	WCEF
			(en t CO2 / MWh)	
AHMED EL HANSALI	HYDRO	224 010	0,000	0,000
AIT MESSAOUD	HYDRO	18 000	0,000	0,000
DAKHLA	DIESEL	30 373	0,675	0,002
ABDELKHALEK TORRES	EOLIEN	202 752	0,000	0,000
JORF LASFAR	CHARBON	9 375 155	0,788	0,750
Total		**9 850 290**		**0,752**

Annex 4

MONITORING INFORMATION

1. Data collection frequency, data storage and quality control

Data source	**Frequency of reading**	**Form of Data storage**	**Comments**
Flow Meter for biogas sent to the generating sets and flow meter for biogas flared	Continuously electronically on the meter Daily on Paper Monthly report	Electronically inside the meter On paper in the plant operation journal On paper in the monthly report	Flow meter Vortex type. This type of flow meter does not have any moving parts and is resistant against aggressive gases. Information on the calibration by the manufacturer is documented. The accuracy is provided by calculations of the manufacturer, taking into account the range of gas-volume. All documents are available for the validator/verifier.
Methane fraction in biogas	Continuously electronic on the meter Daily on Paper Monthly report	Electronically inside the meter in regular intervals. Data continuously transmitted to panel PC On paper in the plant operation journal On paper in the monthly report	The manufacturer states the accuracy of the methane analyzer. The methane analyzer is subject to regular calibration as prescribed by the manufacturer. The accuracy must be higher than 95% as required by the methodology.
Temperature of the biogas	Continuously Daily on Paper Monthly report	Data transmitted to panel PC On paper in the plant operation journal On paper in the monthly report	Standard device for electronic reading. Documentation by the manufacturer will be available for the validator/verifier. Value used for prove of flare efficiency.
Pressure of the biogas	Continuously Daily on Paper Monthly report	Data transmitted to panel PC On paper in the plant operation journal On paper in the monthly report	Standard device for electronic reading. Documentation by the manufacturer will be available for the validator/verifier.
Electricity delivered to the grid	Continuously Daily on Paper Monthly report	Data transmitted to panel PC On paper in the plant operation journal On paper in the monthly report	Standard device for electronic reading. Documentation by the manufacturer will be available for the validator/verifier.

2. **Procedure for data storage**

First level: Data storage on meters

Equipments	Data storage
Flow meters	Electronic counter built in the flow meters (for generating sets and for the flare). During any change of the meter, a protocol will be immediately issued for the verifier.
Methane analyzer	An internal electronic storage for the data of the last year of operation.
Flare operation	The operation hours of the flare will be counted by an operation hour counter, alternatively the regular automatic recording will give a very safe indication about the flare performance by regular recording of the flare operation temperature.
Electricity meters	The metered data is supported by values from official invoices.

Second level: Data recording on the plant operation journal

The operator's personnel will record the following data in the plant operation journal:

- ► Time and date
- ► Name of person that conducts the data audit
- ► Counter of flow meter (biogas to the flare)
- ► Actual % of methane in the biogas
- ► Actual temperature of the biogas
- ► Actual pressure of the biogas
- ► Flare working status, temperature
- ► Any calibration or service works on the metering devices

The data in the plant operation journal will be audited once a month by the operator management. Regular cross checks with the data on the meters and the data electronically stored serve as a tool for controlling the accuracy.
The operator management will issue a protocol each month and remove the operation journal from the plant to the office of the operator.
The monthly protocol will be photocopied and the copy placed in the plant while the original will stay at the office of the operator.
The copies of the monthly protocol will stay at the plant until the end of operation.

Third level: Data distance reading and electronically storage (if technically available)

A PC will compute the norm m^3 for methane out of the volume of biogas, the pressure, temperature and percentage of methane content in the biogas.
The data security of the server is very high due to professional operation and regular data backup.
However the data security of the build-in meters or the plant journal is higher.

Prior to annual verification the online storage data has to be cross checked with the data recorded in the plant operations journal. In case of differences the data in the plant journal and on the meters has priority.

3. Procedures in case of loss of data:

Failure of the flow meters:

It is possible to reconstruct the data of the flow meters. Any failure of the meters will be recorded immediately after discovery in the plant operation journal.
The electricity meter is subject to independent control by the ONE. It is possible to assume that the utility will use a very conservative approach to calculate the amount of power delivered to the grid.
The regular billing sheets are therefore always the resource for valid data.

Failure of the methane analyzer:

As the average methane content of the biogas will change only very slowly due to changing seasons or the reduced biologic activity of the waste, it is possible to estimate with high accuracy that the methane concentration in the biogas would be the same average value as in the previous week before the failure.
Any failure of the methane analyzer will be recorded immediately after discovery in the plant operation journal and a replacement ordered as soon as technically possible.
During the time of malfunction the methane content of the biogas will be measured once a day by a mobile device and recorded in the plant journal.
During time of calibration, the last measured value will be used for ongoing calculations of methane concentration during the time of calibration.

Failure of pressure or temperature indicators:

The failure of these devices is immediately visible at least when a new shift will check the meter data.
As a biogas extraction plant will work under similar conditions for long periods of time, the average data of the last week before failure can be used without compromising conservativeness of the measurement.
In case a methane meter, temperature meter or pressure meter will fail, it is possible to use the average value of the previous week before the meter failure for electronic calculation of the methane mass until the meter has been replaced. Any meter malfunction has to be recorded as well as how the data were reconstructed.

Failure of the flare:

Any failure of the flare to regularly ignite the biogas will cause an automatic shutdown of the blower. This security feature is built in by the producer of the flare and will not be altered. It is therefore impossible to emit biogas through the flare without combustion.
Any failure of the flare system will be recorded immediately after discovery in the plant operation journal.
The continuously recording of the flare temperature will exactly indicate the working conditions of the flare.

Failure of the PLC:

The data recorded by hand on paper will be used to calculate for a limited time the mass of methane. Any failure of panel PC will be recorded immediately after discovery in the plant operation journal.

4. Documentation on the accuracy of monitored data:

Equipments	Accuracy
Flow meters	Diagram of accuracy by the manufacturer Regulation of the manufacturer for service and range of the calibration
Effectiveness of the flare	Statement of efficiency by the manufacturer Automatic protocol of operations by regular measurement of the temperature. The verifier is free to ask for a methane concentration measurement in it's presence during verification
Methane analyzer	Statement of accuracy by the manufacturer Regulation of the manufacturer for service and range of the calibration
Temperature and pressure sensors	Diagram of accuracy by the manufacturer Regulation of the manufacturer for service and range of the calibration

5. Comment on difficulties related to the methodology

Concerning accuracy of the methane analyzer:
The methodology asks for an accuracy of the methane analyzer of at least 95%. The authors of the monitoring plan assume that in case the manufacturer states a higher accuracy than 95% and regular calibration is performed according to the requirements of the manufacturer that the resulting data of the gas analyzer can be taken fully into account for the calculation of the methane concentration of the biogas. Therefore any deductions for conservativeness of the data of the gas analyzer are not necessary as the methodology's requirements for accuracy are fulfilled.

Technical explanation:
Due to limited accuracy of the pumps within the gas analyzer a technically given inaccuracy will take place in all currently available types of suitable gas analyzers for biogas. Further it is necessary to state that it is very difficult to get gases for calibrations that have a 100% purity. Better results are only possible under laboratory conditions using mass-spectrometers and special calibration gases for laboratory usage. Regular tests with this technology would cause high costs that would not be justified by the limited gain of accuracy.

Annex 5

ADDITIONNALITY: FINANCIAL ANALYSIS

General assumptions		
Electricity price	€/MWh	86
CER price	€/teCO2	15
Corporate income tax	%	30%
Cost for insurance	% of total investments	1%
Discount rate	%	8%
Interest rate	%	5,50%
Loan duration	year	10

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Assumptions										
Electriticy generated (MWh)	2 908	6 162	9 664	10 002	10 353	10 715	11 091	11 452	11 824	12 095
Electricity price (€/MWh)	86	86	86	86	86	86	86	86	86	86
CER generation (tCO2e)	7 208	25 037	44 470	46 028	47 640	49 309	51 036			
CER price (€/tCO2e)	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €	15,00 €
Maintenance and operating costs (k€)										
Geomembranes	0,5%	of corresponding investments								
Flaring	1,5%	of corresponding investments								
Desulfuring equipments	0,06	c€/kWhel produced								
Gazometer	1,5%	of corresponding investments								
Combustion/Generation engines	1,5	c€/kWhel produced								
TOTAL MAINTENANCE AND OPERATING COSTS (k€)	55	109	168	173	178	184	190	195	201	206
Investment (k€)										
Geomembranes	753	753	753							
Flaring	50									
Desulfuring equipments	40									
Gazometer	318									
Combustion engines	1113									
Civil works	65									
ONE grid connection	10									
Other (15%)	559									
Sensibility analysis: decrease in investments	0%									
TOTAL INVESTMENT (k€)	2 908	753	753	0	0	0	0	0	0	0
total	4 414									
autofinancing	50%									
on the market	2 207									

Debt

Interest rate	5,5%
Credit (k€)	2 207
Duration (y)	10

Year	*Deadline*	*Nb days*	*Capital*	*Payments Principal*	*Payments, Interest*	*Total payments per year*
1	31/12/2010	365	2 207	-171	-121	-293
2	31/12/2011	365	2 035	-181	-103	-284
3	31/12/2012	365	1 855	-191	-86	-276
4	31/12/2013	365	1 664	-201	-69	-270
5	31/12/2014	365	1 463	-212	-53	-266
6	31/12/2015	365	1 250	-224	-39	-263
7	31/12/2016	365	1 026	-236	-26	-263
8	31/12/2017	365	790	-249	-16	-265
9	31/12/2018	365	541	-263	-7	-270
10	31/12/2019	365	278	-278	-2	-279
Total (k€)				**-2 207**	**-523**	**-2 729**

Bundled Project RAMSA's M'zar wastewater treament plant	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Income (k€)										
Electricity sold	250	530	831	860	890	922	954	985	1017	1040
CDM income	108	376	667	690	715	740	766	0	0	0
TOTAL INCOME (k€)	358	906	1 498	1 551	1 605	1 661	1 719	985	1 017	1 040
Operating costs										
Maintenance and operating costs	55	109	168	173	178	184	190	195	201	206
Insurance	44	44	44	44	44	44	44	44	44	44
Investments costs										
Cost of acquisition	2207									
Financial costs (k€)	293	284	276	270	266	263	263	265	270	279
TOTAL COSTS (k€)	2 598	437	488	487	488	491	497	504	516	529
RESULT (k€)	-2 240	468	1 010	1 063	1 117	1 170	1 223	480	501	511
Taxes	0	140	303	319	335	351	367	144	150	153
RESULT without CDM revenue (k€)	-2 348	93	343	373	402	430	457	480	501	511
Taxes without CDM revenue	0	28	103	112	121	129	137	144	150	153
NET RESULT (k€)	-2 240	328	707	744	782	819	856	336	351	358
NET RESULT without CDM revenue (k€)	-2 348	65	240	261	282	301	320	336	351	358
Discount rate (%)	8%									
NPV (k€)	1 386									
NPV without CDM revenue (k€)	-645									

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