NovaGerar Landfill Gas to Energy Project

Response to the revised Meth Panel recommendations

15 July, 2003

Introduction

This document lays out the NovaGerar Landfill Gas to Energy Project project participants' responses to the changes required and comments made by the CDM executive board and its methodology panel. Revisions to the text in the draft PDD and its Annexes are introduced in this document. The same changes have also been made to the actual draft PDD and its Annexes. Deletions are indicated with strikethrough font and additions with a yellow highlighting color.

If the methodology and the proposed changes are approved, corresponding changes will be made to the supporting documents (baseline study and full monitoring plan) and these changes will be verified by the Applicant Entity (DNV).

1) BASELINE METHODOLOGY

Required change 1

Include in Annexes 3 and 4 procedures for defining the system and project boundaries. These are provided only in the project specific application (Section B), and are absent from methodology (Annex 3, Section 4).

Response and proposed action

Procedures described and included in Annex 3.

Changes to the text

Revised text
PDD, Annex 3, Section 4 The project boundary, for the purpose of establishing the baseline scenario, defines where possible alternative scenarios to the proposed project are likely to be found. For investment projects applying the proposed methodology the physical site(s) of the business-as-usual activities and of the proposed project activity ~~itself~~ typically define~~s~~ the boundary. The project boundary, for the purpose of monitoring and calculating emission reductions, defines where sources of GHG emissions are to be found that are under the control of project participants, significant, and reasonably attributable to the project activity, and conversely which GHG sources are outside of the boundary and may have to be treated as leakage. GHG

emissions that occur from the same source and in the same amounts in baseline and project scenarios are usually not significant for the purpose of calculating emission reductions and may not be attributable to the proposed project activity. Such sources can be treated as insignificant and not attributable (in the sense of the above definition) and can therefore be excluded from the monitoring boundaries.

For landfill gas to energy projects, the geographic monitoring boundaries are typically drawn around the site of the landfill and of the power production facilities in baseline and project scenarios, since the sources inside the boundaries can be controlled by project participants, may be significant and attributable to the project activity. This includes the landfill gas emissions in the baseline and project scenarios. The system boundaries may exclude some on-site emissions, because they may be insignificant such as from the use of operating equipment. For projects that claim emission reductions from displacement of electricity, the system boundaries for the purpose of monitoring may have to include the electricity system in which power is displaced by the project's generation.

Consequently, the analysis leading to the definition of the monitoring boundaries should comprise all elements of the waste management and landfill gas collection systems and the equipment for electricity generation in the baseline and project scenarios.

The following GHG sources are typically inside the monitoring boundaries:

- Direct on-site emissions: landfill gas released to the atmosphere in baseline and project scenarios.

The following GHG sources are typically excluded from the monitoring boundaries, because they are not under the control of project participant, insignificant, or not attributable to the project activity.

- Indirect on-site emissions: e.g., landfill operation equipment (no change due to project), electricity used to operate the project (parasitic load: insignificant, most likely generated from LFG), emissions from construction of the project (not significant)
- Direct off-site emissions: e.g., transport of equipment and construction materials (not significant, not under control of participants), emissions associated with the electricity generated (insignificant, where LFG contains only climate neutral biological carbon),

Indirect off-site emissions: e.g., transport of waste to the landfill (no change due to project)

Required change 2

Include in Annexes 3 and 4 calculation of baseline emissions (Section 6 of Annex 3). The “formulae and algorithms” of the methodology shown in Steps 1 and 2 of Section E, as well as the rationale for not counting combustion CO2 (in E.1), should be provided.

Related required changes:

Revise Section 6 of Annex 3:

- Remove references to “environmental additionality” in the methodology
- Point 3 of Section 6 (Annex 3) should be removed.
- Additionality should be determined by applying a methodology to determine whether the project activity is part of the baseline scenario.

Response and proposed action

Regarding Required Change 2:
The proposed baseline methodology builds on para 48b, Marrakech Accords which identifies the baseline scenario as an economically attractive course of action. This approach does not contain any instructions regarding the determination of emissions associated with this scenario. The determination of the baseline emissions depends strongly on specifics of the baseline scenario such as technology. Thus, the calculation of baseline emissions is not determined by the baseline methodology which only singles out the baseline scenario.

For landfills, the calculation of baseline emissions can be estimated by calculating the amount of landfill gas that the landfill site can generate using an appropriate landfill gas model. A reference to a standard methodology for calculation of baseline emissions for landfills has been included in **Sections 3 and 6 of Annex 3** (see below). A description of how baseline emissions are calculated in the case of NovaGerar has been added to **Section B3** (see below).

The “formula and algorithms” in Steps 1 and 2 of Section E and the rational for not counting CO2 emissions from flaring and combustion of LFG have been included in **Annex 4, Section 1** (see below).

Regarding related changes
The term “environmental additionality” has been replaced by “additionality” throughout the documents.

Point 3 of Section 6 (Annex 3) has been removed.

In **Section 6, Annex 3**, a clarification has been provided on how the methodology demonstrates that the proposed project activity is additional and not part of the baseline scenario.

Revised text
PDD, Annex 3, Section 6

(1) ~~The methodology for the calculation of baseline emissions and project emissions is contained in the monitoring plan which, together with reasonable assumptions about data to be monitored, should be used to estimate the emission reductions generated by the project activity~~.

(1) The baseline methodology described in Section 2 of Annex 3 above determines the baseline scenario as an economically attractive course of action. The methodology identifies that only two alternative scenarios (the business as usual scenario and the proposed project activity) are plausible courses of action and then shows that one of them (the proposed project) is not an economically attractive course of action. This demonstrates (a) that the business as usual scenario is the only economically attractive course of action and (b) that the proposed project is not part of the baseline scenario and thus additional.

(2) In LFG-to-energy projects (such as the above), project-related reductions in methane emissions can often be directly monitored and calculated (see Annex 4, section 1). Hence, monitoring emissions in the baseline scenario and the project are not necessary.What is needed, however, is to estimate the amount of flaring that would have taken place in the absence of the project, so to deduct this amount from the emission reductions that will be directly measured by the monitoring program once the project becomes operational.

(3) In order to estimate the amount of flaring that would occur in the absence of the project, it is necessary to estimate the future GHG emissions of the landfill (the proposed methodology uses the US EPA First Order Decay Model -see Section 3 above) and subtracting the amount of landfill gas that would be flared or otherwise destroyed in the absence of the project activity taking into account the effectiveness of the gas collection systems that would be imposed by regulatory or contractual requirements or similar circumstances at the time of inception of the project (the 'Effectiveness Adjustment Factor'). Given the complexity and variability of conditions in landfills, the need for interpretation of regulation and other requirements and the variability in landfill gas systems, any estimates of the expected landfill gas generation and of the type and effectiveness of a gas collection systems in the baseline scenario should be done as an application of the methodology on a case-by-case basis by a specialist in this field.

(4) The 'Effectiveness Adjustment Factor' will need to be revised at the end of the baseline crediting period, by estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future.

(5) Once the project becomes operational, the emission reductions associated with project can be calculated directly by measuring the amount of GHGs flared and deducting the amount that would have been flared in the baseline scenario (the 'effectiveness adjustment factor'). The method used for the calculation of emission reductions after the project becomes operational is described in Annex 4, Section 1.

(3) ~~The baseline methodology does typically not address the determination of~~

additionality. Project additionality requires a compelling demonstration of environmental additionality (i.e. the project results in ERs). Environmental a Additionality may often be obvious after the baseline scenario has been determined and information about technology or fuel use in the baseline and project scenarios has been considered. The estimation of an exact quantity of expected ERs is irrelevant for the assessment of environmental additionality. Showing that a reduction in emissions below the baseline (and not offset by leakage) occurs is sufficient in order to demonstrate additionality.

PDD, Section B.3

The following paragraphs first describe how the proposed baseline methodology is applied to single out the baseline scenario for the NovaGerar project. Secondly, emissions resulting from the baseline scenario are estimated.

1. Identification of the baseline scenario through the baseline methodology

The baseline above methodology is here applied in the following way:

(…)

2. Estimation of emissions associated with baseline scenario (including estimation of the amount of flaring that would occur in the absence of the project)

This was conducted by estimating the amount of LFG that could be generated in the baseline scenario using the US EPA First Order Decay Model and deducting the amount that would have been flared in the absence of the project according to the effectiveness of the gas collection systems imposed by regulatory requirements at the time of inception of the project (the 'Effectiveness Adjustment Factor').

The First Order Decay Model was used with the assumptions listed in Annex 5 and estimated that in the baseline there will be the production of 16 million tCO2e during the project's 21-year lifetime.

The estimation of the Effectiveness Factor for this project was based on the regulatory requirements imposed on SA Paulista (the landfill operator) at the time they signed a contractual agreement with the Municipal waste management company (EMLURB) to operate the landfill (Licitação por Concorrencia Publica n. 001/CP/EMLURB/2000 - Anexo 2, Item 7). Based on these specifications, NovaGerar's landfill waste consultant estimated the effectiveness of this system in comparison with the system that will be adopted by the project funded with carbon finance.

The effectiveness of a landfill gas collection and flaring system can be affected by a number of factors including:

- The frequency of gas wells;
- The depth of gas wells;
- Whether suction is applied to the gas wells;
- The efficiency of the flares used.

These factors will impact on the area of influence of a gas well, for example a gas collection system where suction is applied will draw gas from a larger area of waste than a system without suction. Similarly, a deep gas well will have a larger area of influence than a shallow well.

While currently no regulation exist that require landfill gas control for the Adrianopolis landfill, the contract between the Marambaia landfill operator and municipal authorities foresees remediation of the existing dump and installation of a rudimentary gas drain net as a part of the bidding documents. The bidding documents (Licitação por Concorrencia Publica n. 001/CP/EMLURB/2000 - Anexo 2, Item 7) only require the installation of 40 passive (i.e. no suction) drainage wells at approximately 50 m intervals and reaching 2m in depth, resulting in a total well capacity of 80 m (40 x 2 m). The total area of the Marambaia landfill cells is estimated to be 79,820 m^2; the peak depth of the landfill is estimated to be between 40-50 m, with an estimated total volume of waste in place of 1,914,498 m^3. Expressed as a function of the total volume of the landfill, the necessary wells as required by the municipal contract represent 0.0042 cm of well/m^3 waste.

In the project scenario, 40 wells are also proposed, but with a depth of 23 m rather than 2 m as required in the Marambaia bidding documents. This gives a total well capacity of 920 m (40 x 23 m). Expressed as a function of the total volume of the landfill, the proposed wells in the project scenario represent 0.0481 cm of well/m^3 waste. This ratio is 11.4 times greater than that required by the municipal contract. The proposed well capacity in the baseline scenario represents 8.73% of the well capacity proposed in the project scenario.

Furthermore, the system required is based on the passive drainage of gas, which is not an effective system. The project will adopt suction to improve the landfill gas extraction and reduce emissions to the atmosphere.

Another factor that reduces the effectiveness is that the wells required by the municipal contract are very shallow (2 m) compared to the depth of the Marambaia landfill (peak depth 40 - 50 m, average depth 23.9 m). It is assumed that in the top layers of waste, decomposition will be both aerobic and anaerobic. Therefore, the gas captured in the shallow wells is assumed to have a lower methane percentage than gas collected from deeper wells. Current flaring practice in Brazil usually takes the form of a landfill operator manually lighting the top of gas wells in the landfill. It is therefore very common for flares to 'blow out'. Given that the gas collected by the wells required by the municipal contract is likely to have a lower methane percentage it is assumed that the use of typical flaring practices would not be very effective. If a reduction factor of 40% is attributed to each of these additional problems, it can be estimated that the effectiveness of this system can be less than 4% of the well capacity of the project.

Conversely, the project scenario proposes the installation of pipes connecting the gas wells, the application of suction to the wells, and the installation of Modular Ground Gas flares. The flares are based on an advanced design and will be skid or base frame mounted ground flares. Ground flare stacks enable higher burning temperatures to ensure low emissions. The burner unit is fully adjustable to enable high temperature flaring of the landfill gas, which will vary in both quality and quantity from site to site, and over time. The effectiveness of this system is estimated to be 85%.

Although current legislation and municipal contracts only require an approximate collection

of 0% (Adrianopolis) resp. 4% (Marambaia) of the gas collected through the project, all emission reductions arising from the project will nonetheless be reduced by 20%, in order to provide a large enough margin to what could have been flared in the baseline scenario during the first baseline crediting period. Hence, the chosen discount value for NovaGerar is extremely conservative.

Once the project becomes operational, the emission reductions associated with project can be calculated directly by quantifying the amount of GHGs flared and deducting this 20% Adjustment Factor to conservatively account for any flaring that may have taken place in the baseline scenario.

At the end of the crediting period, this 'Effectiveness Adjustment Factor' will be revised, as described in Section D.2.

PDD, Annex 4, Section 1

The proposed methodology utilizes direct monitoring of the emission reductions from the project activity. The emission reductions due to the project activity are monitored and calculated as a differential. Accordingly, the methodology does not monitor the emissions emitted in the project and baseline scenarios in order to calculate the emission reductions as the difference between the two amounts of GHG emissions released.

Calculation of the emission reductions for the project should be done in the following way:

STEP 1 – Methane combustion in electricity generators

As and when electricity is generated, take the metered gross annual (aggregated from monthly readings) electricity produced by the project (MWh)

⇩

Multiplied by generator heat rate (GJ/MWh)

⇩

Total energy input (GJ)

⇩

Convert GJ to equivalent tonnes of methane (using appropriate factors for GJ/m^3 CH_4 and $tCH_4/m^3 CH_4$) (tonnes of CH_4)

⇩

Multiply by Global Warming Potential of methane (tCO_2e)

⇩

Annual CO_2 emissions displaced by the project through methane combustion to generate

electricity
(tonnes CO_2 equivalent)

If the project decides to claim the CO2 emission reductions from fossil fuel displacement derived from electricity generation, this component will need to be calculated using the appropriate methodology for electricity generation (grid or non grid connected systems). Given that this specific project is not currently claiming credits for the emission reductions associated with fossil fuel displacement, this methodology is not described in this document.

The CO_2 emission reductions from methane combustion in flares will be calculated on an annual basis as shown diagrammatically below:

STEP 2 – Methane combustion in flares

Volume of landfill gas channelled to flares (m^3)

⇩

Multiplied by methane fraction of landfill gas (readings from a gas analyser or deducted from the electricity generation readings)

⇩

Volume of methane combusted in flare (m^3)

⇩

Multiplied by flare efficiency (%)

⇩

Net volume of methane combusted in flare (m^3)

⇩

Multiplied by volume:mass conversion factor (0.00067899 $tCH_4 = 1m^3\ CH_4$)
(tonnes of methane)

⇩

Multiplied by Global Warming Potential of methane
(tonnes of CO_2 equivalent)

⇩

Annual emission reductions due to methane combustion in flares
(tonnes of CO_2 equivalent)

⇩

Total ERs generated by the project (tCO_2)
(Results of Step 1 + Step 2) – Effectiveness Adjustment Factor X% related to the amount of flaring achievable by using the gas collection system requested by regulatory agencies at the inception of the project and adjusted in the future.

The total emission reductions (in tonnes of CO2 equivalent) are the summation of results from Step 1 (Methane combustion in generators) and Step 2 (Methane combustion in flares). The sum is then discounted by an Effectiveness Adjustment Factor - an appropriate factor to reflect the level of flaring that would occur if the project adopted the gas collection system requested by regulatory agencies at the inception of the project. Given the complexity and variability of conditions among such systems, such estimates of the effectiveness of gas collection systems would have to be done in a case-by-case basis by specialists in the field, and the results verified by the Operational Entity validating the project design (or the revision of the baseline).

This 'Effectiveness Adjustment Factor' will then need to be revised at the end of the baseline crediting period, by estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future. This can be done using a control group of landfill operations that did not receive carbon finance for their development. At every baseline revision point in the future, an expert will need to provide an estimation of the percentage of gas being flared at each of the control group landfills, in relation to the potential gas collected by a state of the art installation. The averaged of these sites will become the new 'Effectiveness Adjustment Factor' to be applied to the revised project baseline.

The destruction of methane in flares and engines will lead to a conversion of methane emissions to CO2 emissions. The source of the methane and therefore the CO2 emissions is the organic fraction in deposited waste, which forms part of the natural organic CO2 cycle. Therefore, these CO2 emissions should not be counted as net contributors to climate change.

~~Details of the methodology are described in Section D. It~~ The methodology is currently mainly applicable in waste management projects involving methane destruction. In principle, all project types that involve a treatment of measurable GHG quantities that would otherwise be released are conducive to the application of modified forms of the proposed direct monitoring methodology. Such project types are: geological sequestration of CO_2 (e.g. in oil wells) and other applications that directly bind CO_2 or destroy or modify GHGs in a chemical or physical process that removes or diminishes their global warming potential.

Required change 3

Specify the COP-accepted value for the GWP of methane (21) and, where necessary, perform all calculations accordingly using the correct (21 instead of 23) GWP.

Response and proposed action

GWP has been changed to 21 and all calculations have been revised accordingly. However, it is suggested that once/if COP approves 23 as the GWP for methane, this GWP should be used for that point on as well as to revise the number of CERs issued prior to that date. **Project Participants seek clarification from the Executive Board on this suggestion.**

Changes to the text

Revised text
Changes are indicated in the revised draft PDD and its Annexes as well as in the Baseline Study and Monitoring Plan.

Required change 4

Define more clearly how conservatism is assured (in Section 8, Annex 3). There are two apparent forms of "conservatisms", but these are not clearly specified in the Annex.
a. "[A] conservative IRR" (Step 3). "An IRR is calculated conservatively if assumptions made tend to result in a rather higher than lower IRR". Please provide guidance (even if brief) as to how this will be applied and assured, e.g. whether lower values be used *each* assumption? How will a conservatism of these assumptions be reviewed? For instance can high and low values for the financial parameters given in Annex 5 be shown along side the values selected?
b. The NovaGerar application uses a 20% discount on calculated ERs "in the interests of making a conservative claim…and in anticipation of possible regulatory developments during the 7 years of the first crediting period." However,
i. It should be specified whether this 20% discount is part of the "new methodology", and if so, include it within Annex 3 or 4.
ii. The choice of this value should be adequately justified.
iii. A process of *ex ante* evaluation of reasonably anticipated policy or practice change should be provided for in the methodology. The current methodology would only yield a conservative result if policy or practice change within the next 7 years appears unlikely.

Response and proposed action

With regard to point a. above, further guidance on this matter has been included in Annex 3, Section 2.2. Values that tend to lead to a higher IRR should be used for all assumptions. Conservatism of these assumptions should be ensured by obtaining expert opinions and by the Operational Entity validating the project.

With regard to points b. i. and b.ii. above, the specific value of the discount factor is not part of the methodology. It was intended to secure the conservativeness of the approach for the NovaGerar Project only. The methodology, however, does propose the use of a factor to account for the amount of LFG that would have been flared in the absence of the project according to the effectiveness of the gas collection systems imposed by regulatory requirements (the 'Effectiveness Adjustment Factor'). For NovaGerar, the factor has been determined based on the regulatory requirements affecting the landfill operator at the time that the concession agreement is granted (similarly to the way that the Vega Landfill project, NM004, was formulated). The factor should be set conservatively in order to account for possible policy or practice changes. This is described in Annex 4, Section 1.

With regard to point b.ii. above, The choice of the 20% discount factor for NovaGerar is very conservative as it by far exceeds the current regulatory requirements and incorporates a significant safety cushion against future tightening of the regulations during the 7-year

crediting period which are at present not foreseen. Please see clarifications in **Section B3 (2) of the PDD.**

With regard to point b.iii. above, it seems very difficult if not impossible to correctly assess future regulatory changes. This is why the methodology opts for a conservative discount factor (Effectiveness Adjustment Factor) with a significant safety margin. In the very unlikely event that future regulations would require a collection and flaring exceeding the 20% of the project's gas capture, this would be compensated through foregone emission reductions during the early years of the crediting period.

Changes to the text

Revised text
PDD Section B.3.: ~~In the interests of conservatism, and to enhance the environmental integrity of the NovaGerar project, all emission reductions arising from the project will be discounted by 20%. It is anticipated that by discounting emission reductions by 20% the project will account for any regulatory changes, or improvements in waste management practice over the first 7 years of the project.~~ The following text was inserted, instead: **2. Estimation of emissions associated with baseline scenario (including estimation of the amount of flaring that would occur in the absence of the project)** This was conducted by estimating the amount of LFG that could be generated in the baseline scenario using the US EPA First Order Decay Model[1] and deducting the amount that would have been flared in the absence of the project according to the effectiveness of the gas collection systems imposed by regulatory requirements at the time of inception of the project (the 'Effectiveness Adjustment Factor'). The First Order Decay Model was used with the assumptions listed in Annex 5 and estimated that in the baseline there will be the production of 16 million tCO2e during the project's 21-year lifetime. The estimation of the Effectiveness Factor for this project was based on the regulatory requirements imposed on SA Paulista (the landfill operator) at the time they signed a contractual agreement with the Municipal waste management company (EMLURB) to operate the landfill (Licitação por Concorrencia Publica n. 001/CP/EMLURB/2000 - Anexo 2, Item 7). Based on these specifications, NovaGerar's landfill waste consultant estimated the effectiveness of this system in comparison with the system that will be adopted by the project funded with carbon finance. The effectiveness of a landfill gas collection and flaring system can be affected by a number of factors including:

[1] On this model, see US EPA manual "Turning a Liability into an Asset: A Landfill Gas to Energy Handbook for Landfill Owners and Operators" (December 1994).

- The frequency of gas wells;
- The depth of gas wells;
- Whether suction is applied to the gas wells;
- The efficiency of the flares used.

These factors will impact on the area of influence of a gas well, for example a gas collection system where suction is applied will draw gas from a larger area of waste than a system without suction. Similarly, a deep gas well will have a larger area of influence than a shallow well.

While currently no regulation exist that require landfill gas control for the Adrianopolis landfill, the contract between the Marambaia landfill operator and municipal authorities foresees remediation of the existing dump and installation of a rudimentary gas drain net as a part of the bidding documents. The bidding documents (Licitação por Concorrencia Publica n. 001/CP/EMLURB/2000 - Anexo 2, Item 7) only require the installation of 40 passive (i.e. no suction) drainage wells at approximately 50 m intervals and reaching 2m in depth, resulting in a total well capacity of 80 m (40 x 2 m). The total area of the Marambaia landfill cells is estimated to be 79,820 m^2; the peak depth of the landfill is estimated to be between 40-50 m, with an estimated total volume of waste in place of 1,914,498 m^3. Expressed as a function of the total volume of the landfill, the necessary wells as required by the municipal contract represent 0.0042 cm of well/m^3 waste.

In the project scenario, 40 wells are also proposed, but with a depth of 23 m rather than 2 m as required in the Marambaia bidding documents. This gives a total well capacity of 920 m (40 x 23 m). Expressed as a function of the total volume of the landfill, the proposed wells in the project scenario represent 0.0481 cm of well/m^3 waste. This ratio is 11.4 times greater than that required by the municipal contract. The proposed well capacity in the baseline scenario represents 8.73% of the well capacity proposed in the project scenario.

Furthermore, the system required is based on the passive drainage of gas, which is not an effective system. The project will adopt suction to improve the landfill gas extraction and reduce emissions to the atmosphere.

Another factor that reduces the effectiveness is that the wells required by the municipal contract are very shallow (2 m) compared to the depth of the Marambaia landfill (peak depth 40 - 50 m, average depth 23.9 m). It is assumed that in the top layers of waste, decomposition will be both aerobic and anaerobic. Therefore, the gas captured in the shallow wells is assumed to have a lower methane percentage than gas collected from deeper wells. Current flaring practice in Brazil usually takes the form of a landfill operator manually lighting the top of gas wells in the landfill. It is therefore very common for flares to 'blow out'. Given that the gas collected by the wells required by the municipal contract is likely to have a lower methane percentage it is assumed that the use of typical flaring practices would not be very effective. If a reduction factor of 40% is attributed to each of these additional problems, it can be estimated that the effectiveness of this system can be less than 4% of the well capacity of the project.

Conversely, the project scenario proposes the installation of pipes connecting the gas wells, the application of suction to the wells, and the installation of Modular Ground Gas flares. The flares are based on an advanced design and will be skid or base frame mounted ground flares. Ground flare stacks enable higher burning temperatures to ensure low emissions. The burner

unit is fully adjustable to enable high temperature flaring of the landfill gas, which will vary in both quality and quantity from site to site, and over time. The effectiveness of this system is estimated to be 85%.

Although current legislation and municipal contracts only require an approximate collection of 0% (Adrianopolis) resp. 4% (Marambaia) of the gas collected through the project, all emission reductions arising from the project will nonetheless be reduced by 20%, in order to provide a large enough margin to what could have been flared in the baseline scenario during the first baseline crediting period. Hence, the chosen discount value for NovaGerar is extremely conservative.

Once the project becomes operational, the emission reductions associated with project can be calculated directly by quantifying the amount of GHGs flared and deducting this 20% Adjustment Factor to conservatively account for any flaring that may have taken place in the baseline scenario.

At the end of the crediting period, this 'Effectiveness Adjustment Factor' will be revised, as described in Section D.2.

Annex 3, Section 2.2 (Step 3)

Step 3: Calculate a conservative IRR for the proposed project activity not taking carbon finance into account. The calculation must include the incremental investment cost, the operations and maintenance costs, and all other costs of upgrading the BAU scenario to the proposed project activity. It must also include all revenues generated by the project activity except carbon revenues. An IRR is calculated conservatively if the assumptions made tend to raise the IRR of the project scenario instead of lowering it. To ensure this, values that tend to lead to a higher IRR should be used for all assumptions. Conservatism of these assumptions should be ensured by obtaining expert opinions and by the Operational Entity validating the project.

Required change 5

Related Required Change
Provide clearer thresholds or procedures for IRR (or NPV) calculations.

a. Clarify the conditions that define a "borderline case" (Annex 3, 2.2), i.e. where the "calculated IRR (or NPV) does not, without a doubt, indicate that the project activity is not an economically attractive course of action" and "…the method cannot be applied". (See Thorne review)
b. Similarly, define a procedure for determining the "normally expected and acceptable IRR [or NPV] for comparable investments with a similar risk profile in the relevant sector and country" (Annex 3, Section 2.2.). See Thorne and Michelowa comments.
c. Specify conditions under which NPV, instead of IRR, would be the appropriate metric for financial analysis.

Quantitative *or* qualitative criteria could be used, as long as they are sufficiently clear and that a DOE can implement them with little ambiguity *by looking at the Annexes alone.* Use of government bond or other hurdle rates should be specified in the appropriate Annex.

Response and proposed action

With regard to 5.c above, we acknowledge that the use of the NPV has been introduced in order not to restrict the use of the methodology but without having in mind situations in which the NPV seems to be the more appropriate metric than the IRR. Rather, the use of the IRR seems to dominate the use of the NPV in relevant aspects. For instance, project alternatives with different investment amounts are comparable by use of the IRR whereas the NPV criterion limits the analysis to equal investment amounts. As the analysis of NovaGerar is based on the IRR, we propose to drop the NPV from the methodology.

Clarifications on **5.a and 5.b** have been added to the relevant sections (see below).

Changes to the text

Revised text
Annex 3, Section 2.2. (Step 4 and Condition 2a) Step 4: Determine whether the project IRR is clearly and significantly lower than a conservatively (i.e. rather low) expected and acceptable IRR for this or a comparable project type in the relevant country. This can be determined by comparing the project IRR to relevant comparators. These can include: **a.** government bond rates **b.** expert views on expected IRRs for this or comparable project type **c.** other hurdle rates that can be applied for the country or sector In the case of NovaGerar project government bond rate was used as the comparator. Condition 2a: The internal rate of return (IRR) (without carbon revenues) of the proposed investment project is clearly and significantly lower than the normally expected and acceptable IRR for comparable investments with a similar risk profile in the relevant sector and country. This is determined by comparing the project IRR to relevant comparators. These can include: **a.** government bond rates **b.** expert views on expected IRRs for this or comparable project type **c.** other hurdle rates that can be applied for the country or sector The project IRR must be calculated conservatively, that is using assumptions that tend to raise the IRR instead of lower it; ~~Condition 2b: The net present value (NPV) (without carbon revenues) of the proposed investment project is clearly unattractive from an investor standpoint when assuming a conservative (i.e. comparatively low) discount rate and choosing other assumptions that lead to a rather low NPV. Factors that influence the NPV are chosen conservatively if they tend to raise the NPV instead of lower it.~~

Required change 6
Specify the all equations in units of the international system (IS), or provide conversion factors within the document.

Response and proposed action

All equations with the exception of the EPA first order decay model equation for landfill gas generation. Conversion factors have been added.

Changes to the text

Revised text

- A first order decay model equation for landfill gas generation, such as:

$$\mathbf{LFG=2L_0R(e^{-kc}-e^{-kt})}$$

Where:

LFG = total landfill gas generated in current year (cf) (conversion factor from cubic feet to cubic meters is 1cf = 0.02832 m3)
L_0 = theoretical potential amount of landfill gas generated (cf/lb) (conversion factor 1b = 0.4536 kg)
R = waste disposal rate (lb/year)
t = time since landfill opened (years)
c = time since landfill closed (years)
k = rate of landfill gas generation (1/year)

Required change 7

Reword Annex 3, section 2, step 5

Response and proposed action

The section has been reworded.

Changes to the text

Revised text

Annex 3, Section 2 (Step 5)

Step 5: If the project IRR is clearly and significantly lower than a conservatively acceptable IRR, c~~C~~onclude~~, if possible,~~ that the project is not an economically attractive course of action and that therefore the BAU alternative is the most economically attractive course of action and the most likely baseline scenario.

2) MONITORING METHODOLOGY

Required change 1

Monitoring of generator heat rate and of flare efficiency should be done at least semiannually (or after every stop of operation of the flare) so as to capture possible variations that can be considered "abnormally high". In case "a significant variation" occurs since the last monitoring, the monitoring has to be repeated after one month.

Response and proposed action

Relevant sections revised accordingly.

Changes to the text

Revised text

PDD Section D.3. AND the same rows in Annex 4, Section 2

3	Generator heat rate	GJ/ MWh	M & C	Semi-annual verification of validity of generator plate rating (if significant variation since last monitoring, monitoring repeated every month)	~~Once per year~~ Semi-annually or more frequently depending on observed deviations from previous rating	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	*Data will be used to test and, if necessary correct the generators' standard heat rate plate ratings*
4	Flare efficiency	%	M & C	Semi-annual determination of flare efficiency (if significant variation since last monitoring, monitoring repeated every month)	~~Once per year~~ Semi-annually or more frequent depending on observed deviation from previous rating	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	*Data will be used to test and, if necessary correct the flares' efficiency ratings.*

Required change 2

Clarify how regulation and practice will be monitored. Section B.3. suggests that monitoring plan will determine if at "some future time… the collection and treatment of LFG will either be required by law or becomes an economically attractive course of action." Section D.2. also notes that control groups will be used to re-assess the baseline every 7 years. However, no mention is made in Annex 4 of how changes in the regulation or standard operating practice of landfills in the region will be tracked, nor of the control groups and how they will be defined, and how any changes will translate into modifications of the baseline.

Response and proposed action

It is acknowledged that the methodology as originally proposed is not clear in terms of what would be the implication of any observed behavior from the control group landfills on the baseline.

Prior to the renewal of the crediting period, the average landfill gas collection practice of a control group will be assessed. Please note, that all regulatory or practice changes **within** the crediting period are taken into account upfront through the conservative setting of the Effectiveness Adjustment Factor including a safety margin (see our response to Required Change 4). Thus, the control group approach only affects the setting of the discount factor in subsequent crediting periods. The approach shall work as follows: If the average collection practice exceeds the discount factor of the first commitment period (in this case, conservatively set at 20%), a new discount factor shall be established, based on the findings of the control group.[2] A new conservative factor based on current practice and reasonably anticipated changes shall be determined. If the average collection practice however stays below the initial discount factor, no changes to the factor shall be made.

Furthermore, a specification of the control group for NovaGerar has been added to section D.2.

Changes to the text

Revised text
PDD, Section D.2.: **Revision of the Effectiveness Adjustment Factor** Please note that, in the interests of making a conservative claim to ERs achieved by the project, the monitoring plan proposed to reduce the directly monitored ERs by an 'effectiveness adjustment factor' of 20 % (see section B3-2). The effectiveness adjustment factor will need to be revised at the time of each baseline revision (at the end of each baseline crediting period), by estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future. As the baseline scenario is the continued uncontrolled release of landfill gas to the atmosphere, similarly to most landfills in Brazil. The Brazilian Ministry of the Environment has no immediate plans to introduce legislation requiring the collection and flaring of landfill gas from landfill sites. The implementation of environmental protection legislation in Brazil has a relatively long lead-time. In addition, historically in Brazil there also tends to be a gulf between stated regulations and actual practice with regards to the

[2] Please note that for the purpose of comparing the two factors, the 20% discount factor applied to NovaGerar needs to be converted into overall collection efficiency. The 20% discount factor applied to NovaGerar represents the share of methane that would also have been captured in the baseline scenario, by which the emission reductions need to be reduced. It does not represent the overall collection efficiency of the baseline scenario. As the project is not able to collect 100% of the emissions generated in the landfill, the share of 20% of methane that is also captured in the baseline scenario represents an overall collection efficiency **lower** than 20%.

implementation of environmental protection legislation. Therefore it is considered sufficient to reconfirm the baseline assumptions at seven-year intervals, i.e. when the crediting period is renewed.

However, to account for the implementation of regulatory requirements, or improvements in waste management practices, within Brazil, a control group will be formed and surveyed at each baseline revision point in the future. The survey will aim at estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future, within the companies in the control group. At every baseline revision point in the future, an expert consultant will provide an estimation of:

- Whether there are sufficient gas collection wells in place;
- The depth of the wells in relation to the depth of the sites;
- The number of gas collection wells operating satisfactorily i.e. gas is flowing;
- The number of gas collection wells not operating i.e. blocked by leachate, poorly maintained etc.;
- The number of flares operating satisfactorily i.e. burning landfill gas;
- Whether the site applies suction to the wells;
- Whether the site is appropriately capped, to avoid venting;
- The efficiency of the flares utilized.

A Control Group was already formed and a preliminary initial survey was conducted by the NovaGerar project and has shown that none of these landfills is currently capturing and/or flaring landfill gas except for safety purposes (see table below).

Table: The NovaGerar control group

Landfill	*Waste in place (million of tons)*	*Waste deposition rate (tons/day)*	*Current flaring status*
Natal (RN)	8.0	450.0	No exhaust system, no flaring
Salvador (BA)	2.5	2500.0	Only natural exhaust system, no controlled flaring
São João landfill (SP)	17.0	6500.0	Only natural exhaust system, no controlled flaring
Cariacica (ES)	4.3	800.0	No exhaust system, no flaring
Marambaia (RJ)	3.0	1100.0	No exhaust system, no flaring
Guarulhos (SP)	3.5	1000.0	Only natural exhaust system, no controlled flaring
Itaquaquecetuba (SP)	2.0	2000.0	Only natural exhaust system, no controlled flaring
Maua (SP)	3.0	1500.0	Only natural exhaust system, no controlled flaring
Osasco (SP)	3.4	500.0	Only natural exhaust system, no controlled flaring
Florianópolis (SC)	1.2	350.0	Only natural exhaust system, no controlled flaring
Gravatai (RS)	4.3	1000.0	Only natural exhaust system, no controlled flaring
Joao Pessoa (PB)	2.8	400.0	No exhaust system, no flaring
Total	**55.0**	**18,100**	

Based on the data collected, the expert will estimate the percentage of gas being flared at each of the control group landfills and a decision will be made on whether the discount factor of 20% is still appropriate, or whether it should be changed to 20% + n%. If the

[3] Please note that for the purpose of comparing the two factors, the 20% discount factor applied to NovaGerar needs to be converted into overall collection efficiency. The 20% discount factor applied to NovaGerar represents the share of methane that would also have been captured in the baseline scenario, by which the emission reductions need to be reduced. It does not represent the overall collection efficiency of the baseline scenario. As the project is not able to collect 100% of the emissions generated in the landfill, the share of 20% methane captured also in the baseline scenario represents a collection efficiency **lower** than 20%.

average collection practice exceeds the discount factor of the first commitment period of 20%, a new discount factor shall be established, based on the findings of the control group.[3] A new conservative factor based on current practice and reasonably anticipated changes shall be determined. If the average collection practice however stays below the initial discount factor, no changes to the factor shall be made. The new discount factor of X% shall be proposed by NovaGerar and the appropriateness of the proposed factor reviewed and verified by the designated Operational Entity in the context of the renewal of the project crediting period.

In addition, after the first and second crediting periods, the consultant will also determine whether electricity generation has become the most attractive course of action.

PDD, Annex 4, Section 2

This 'Effectiveness Adjustment Factor' will then need to be revised at the end of the baseline crediting period, by estimating the amount of GHG flaring taking place as part of common industry practices at that point in the future. This can be done using a control group of landfill operations that did not receive carbon finance for their development. At every baseline revision point in the future, an expert will need to provide an estimation of the percentage of gas being flared at each of the control group landfills, in relation to the potential gas collected by a state of the art installation. The averaged of these sites will become the new 'Effectiveness Adjustment Factor' to be applied to the revised project baseline.

Required change 3

Monitor atmospheric pressure or otherwise clarify how the variations from the assumed density value for methane will not result in significant error.

Response and proposed action

The pressure (and temperature) of the gas in the pipe and not atmospheric pressure effects the density. The NovaGerar project will install equipment make sure the measurements are accurate using an in-pipe pilot tube difference in pressure for the flow determination taking internal pipe temperature and pressure into account while also monitoring the CH4, CO2, and O2 content of the gas stream with an online sensor. The method is state-of-the-art with great accuracy assured as long as calibrations are done as specified by the equipment suppliers. The calibrations are recorded as part of the project and verification data. Therefore, there is no need to monitor atmospheric pressure.

In any case, atmospheric pressure, temperature, and relative humidity are all data sources that are regularly monitored and recorded in most energy projects and are routinely used for engine system performance evaluation purposes.

Changes to the text

No changes required.