CDM: Proposed New Methodology
Meth Panel recommendation to the Executive Board

To be completed by UNFCCC Secretariat

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Signature of Meth Panel Chair ……………………………………………..
Date: 23/10/2009 *(Philip Gwage)*

Signature of Meth Panel Vice-Chair ……………………………………………..
Date: 23/10/2009 *(Pedro Martins Barata)*

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CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW BASELINE AND MONITORING METHODOLOGIES
(CDM-NM)
(Version 03.1)

CONTENTS

Instructions for using this form

In using this form, please follow the guidance established in the following documents:

- Guidelines for completing the project design document (CDM-PDD) and proposed new baseline and monitoring methodologies (CDM-NM);
- Technical guidelines for the development of new baseline and monitoring methodologies (contained in part III of the above);
- Relevant methodological guidance by the Executive Board.

This guidance can be found at <https://cdm.unfccc.int/Reference/Guidclarif/index.html>

Formatting Instructions:

- The form provides the formatted headings which should be used throughout the document;
- Please note that each paragraph in section C and D should have a paragraph number, as demonstrated through example. When adding further paragraphs, please ensure it is numbered;
- Please use word equation editor to write equations;
- Please format figures, tables and footnotes to update automatically;
- Please note the footnotes have a separate format (Times New Roman - size 10).[1]

Please complete sections B to E. In section C, the text shaded in grey shall not be changed, whereas other text is used as an example and may be changed or deleted.

[1] Format for footnotes.

Section A. Recommendation by the Methodological Panel (to be completed by the Meth Panel)

Recommendation (preliminary or final / approval or rejection / consolidation)

Preliminary Recommendation

The Methodologies Panel considers that (i) clarifications and (ii) implementation of changes by the project proponents to their submission, in order to address the issues raised by the panel below, are required before a final recommendation is provided.

2. Major changes required

Applicability conditions

1. The proposed methodology does not count with the appropriate applicability conditions and procedures in order to ensure that the ammonia off-gas "AOG" has historically been a waste stream and would continue as such in the absence of the project activity. The project proponents should include the required provisions to comply with this requirement, and it is advised to use a similar approach as the one presented in the approved consolidated methodology ACM0012, in the section "Demonstration of use of waste energy in absence of CDM project activity", for Type-1 project activities.
    - *We have moved the related statement from the preamble of the applicability condition (specifying the existing (Type-1) facility) to the first bullet in the applicability condition and have added a description on how to demonstrate that the AOG has been 'waste' (direct measurement method) as per ACM0012.*
    - *In addition, condition (6) has been added to exclude abnormal operation time as per ACM0012.*
    - *A paragraph (para. 6) has been added to say that the methodology cannot be applied to Type-2 case (as the categorization of ACM0012) for clarification.*
2. The methodology implicitly assumes that the AOG is used for heat generation. Please, make this an explicit applicability condition or provide procedures for cases where the AOG is used for other purposes (e.g. electricity generation, processes, etc)
    - *We have added the word 'only' in the condition (5) to emphasize this point. The condition that the steam demand of the project is equal to or less than the baseline is also specified here as per ACM0012. This is a conservative estimation because baseline steam demand is assumed to be common with that in the project in the calculation. In case ammonia is partly recovered by the project, the baseline steam demand becomes larger on the assumption that total ammonia production is common for both cases.*
3. The proposed methodology considers that given the volume of AOG, and the composition of AOG (including concentration of methane and other hydrocarbons), it is safe and legally allowed to vent "AOG" as in the baseline case. Please, make this as one of the applicability conditions.
    - *We have added the above specifications in the (re-numbered) condition (2) as well as in the section for baseline scenario identification.*

4. The methodology is unclear on whether any other fuel may be mixed with the cleaned AOG before being fed into the boiler. Please clarify this.
    - *Possibilities of fuel mix are not considered in the condition (5) as well as in the use of an AOG-specific new boiler.*
5. The selected baseline approach is Para 48 (a) of the CDM M&P, hence the methodology should be restricted only to existing facilities.
    - *No change is needed for this point.*

Project Boundary

6. To improve clarity, diagrams of the baseline scenario and the project scenario would be useful.
    - *A diagram that combines both baseline scenario and project activity in one picture has been attached. An alternative, a set of two diagrams for baseline scenario and project activity separately, has been also inserted. Please choose whichever you like.*
7. Furthermore, it would be required to include a brief but clear description of the project technology with relevant schemes, similar as the one presented in Section A.4.3 of the underlying PDD.
    - *The following explanation has been added as the first paragraph of the "project boundary" section: "The project aims to install equipment to collect all of the AOG (except for the case of emergency) and use it as a single fuel (not mixing with other fuels) for steam generation in a new boiler specifically designed for AOG. It replaces some exiting boiler(s) which use(s) a fossil fuel (although the replaced one may be kept as it is for back-up purposes). In order to clean AOG, ammonia absorber and/or DeNOx equipment may be introduced to collect ammonia from it and/or to clean the exhaust gas as shown in Figure 1." Some other technical aspects of ammonia production are described in the definition section (in the explanation of "AOG").*
8. It is not addressed in the proposed methodology the case where AOG only replaces part of the baseline fuel, and consequently how will $Q_{project,y}$ be measured in this case? Will the total be measured and then apportioned according to energy input?
    - *It is not clear for me what is required here. First, all of the AOG, which is associated with the production of ammonia $Q_{project,y}$, is used only in the project activity (except for the case of emergency). Second, the amount of the baseline fuel is the 'replaced' amount calculated based on the steam generations from the new AOG-specific boiler (project activity) fuelled only by AOG (not being mixed with other fuels). I suppose that we should emphasize the boiler is exclusively for the AOG, i.e., so that the associated steam can be measured 'independently'. We clarify this point in several parts of the methodology.*

Identification of the baseline scenario

9. In the credible alternatives for steam generation, it should be differentiated the alternatives of (i) using the cleaned AOG in the existing boilers for steam generation, and (ii) using the cleaned AOG in the new boilers for steam generation.
    - *We have added a new scenario alternative (new 'AOG2' option) to use a boiler, which mixes AOG with other fuels as well as its possible option to generate power. We do*

not consider the categorization of "new or exiting" is important. Rather, whether it is exclusively for AOG or not counts to identify the amount of the project-specific steam generation.

10. In the case that the project activity results in the installation of new boilers for steam generation, due to the use of AOG as fuel, a procedure for the assessment of the remaining lifetime of the existing boilers should be included. This is required as it has to be demonstrated that the new boilers to use the wasted AOG are not installed because of the end of the lifetime of the existing boilers, and as a consequence this investment would be done in the baseline scenario as well as under the project activity.

    - *This point has been specified in the (re-numbered) applicability condition (4). In addition, we have inserted a phrase "during the entire crediting period" to the (re-numbered) AOG3 option (continuation of current practice). And also we have added a relevant paragraph (20) at the end of Step 1 (Identification of alternative scenarios).*

<u>Additionality</u>

11. As the project activity may bring revenues to the ammonia plant owner, it is advised to include guidance on what is to be taken into consideration in the investment analysis, if applied, e.g. revenues from saving fuel, from usage of recovered ammonia, and also the related expenditures.

    - *A new bullet for "revenue" has been added in the Step 4 of the "Identification of the Baseline Scenario". In Step 4 in the previous section (baseline scenario identification), the "fuel cost" is calculated for each remaining scenario. Meanwhile, in the section to demonstrate additionality, the difference of the fuel cost "savings" can be expressed in the form of revenue as explained in paragraph 31. Both treatments are equivalent.*

12. The barrier analysis is not appropriate and requires substantive improvement. Several barriers are vague and subjective. COP/MOP has called for more objective approaches to demonstrate barriers, including quantitative approaches. It is recommended to substantially improve the guidance on the barrier analysis in order to make it clear and objective for the DOE in its validation. This guidance should describe which type of prove and documentation should be presented to the DOE, in order to objectively validate that such barrier is effectively alleviated by the CDM. In particular:

    - The barrier "there are other activities which are much more attractive" is not appropriate. The lack of economic attractiveness of the proposed project could be demonstrated with an investment analysis;
    - Perceived risks associated with the technology are not an investment barrier but rather a technological barrier. However, it is unclear what risks could be prohibitive for the proposed technology given that it is frequently implemented in the industry in many CDM countries;
    - The barrier "Technology supplier is lacking considering the specific situation of the host country, e.g., under sanction or other politically and/or economically constrained environment" is quite unclear and not an objective barrier;
    - Barriers should not refer to the willingness or perception of the management of the company (see the type of evidence that is allowed in the additionality tool); and

- Several barriers listed under "prevailing practice" are not related to the issue of prevailing practice.

A revised barriers analysis should take into consideration the guidance from the EB on demonstrating barriers. Project proponents may refer to the Annex 13 of the EB50 report.

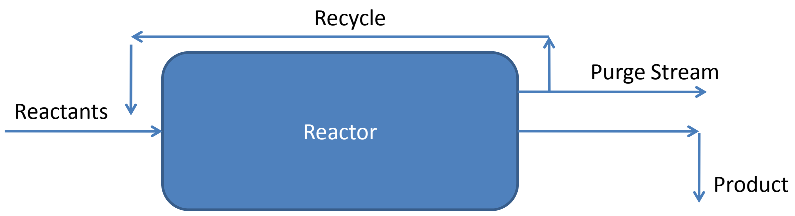
- *The relevant EB guidelines got released after the submission of the original version of this methodology. Based on the guidelines, we have added specific procedures for a DOE to validate how and whether the barriers are crucial for demonstrating additionality in (ne-numbered) paragraph 32. And the relevant explanation on how to apply the investment analysis to mitigate the barriers has been added in paragraph 25.*

13. Additional guidance should be provided to the implementation of the common practice analysis. Please provide additional guidance when the use of purge gases cannot be considered as common practice.

- *Paragraph 34 has been added for the explanation of common practice.*

<u>Baseline emissions</u>

14. The CDM benefits should not provide any incentive to increase the level of methane content in the AOG or increase in the quantum of AOG per unit of ammonia produced. In the present case, it is possible to carry out the operations at different levels of purge ratio. It is presented below under what conditions the concentration of methane or the volume of AOG can vary:



Stream	Flow Rate	Concentration of Non Reacting Substance (Methane in this case)
Reactants	R	X_R
Purge	P	X_P
Product	Q	0 (Zero)

Purge ration = P / R
= X_R / X_P (by Material Balance)
Value of X_P is generally fixed based on maximum allowable concentration of poisoning / non-reactive material whose concentrations may build up in the absence of purge stream. However the value of X_P can be varied by over a wide range to optimize the performance. Variation in the purge ratio is also possible due to intentional or unintentional variations in the concentration of poison / inert material (Methane in this case) in the reactant stream

As a consequence, provisions should be included in order to cap the emissions reduction potential by capping the quantum of methane per unit of ammonia production. This is to be based on historic level of emissions of methane and the corresponding volume of ammonia produced. Alternatively the purge ratio be fixed at the historical levels. Minimum purge ratio based on past three years historical data may be used. Moreover, project proponents are asked to assure in the procedure that the amount of methane vented or flared in the baseline is adequately determined.

- *In order to avoid gaming, Eq. (2) has been modified to set a cap on the volume of AOG per unit of ammonia production.*
  In the real world, the project owners' interest is not to obtain CERs but to increase ammonia production (their core business). Therefore, there is a strong incentive for them to reduce the volume of AOG. I personally consider that the provision to avoid gaming is not so important for "methane reduction" type projects. Reduction of methane is completely different from the case of HFC 23 or N_2O and does not provide strong incentive for gaming.

15. The methodology attempts to claim emission reduction due to avoiding venting of methane. However, as discussed previously in this recommendation, the methodology does not provide robust and sufficient provisions to ensure that venting occurred historically and systematically, and that it would continue in the absence of the project activity. For further clarity the project proponents should provide the gas composition of AOG in the underlying CDM-PDD.

- *Chemical composition of AOG has been added as a monitoring item. It is referred in the CO_2 emission factor, NCV and methane fraction of AOG after implementation of the project activity.*

16. Equation (1) should be editorially improved. It may be presented as: AOG * (CH_4 term * GWP_CH_4 + CO_2 term).

- *Eq. (1) has been modified to clarify this point as well as to specify underlying concept.*

17. It is not clear what emission factor should be used if several fuels are used in the boiler in the baseline. It is recommended to use the fuel with the lowest CO_2 emission factor in such cases.

- *Explanation of EF_{CO2,BL_fuel} has been modified as suggested.*

Monitoring

18. The vintage of data for the parameter 'efficiency of the baseline boiler' is indicated to be at least one month, which is collected once before project implementation. This procedure may not provide a representative estimate of the efficiency. It is recommended to use the "Tool to determine the baseline efficiency of thermal or electric energy generation systems" to determine the efficiency of the baseline boiler.

- *As per the above suggestion, the tool has been referred for the determination of the baseline boiler efficiency in the section of parameters not-monitored as well as in the section of baseline emissions formula.*

19. Data sources and measurement procedures need to be elaborated clearly for the parameter $AOG_{total,y}$.

- *The explanation for the monitoring item has been elaborated. Also, the name of the parameter has been changed to $Vol_{AOG,y}$ to avoid confusion.*

20. The parameter $MD_{project,y}$ should be rephrased. It is a term monitored under the project and not a hypothetical baseline term, as the wording suggests. This term is not needed if the equation is restructured.

- *The term MD is based on the concept of ACM0001, where MD represents methane emission reduction. This is also the case for ACM0008 for CMM use. We do not stick to the name of this term, but we maintain its name as it is to keep consistency with ACM0001 and ACM0008. Please change it as appropriate. The final expression of the equation (1) does not include MD in it.*

3. Minor changes required

Project emissions

21. In this section, it is advised that the project proponents use the approved "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" and "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", for calculating project emissions.

    - *We have added the explanation about the tools as you suggested.*

22. Moreover, for efficiency in the baseline, the methodology may refer to the approved "Tool to determine the baseline efficiency of thermal or electric energy generation systems" in case of single fuel, and also incorporate the approved "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", unless NCV for AOG can be measured directly on a GJ/m^3 basis instead of a GJ/t basis.

    - *We have added the reference to the tool to determine the baseline efficiency as you suggested. For AOG, NCV is calculated based on the chemical composition as specified in the monitoring section.*

Monitoring

23. It is not clear how $Q_{project,y}$ is monitored continuously, unless this means that the components (e.g. steam flow, temperature and pressure, feed water flow and temperature) are all monitored continuously. More explanation here or reference to a standard or tool would be useful.

    - *The original expression is from AM0006. It is replaced by the expression of ACM0012.*

24. If that is the case, monitoring provisions for the parameter $w_{CH4,y}$ should include continuous monitoring.

    - *Methane fraction $w_{CH4,y}$ has no direct relationship with the heat quantity $Q_{project,y}$ of generated steam.*

Project activity applicable under ACM0012

25. The panel would like to enquire the project proponents on whether they have considered submitting their project activity using the approved consolidated methodology ACM0012. In case that the project proponents considered that ACM0012 is not an appropriate alternative, please elaborate on the issues that would refrain you from using ACM0012.

    - *In order to apply ACM0012 for the proposed project activity, it is necessary to have it revised to take account of the methane decomposition effect, which constitutes the principal component (not a supplemental part) of our project. Therefore, we consider that it might be better to submit a new methodology (rather than to request the*

revision of ACM0012) that treats methane destruction effect as the principal part of emission reductions.
In addition, ACM0012 covers a wide range of waste energy recovery project, making the methodology itself rather complicated. We now understand that CMP has requested the CDM EB to provide the objective and 'concrete' procedures in the methodology, while ACM0012 is too generic to address different project types.

Editorial improvements

26. While the document is transparent and consistent, it does need a language edit to sharpen the grammar and syntax.

   - *We have tried our best to brush up English expressions. Please correct the wording and expressions at your discretion for the final recommendation to the CDM EB.*

27. All equations should be presented as per the guidelines for preparing new methodologies. Please use the correct symbols for relevant terms.

   - *We have tried to follow the guidelines, but if you find any inconsistencies with the guidelines, please correct them.*
     We would also like to notify the Meth Panel to keep stringent expression as specified in paragraph 36 for time-variant parameter in all of the methodologies. Sometimes, expressions are misleading:
     $$A_y \times B_y = \sum_{\text{interval}} (A_{\text{interval}} \times B_{\text{interval}}) \neq \left(\sum_{\text{interval}} A_{\text{interval}}\right) \times \left(\sum_{\text{interval}} B_{\text{interval}}\right).$$
     I remember that the original new methodology NM0007 specified the time-dependence as BE(t), while the reformatted AM0001 specified it as the suffix of y like BE_y which indicates the year (not interval). This may confuse the project participants as well as DOEs. Otherwise, it may be better to provide guidance for the meaning of this expression.

Section B. Summary and applicability of the baseline and monitoring methodology

1. Methodology title (for baseline and monitoring), submission date and version number

>>

Effective use of the waste gas emitted from ammonia production plant

Version 02
Completed: 18/01/2010

2. If this methodology is based on a previous submission or an approved methodology, please state the reference numbers (NMXXXX/AMXXXX/ACMXXXX) here. Explain briefly the main differences and their rationale.

>>

This is the revised version of NM0321 reflecting the suggestions in the preliminary recommendation dated 23/10/2009.

3. Summary description of the methodology, including major baseline and monitoring methodological steps

>>

Structure of baseline methodology

(A) Chooses the baseline scenario;

The project developer selects the baseline scenario, taking consideration of various technological options available to them. The alternatives must be credible and the technologically available to the developer. Several barriers, with examples specified in the methodology, must be considered. The baseline is the scenario that is the most economically attractive among the alternative scenarios, taking account of barriers to investment and national and/or sectoral policies or regulations. Analysis of the current practice as well as its justification shall be provided for the baseline scenario determination. The methodology can be used if the baseline scenario is identified as the continuation of current practice.

For identifying baseline scenario alternatives, the elements of the project activity can be divided into two components as follows:

(a) treatment/utilization of the ammonia-plant off gas (AOG), and

(b) heat supply for the steam generation.

(B) Demonstrates additionality of the project activity;

Additionality should be demonstrated by using 'Tool for the demonstration and assessment of additionality'. Elements in common with Procedure for the selection of the most plausible baseline scenario are excluded for simplicity.

(C) Calculates baseline emissions;

Calculation for the baseline emissions is composed of that for two gasses (CO_2 and CH_4), which expresses how the anthropogenic emissions of GHG by sources are reduced in the project boundary. These are, fundamentally, calculated from direct measurements of data for all emission sources *ex post*.

(D) Calculates project emissions;

Project emissions are to be calculated from direct measurements of data for all GHG emission sources within the project boundary during the implementation of the project activity. A cap is set for the volume of AOG per unit of ammonia production to avoid gaming.

(E) Calculates leakage;

No significant leakage is anticipated from the project activity.

(F) Identifies and collects monitoring data;

The methodology should describe all data parameters that must be measured and should describe the principles of data monitoring and recording system that must be in place for the determination of both baseline and project emissions.

(G) Calculates emissions reductions;

The amount of emission reductions is simply calculated by subtracting the project emissions from the baseline emissions.

Section C. Proposed new baseline and monitoring methodology

Draft baseline and monitoring methodology AMXXXX

"Effective use of the waste gas emitted from ammonia production plant"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This consolidated baseline and monitoring methodology is based on the following proposed new methodologies:

- NM0321 "Effective use of the waste gas emitted from ammonia production plant" prepared by Climate Experts, Ltd.;

This methodology also refers to the latest approved versions of the following tools:

- Tool to calculate project emissions from electricity consumption;
- Tool for the demonstration and assessment of additionality;
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion;
- Tool to determine the baseline efficiency of thermal or electric energy generation systems; and
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption.

For more information regarding the proposed new methodologies and the tools as well as their consideration by the Executive Board please refer to http://cdm.unfccc.int/goto/MPappmeth.

Selected approach from paragraph 48 of the CDM modalities and procedures

1. "Existing actual or historical emissions, as applicable"

Definitions: Please provide definitions of key terms that are used in this proposed new methodology

2. For the purpose of this methodology, the following definition applies:

- **Ammonia-plant off gas (AOG):** The proposed project targets "purge gas" at an ammonia-plant if it is released to the atmosphere without recovery. This gas is called AOG in this methodology. In the last process of ammonia production "NH_3 synthesis" where the synthesis gas needs to be continuously circulated because of its low conversion rate, during which impure substances (argon and methane) are continuously accumulated. Since this accumulation prevents the reaction of NH_3 synthesis, a certain rate of the circulation gas needs to be constantly purged outside of the loop as waste. This purge gas is called AOG. AOG purged outside the loop during the NH_3 synthesis process contains CH_4. This CH_4 is not a component of the natural gas—the raw material of ammonia. CH_4 contained in the natural gas is almost-totally consumed in secondary reforming which is the intermediate process of ammonia production. A fraction of CO/CO_2, remaining in the synthesis gas, can poison the ammonia synthesis catalyst and must be removed usually by conversion to CH_4 through hydrogenation. (As for explanation of the ammonia production process, please see Section A.4.3 in attached PDD.)

Applicability conditions

3. This methodology applies to Sectoral Scope 5 – Chemical industries.

4. The methodology is applicable to the project activity that satisfies the following conditions:

(1) The project activity collects and utilizes all of the ammonia-plant off gas (AOG) which has been released to atmosphere without recovery or flaring at an *existing* ammonia production plant before implementation of the project. It shall be demonstrated by direct measurements of the energy content and the amount of the AOG produced for at least three years prior to the start of the project activity;

(2) Regulations of the host country on volume, concentration, chemical composition or others of the ammonia-plant off gas (AOG) do not prohibit the current practice to release AOG without flaring, recovery or other treatment prior to implementation of the project activity;

(3) The project activity does not increase the lifetime of the boiler existent prior to the project activity during the crediting period (*i.e.*, emission reductions are only accounted up only to the end of the lifetime of the boiler existent prior to the project activity). The options specified in the latest guideline "Treatment of the lifetime of plants and equipment in proposed new baseline methodologies"[2] are applied for the assessment of the lifetime;

(4) The proposed project activity does not result in integrated process change for the chemical complex;

(5) The project activity utilizes the ammonia-plant off gas (AOG) only for steam generation by an AOG-specific new boiler in the ammonia-plant without mixing with other fuels to replace internal fuel use for this purpose. The total of the steam demand in the facility is not affected or reduced[3] by the project activity; and

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[2] http://cdm.unfccc.int/Reference/Guidclarif/meth/meth_guid09_v01.pdf:

(a) A sector and/or activity specific method or criteria to determine when the equipment would be replaced or retrofitted in the absence of the CDM;

(b) The typical average technical lifetime of the type equipment may be determined and documented, taking into account common practices in the sector and country, *e.g.* based on industry surveys, statistics, technical literature, *etc.*;

(c) The practices of the responsible entity/project participants regarding replacement schedules may be evaluated and documented, *e.g.* based on historical replacement records for similar equipment.

[3] In case some ammonia is partly recovered from AOG by the project activity, the total ammonia production in the baseline scenario from steam use would be larger than that of the project activity.

(6) AOG that is released from abnormal operation (*e.g.*, in the case of emergencies, shut down) of the plant shall not be accounted for emission reductions.

5. In addition, the applicability conditions included in the above mentioned tools are applied.

6. This methodology is not applicable to the case where an industrial facility captures and utilizes a portion of AOG in the absence of the project activity.

7. The project activity may clear off ammonia from AOG before its utilization as a fuel and/or install De-NOx equipment from exhaust gas from the AOG-fueled boiler.

8. Finally, this methodology is only applicable when the continuation of total atmospheric release of AOG without flaring, recovery or other treatment is provided to be the most plausible baseline scenario.

II. BASELINE METHODOLOGY PROCEDURE

Project boundary

9. The project aims to install equipment to collect all of the AOG (except for the case of emergency) and use it as a single fuel (not mixing with other fuels) for steam generation in a new boiler specifically designed for AOG. It replaces some exiting boiler(s) which use(s) a fossil fuel (although the replaced one may be kept as it is for back-up purposes). In order to clean AOG, ammonia absorber and/or DeNOx equipment may be introduced to collect ammonia from it and/or to clean the exhaust gas as shown in Figure 1.

10. The **spatial extent** of the project boundary encompasses the site of the project activity where the off gas is captured and used as the boiler fuel in the chemical complex. Figure 1 illustrates the project boundary as well as key equipments:

Figure 1: Project Boundary

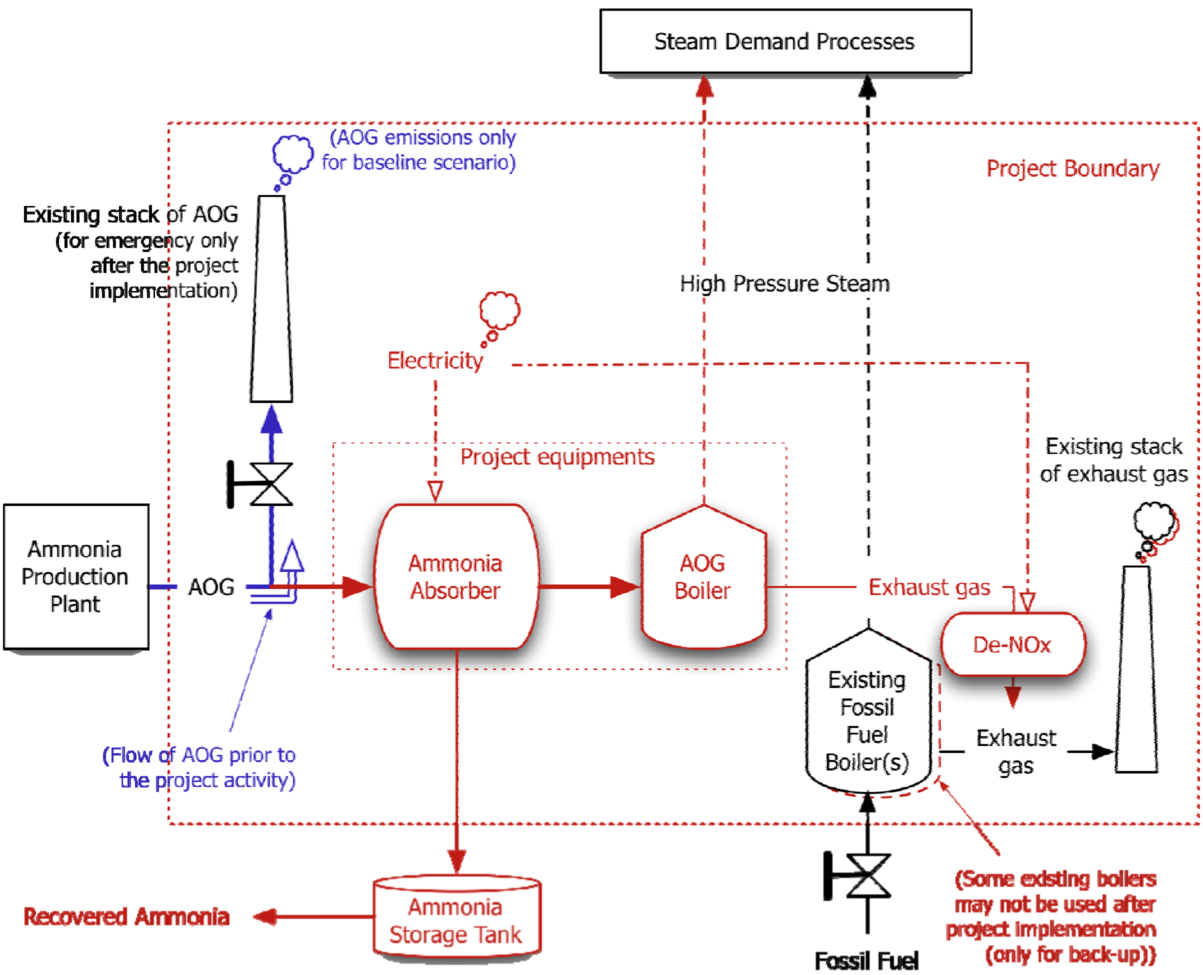
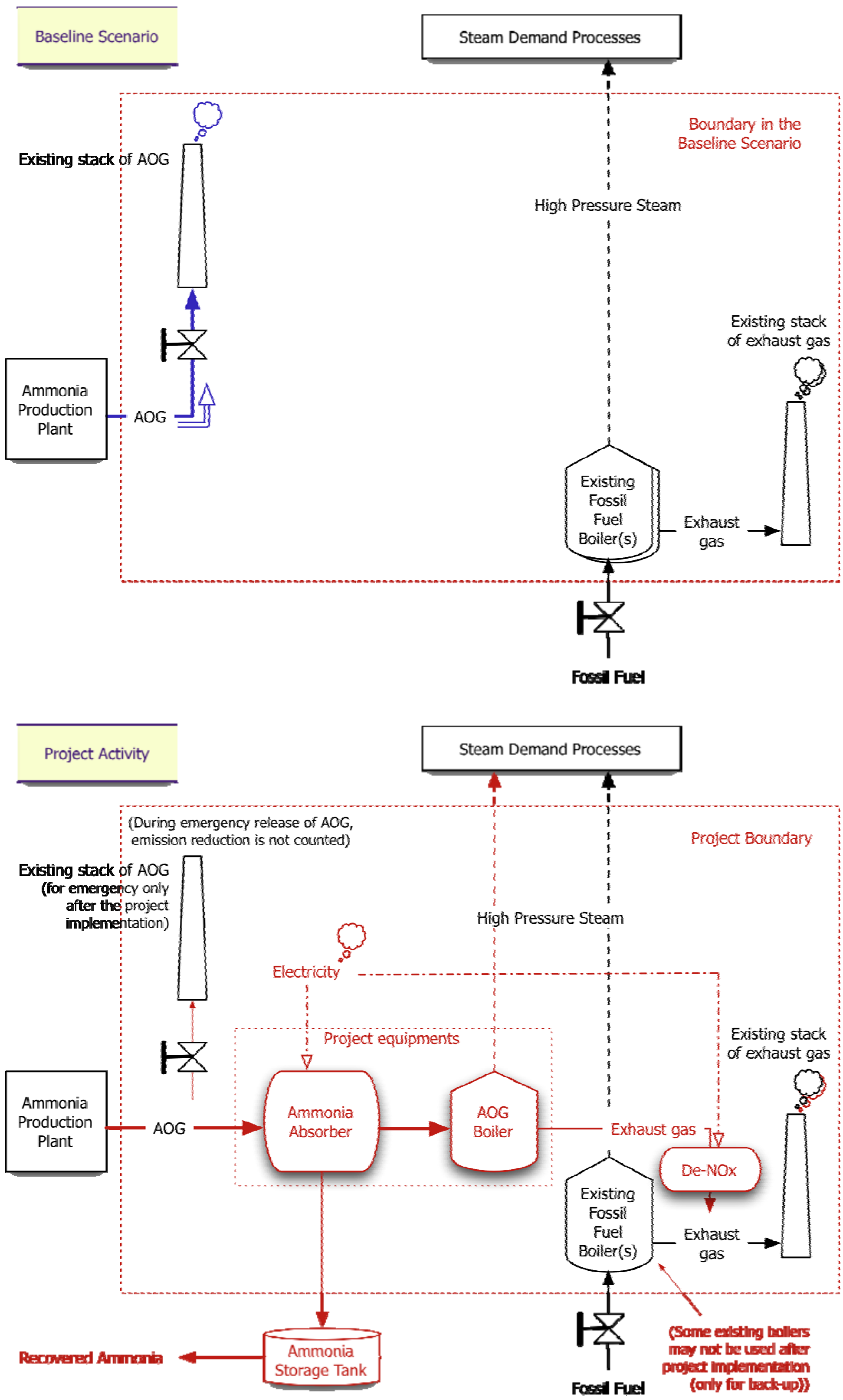


Figure 1 (alternative): Boundaries for the baseline scenario and the project activity



11. The greenhouse gases included in or excluded from the calculation are shown in

12. Table 1:

Table 1: Summary of gases and sources included in the project boundary

Source		Gas	Included?	Justification / Explanation
Baseline	Emissions as the ammonia-plant off gas (AOG) without flaring or any other disposal	CO_2	No	CO_2 is not utilized both for the baseline scenario and the project activity (common emissions).
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	Little N_2O is contained in ammonia-plant off gas (AOG). Exclusion of this gas is conservative.
	Baseline fuel burning for the boiler (equivalent to the thermal output which is displaced by the ammonia-plant off gas)	CO_2	Yes	The major source of emissions in the baseline.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project activity	Combustion and utilization of ammonia-plant off gas (AOG) by the project activity	CO_2	Yes	The major source of emissions. (CO_2 emissions from CO_2 contained in ammonia-plant off gas prior to burning are excluded.)
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from electricity use for the purpose of removing ammonia in ammonia-plant off gas (AOG) and avoiding NO_X generation	CO_2	Yes	Maybe an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

Identification of the baseline scenario

13. Project participants shall apply the following steps to identify the baseline scenario:

Step 1: Identification of alternative scenarios

14. Project participants shall use Step 1 of the latest version of the "Tool for the demonstration and assessment of additionality", to identify all realistic and credible baseline alternatives. In doing so, relevant local policies and regulations related to the management of ammonia-plant off gas (AOG) of the host country should be taken into account. Such policies or regulations may include mandatory ammonia-plant off gas capture or destruction requirements for a safety purpose or local environmental regulations on volume, concentration, chemical composition or others.[4] Other policies could include local policies that promote productive use of ammonia-plant off gas. In addition, the assessment of alternative scenarios should take account of local economic and technological circumstances.

    National and/or sectoral policies and circumstances of the host country must be taken into account in the following ways:

- In Sub-step 1b of the "Tool for the demonstration and assessment of additionality", the project participants must show that the project activity is not the only alternative that is in compliance with all regulations;
- Project participants must take account of the scenario where some/all of the methane generated in the baseline is captured and destroyed to comply with regulations or contractual requirements;
- The project participants must monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

15. In addition, the PDD shall describe in detail the current practice of the ammonia-plant (*i.e.*, release of the off gas without recovery) as well as the reason why the situation has been continued. Chronological description on the project owner's efforts to utilize the off gas, if any, shall be provided as well as the reasons why the efforts have not been realized yet.

16. In identifying baseline scenario alternatives, the elements of the project activity can be divided into two components as follows:

    (a) treatment/utilization of the ammonia-plant off gas (AOG), and

    (b) heat supply for the steam generation.

17. The baseline scenario alternatives for <u>(a) treatment/utilization of the off gas</u> in the absence of the project activity, *i.e.*, the scenario relevant for estimating baseline emissions, to be analysed should include, *inter alia*:

    <u>AOG1</u>: The project activity (*i.e.*, capture of ammonia-plant off gas and its use for steam generation in an AOG-specific boiler not being mixing with other fuels) undertaken without being registered as a CDM project activity;

    AOG2: Capturing AOG and using it for steam or power generation with a boiler by mixing it with other fuels;

[4] The project developer must bear in mind the relevant clarifications on the treatment of national and/or sectoral policies and regulations in determining a baseline scenario as per Annex 3 to the Executive Board 22nd meeting and any other forthcoming guidance from the Board on this subject.

AOG3: Continuation of current practice (*i.e.*, release of the ammonia-plant off gas to the atmosphere without recovery) during the entire crediting period;

AOG4: (Partial) capture of the off gas and flaring it;

AOG5: (Partial) capture of the off gas for energy use other than steam generation at the chemical complex;

AOG6: (Partial) capture of the off gas for feedstock use at the chemical complex; and

AOG7: (Partial) capture of the off gas for sale.

18. For (b) heat supply for the steam generation, the realistic and credible alternative(s) may include, *inter alia*:

HS1: The project activity (*i.e.*, capture of ammonia-plant off gas and its use for steam generation) undertaken without being registered as a CDM project activity;

HS2: Continuation of the current practice of using the existing fossil fuel; and

HS3: Change of the current fossil fuel with another fuel.

19. For heat supply, the technical conditions such as compatibility of burner and/or boiler as well as the possibility of fuel mix and fuel accessibility may be considered.

20. For option AOG3, lifetime of the existing boiler (to be replaced in the project activity) shall be assessed regarding whether it can continuously be used until the end of the crediting period. The options specified in the latest guideline "Treatment of the lifetime of plants and equipment in proposed new baseline methodologies"[5] are applied to assess the lifetime.

Step 2: Eliminate alternatives that are not complying with applicable laws and regulations

21. Eliminate alternatives that are not in compliance with all applicable legal and regulatory requirements. Apply Sub-step 1b of the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board.

Step 3: Eliminate alternatives that face prohibitive barriers

22. Scenarios that face prohibitive barriers should be eliminated plying Step 3 of the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board as well as the elements shown in the following additionality section.

[5] http://cdm.unfccc.int/Reference/Guidclarif/meth/meth_guid09_v01.pdf:

(a) A sector and/or activity specific method or criteria to determine when the equipment would be replaced or retrofitted in the absence of the CDM;

(b) The typical average technical lifetime of the type equipment may be determined and documented, taking into account with common practices in the sector and country, *e.g*. taken into consideration based on industry surveys, statistics, technical literature, *etc*.;

(c) The practices of the responsible entity/project participants regarding replacement schedules may be evaluated and documented, *e.g*. based on historical replacement records for similar equipment.

23. The barriers, which have historically prevented the utilization of the off gas, shall be studied. The relevant guidelines/guidance on the barrier analysis provided by the Board are applied for this step.

- If there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario;
- If there are still several remaining alternative scenarios, project participants shall go to Step 4.

Step 4: Compare economic attractiveness of remaining alternatives

24. Compare the economic attractiveness without revenues of CERs for all alternatives that are remaining after applying Step 2 of the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board. The economic investment analysis shall explicitly state the following parameters:

- Investment requirements (*incl*. break-up into major equipment cost, required construction work, installation);
- A discount rate appropriate to the country and sector
(Use government bond rates, increased by a suitable risk premium to reflect private investment in fuel switching projects, as substantiated by an independent (financial) expert);
- Efficiency of each boiler, taking into account any differences between fuels;
- Current price and expected future price (variable costs) of each fuel
(Note: As a default assumption the current fuel prices may be assumed as future fuel prices. Where project participants intend to use future prices that are different from current prices, the future prices have to be substantiated by a public and official publication from a governmental body or an intergovernmental institution);
- Operating costs for each fuel (especially, handling/treatment costs);
- Revenues from recovered ammonia, *etc*, if any;
- Lifetime of the project, equal to the remaining lifetime of the existing boiler; and
- Other operation and maintenance costs.

25. Barriers that can be mitigated by additional financial means can be quantified and represented as costs. They should be considered in the framework of this investment analysis (*i.e.*, should not be identified as a barrier for implementation).

26. In the calculation of the appropriate economic indicator, the residual value of the new equipment at the end of the lifetime of the project activity should be taken into account. Provide all the assumptions in the CDM-PDD.

27. Compare the economic indicator of the different scenarios and select the most cost-effective scenario as the baseline scenario. Include a sensitivity analysis applying Sub-step 2d of the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM

Executive Board. The investment analysis provides a valid argument that the most cost-effective scenario is the baseline scenario if it consistently supports (for a realistic range of assumptions) this conclusion. In case the sensitivity analysis is not fully conclusive, select the baseline scenario alternative with least emissions among the alternatives that are the most economically attractive according to the investment analysis and the sensitivity analysis.

28. This methodology is only applicable if the continuation of the use of coal or petroleum fuel throughout the crediting period is the most plausible baseline scenario.

29. This methodology is only applicable if the baseline scenario is identified to be the continuation of current practice (AOG3 × HS2), *i.e.*, the continuation of the use of existing fossil fuel throughout the crediting period is the most plausible baseline scenario.

Additionality: Please describe the procedure for demonstrating additionality

30. Additionality shall be demonstrated using the latest version of the "Tool for the demonstration and assessment of additionality". The investment analysis and the barrier analysis can be in arbitrary order.

31. For assessment of investment, the relevant part of the "identification of the baseline scenario" is applied. In it, key factors/assumptions shall be emphasized. The revenues from fuel saving and from usage of recovered ammonia as well as related expenditures shall be clearly stated, especially as the difference between two scenario options: project activity without CERs and continuation of the current practice.

32. The barriers listed below should be evaluated as part of the application of the latest version of the "tool for the demonstration and assessment of additionality" as well as the "Guidelines for objective demonstration and assessment of barriers"[6]:

- Investment barriers, other than the economic/financial barriers, *e.g.*:
    - Funding or finance is not available for innovative projects. The project participants shall provide the loan agreement specifying the attractiveness of CDM as the crucial element if loan is the essential element for investment;
    - There are other activities which are much more attractive and make the priority of the project activity lower. For this, the project participants shall provide the document(s) prepared by the experienced third/independent party for assessment of the possible investment options specific to the project owner company. The document(s) shall include a list of possible investment options with analysis and priority. If the document includes precise economical investment table (to be re-assessed by the DOE) as the essential element of the investment, this is to be specified in the "investment analysis" part.
- Technological barriers[7], *e.g.*:

[6] See http://cdm.unfccc.int/Reference/Guidclarif/meth/meth_guid38.pdf.
[7] The technologies mentioned here are not limited to that of the project activity but covers those of baseline scenario options.

- Real and/or perceived risks associated with the technology or process are too high to attract investment. The project participants shall provide evidences that the penetration of the technology is less than 10% in the world or in non-Annex I countries in a same (ammonia production) sector by using some officially published documents/statistics;
- The technology supplier is not available due to the specific situation of the host country,. This barrier is considered crucial if the host country is under international economical sanction. Other politically and/or economically constrained environment can be considered. The project participant(s) shall provide the technology supplier's opinion/decision in this regard;
- The host company (or companies in similar situation in the host country) has experiences to try to utilize the waste gas, but failed. The history of the trials shall be provided to demonstrate this barrier by providing letters by the technology supplier for assessment of the trials;
- Skilled and/or properly trained labour to operate and maintain the technology is not available, leading to equipment disrepair and malfunctioning. If the associated barrier can be mitigated by additional expenses (by, *e.g.*, implementation of training), this shall be included in the investment analysis part. On the other hand, if other unavoidable situation, *e.g.*, local safety situation or political instability of the host country, is the reason, the difficulties shall be demonstrated objectively why it cannot be overcome by the project owner by showing potential technology supplier's opinion.

● Barriers due to prevailing practice, *e.g.*:

- The project is the "first-of-this-kind". If no other practices (including CDM) in the relevant sector is found in the host country, the project activity can be judged as "first-of-this-kind" and the project activity is additional. If other provisions for "first-of-this-kind" are decided by the CDM Executive Board, such provisions are applicable for its demonstration;

● Other supplemental barriers, each of which cannot be a sole reason to demonstrate additionality, *e.g.*:

- The management of the host company does not have an incentive to increase energy efficiency institutionally, which may be seen in state-owned companies. If so, such institutional reasons shall be explained;
- Developers are not familiar with state-of-the-art technologies and are reluctant to use them;
- Management lacks experience of using state-of-the-art technologies, so that the project receives lower priority by the management;
- Perceived technical and financial risks to enterprises (fears that a new technology may not work, could interrupt production, take time to perfect, or will not actually result in financial savings);
- Real and perceived insignificance of many investments – for example, if energy efficiency projects are relatively small and the value of the generally estimated savings constitutes only a small percentage of the enterprise operating costs.

33. These identified barriers are to be considered only if they would prevent potential project proponents from carrying out the proposed project activity were it not registered as a CDM activity.

34. For common practice assessment, penetration rate for utilization of AOG is assessed in the relevant ammonia production sector of the host country by using the statistics of the host country

government or international body. If it is below 20%, the step of common practice is passed. In addition, in case the technologies to utilize AOG are found in other countries, an assessment shall be provided for what is (are) the key/decisive element(s) for this gap considering the investment and barrier analyses above.

Baseline emissions

35. The baseline emissions is represented as:

$$\begin{aligned} BE_y &= MD_{\text{project},y} \times GWP_{\text{CH4}} + FF_{\text{BL\_fuel},y} \times EF_{\text{CO2,BL\_fuel}} \\ &= MD_{\text{project},y} \times GWP_{\text{CH4}} + \left(\eta_{\text{PJ\_boiler},y} / \eta_{\text{BL\_boiler}}\right) \times Q_{\text{AOG},y} \times EF_{\text{CO2,BL\_fuel}} \\ &= Vol^{\text{CR}}{}_{\text{AOG},y} \times w_{\text{CH4},y} \times \rho_{\text{CH4}} \times GWP_{\text{CH4}} + \left(1/\eta_{\text{BL\_boiler}}\right) \times Q_{\text{project},y} \times EF_{\text{CO2,BL\_fuel}} \end{aligned} \quad (1)$$

with

$$MD_{\text{project},y} = Vol^{\text{CR}}{}_{\text{AOG},y} \times w_{\text{CH4},y} \times \rho_{\text{CH4}} \quad (2)$$

$$Vol^{\text{CR}}{}_{\text{AOG},y} = \min\left[Vol_{\text{AOG},y} / Prod_{\text{AM},y},\ \langle Vol / Prod \rangle_{\text{hist}}\right] \times Prod_{\text{AM},y} \quad (3)$$

$$Q_{\text{AOG},y} = Vol_{\text{AOG},y} \times NCV_{\text{AOG},y} \quad (4)$$

$$\eta_{\text{PJ\_boiler},y} = Q_{\text{project},y} / Q_{\text{AOG},y} \quad (5)$$

where

BE_y : Baseline emissions in a reporting interval *y* (tCO_2e/reporting interval).

$MD_{\text{project},y}$: The amount of methane in the AOG (tCH_4/reporting interval) that would have been combusted by the project activity in an interval *y* (monitored and recorded daily). This is calculated in (2) as a conservative method.

GWP_{CH4} : Global Warming Potential of methane (for the first commitment period, GWP_{CH4} is 21) (tCO_2e/tCH_4).

$FF_{\text{CO2,BL\_fuel},y}$: The amount of baseline fossil fuel which would be used in the replaced baseline boiler (GJ/reporting interval). This is calculated by using $\eta_{\text{BL\_boiler}}$ and $Q_{\text{project},y}$ as shown in (1): $FF_{\text{CO2,BL\_fuel},y} = \left(1/\eta_{\text{BL\_boiler}}\right) \times Q_{\text{project},y}$.

$EF_{\text{CO2,BL\_fuel}}$: CO_2 emission factor of the baseline fuel that would be combusted for steam generation in the absence of the project (tCO_2/GJ). If multiple fuels are used in the baseline, the lowest CO_2 emission factor is applied.

$Q_{AOG,y}$: Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used in a reporting interval *y* by the project activity (GJ/reporting interval).

η_{BL_boiler} : Net efficiency of steam generation for the boiler used in the absence of the project (no dimension; fixed value measured prior to implementation of the project activity). To obtain a rate for this parameter, Option C, D, E or F specified in "Tool to determine the baseline efficiency of thermal or electric energy generation systems"[8] is applied.

$\eta_{PJ\_boiler,y}$: Net efficiency of steam generation for the boiler used by the project activity (no dimension; fixed value measured after implementation of the project activity in reporting interval *y*). This parameter is not expressed in the final expression of (1), thus not to be monitored.

$Prod_{AM,y}$: Production of ammonia in a reporting interval *y* (tNH_3/reporting interval).

$Vol_{AOG,y}$: Total volume of ammonia-plant off gas (AOG) after removing ammonia used by the project activity in an interval *y* (Nm^3/reporting interval). The AOG flow (after removing ammonia) is measured continuously and corrected to the standard condition.

$Vol^{CR}_{AOG,y}$: Corrected total volume of ammonia-plant off gas (AOG) with a cap set by historical emission intensity of AOG per NH_3 production in a reporting interval *y* (Nm^3/reporting interval) as defined in eq. (3).

$\langle Vol/Prod \rangle_{hist}$: The cap set for the volume of AOG per unit of ammonia production. It is defined as the historical weighted average of annual amount of AOG per unit of ammonia production during the latest 3 years before implementation of the project (Nm^3/tNH_3) (fixed value to be determined before implementation of the project).

$w_{CH4,y}$: Mean methane fraction in the ammonia-plant off gas (AOG) after removing ammonia in the project scenario in a reporting interval *y* (m^3CH_4/m^3AOG).

ρ_{CH4} : Methane density (tCH_4/m^3CH_4) in the standard condition.

$NCV_{AOG,y}$: Net calorific value (energy content) of the ammonia-plant off gas (AOG) after removing ammonia in an interval *y* (MJ/m^3) in a reporting interval *y*.

$Q_{project,y}$: Net quantity of heat (steam) generated from firing AOG in a reporting interval *y* (GJ/reporting interval).

36. [Note] The notation "*y*" above should be read as the interval (notably monitoring interval). If *y* is recognized as some period like a year, it shall be noted that the notation $A_y \times B_y$ is NOT the product of the aggregated values BUT the aggregation of the product specified in each monitoring interval, *i.e.*, $A_y \times B_y = \sum_{interval}(A_{interval} \times B_{interval}) \neq \left(\sum_{interval} A_{interval}\right) \times \left(\sum_{interval} B_{interval}\right)$.

[8] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf.

37. The emission intensity of AOG is capped in the baseline emission calculation as shown in (2).

Project emissions

38. Project emissions include

1.– CO_2 emissions due to burning the ammonia-plant off gas (AOG) for fuel, and

2.– CO_2 emissions due to electricity consumption for removing ammonia contained in the AOG and for removing NOx from exhaust gas with additional De-NOx equipment, if any.

39. The project emissions is represented as:

$$PE_y = PE_{\mathrm{AOG},y} + PE_{\mathrm{EL},y}$$
$$= Q_{\mathrm{AOG},y} \times EF_{\mathrm{CO2,AOG},y} + \left(EC_{\mathrm{AA},y} + EC_{\mathrm{DeNOx},y}\right) \times CEF_{\mathrm{EL}} \quad (5)$$

where

PE_y :	Project emissions in a reporting interval *y* (tCO_2e/reporting interval).
$PE_{\mathrm{AOG},y}$:	Project emissions from ammonia-plant off gas (AOG) combustion for fuel in a reporting interval *y* (tCO_2/reporting interval).
$PE_{\mathrm{EL},y}$:	Project emissions from electricity consumption for removing ammonia contained in the ammonia-plant off gas (AOG) and for removing NOx with De-NOx equipment, if any, in a reporting interval *y* (tCO_2/reporting interval).
$Q_{\mathrm{AOG},y}$:	Net heat quantity of the ammonia-plant off gas (AOG) after removing ammonia that would be used in a reporting interval *y* by the project activity (MJ/duration of interval).
$EF_{\mathrm{CO2,AOG},y}$:	CO_2 emission factor of the ammonia-plant off gas (AOG) after removing ammonia in a reporting interval *y* calculated based on the composition of the AOG (tCO_2/MJ). To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”[9] is applied.
$EC_{\mathrm{AA},y}$:	Quantity of electricity consumed for removing ammonia from AOG with ammonia absorber in a reporting interval *y* (MWh/reporting interval).
$EC_{\mathrm{DeNOx},y}$:	Quantity of electricity consumed by DeNOx equipment in a reporting interval *y* (MWh/reporting interval).
CEF_{EL} :	CO_2 emission factor of electricity consumed in the latest year at the time of validation (tCO_2/MWh). A fixed value can be used as far as the grid electricity is used as per the section of “Determination of the emission factor

[9] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf.

for electricity generation" specified in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"[10].

Leakage

40. No leakage needs to be accounted under this methodology.

Emission reductions

41. Emission reductions ER_y in the year y are calculated as follows:

$$ER_y = BE_y - PE_y \quad (6)$$

42. For the time of emergency, emission reductions are not counted.

Changes required for methodology implementation in 2^{nd} and 3^{rd} crediting periods

43. No changes in the methodology will be necessary when the application of the methodology extends to the 2^{nd} and 3^{rd} crediting period. It is noted that the project participant shall confirm that the local laws/regulations do not prohibit continuing releasing the ammonia-plant off gas (AOG) without recovery at the time of renewal of the crediting period.

Data and parameters not monitored

44. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter:	Regulatory requirements relating to ammonia-plant off gas (AOG)
Data unit:	–
Description:	Regulatory requirements relating to ammonia-plant off gas (AOG)
Source of data:	Publicly available information of the host country's regulatory requirements related to ammonia production plant.
Measurement procedures (if any):	–
Data unit:	–
Any comment:	Conditions of the regulation shall be checked, *e.g.*, on volume, concentration, chemical composition or others.

[10] See http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf.

	Relevant regulations for ammonia-plant off gas (AOG) utilization project activities shall be updated at renewal of each credit period. Project participants should explain how regulations are translated into that amount of gas.

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC (Second Assessment Report for the first commitment period).
Measurement procedures (if any):	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
Any comment:	–

Data / Parameter:	ρ_{CH4}
Data unit:	tCH_4 /Nm^3CH_4
Description:	Methane density in the standard condition.
Source of data:	Chemical theory
Measurement procedures (if any):	At standard temperature and pressure (0 degree Celsius and 1 atm), the density of methane is 0.0007168 tCH_4/m^3CH_4.
Any comment:	–

Data / Parameter:	CEF_{EL}
Data unit:	tCO_2 /MWh
Description:	CO_2 emission factor of electricity consumed by ammonia absorbers and/or by DeNOx equipment.
Source of data:	Grid supplier data, reliable official publications. Or relevant fuel and power generation data if power is supplied by in-house power system.
Measurement procedures (if any):	A fixed value can be used as long as the grid electricity is used as per the section of "Determination of the emission factor for electricity generation" specified in the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 01.
Any comment:	In case the power supply source, fuel or generator is changed, the relevant recalculation shall be undertaken as appropriate to revise the data which is to be verified at verification.

Data / Parameter:	$\eta_{BLboiler}$
Data unit:	– (no dimension)
Description:	Net efficiency of steam generation for the boiler in the absence of the project.
Source of data:	See below.
Measurement procedures (if any):	To obtain a rate for this parameter, Option C, D, E or F specified in "Tool to determine the baseline efficiency of thermal or electric energy generation systems" is applied.
Any comment:	Fixed value measured prior to implementation of the project activity.

Data / Parameter:	$\langle Vol/Prod \rangle_{hist}$
Data unit:	Nm^3/tNH_3

Description:	Cap set for the volume of AOG per unit of ammonia production
Source of data:	Historical (annual) data of AOG volume and ammonia production for the latest 3 years prior to the validation
Measurement procedures (if any):	This is defined as the historical weighted average of annual amount of AOG per unit of ammonia production during the latest 3 years before implementation of the project (Nm^3/tNH_3). Calculated by historical record of these data. In case direct measured historical data are not available, calculation based on stoichiometry and mass/energy-balance relation using historical data can be applied. For this case, statistically conservative estimation within the 95% confidence level shall be maintained.
Any comment:	Fixed value measured prior to implementation of the project activity.

III. MONITORING METHODOLOGY

45. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

46. In addition, the monitoring provisions in the tools referred to in this methodology apply.

Data and parameters monitored

Data / Parameter:	$Prod_{AM,y}$
Data unit:	tNH_3/reporting interval
Description:	Production of ammonia in a reporting interval *y*
Source of data:	Measurement device
Measurement procedures (if any):	Measured by volume flow meter or other gauge for volume measurement of liquid ammonia.
Monitoring frequency:	Monitored continuously or daily. Recorded daily for accumulated volume data.
QA/QC procedures:	Checked against the sales record.
Any comment:	This data is used to determine the corrected volume of AOG. The correction is by setting a cap for its intensity per ammonia production (see eq. (3)).

Data / Parameter:	$Vol_{AOG,y}$
Data unit:	Nm^3/reporting interval
Description:	Total volume of ammonia-plant off gas (AOG) used adjusted at standard temperature and pressure after removing ammonia by the project activity in a reporting interval *y*
Source of data:	Volume flow meter
Measurement procedures (if any):	Measured by volume flow meter adjusted by normalizing function set between the ammonia absorber and the AOG-fuelled boiler.
Monitoring frequency:	Continuously
QA/QC procedures:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	–

Data / Parameter:	Chemical composition of AOG
Data unit:	Vol. %
Description:	Chemical composition of the ammonia-plant off gas (AOG) after removing ammonia in an interval *y.*
Source of data:	Laboratory componential analysis.
Measurement	Laboratory analysis of the ammonia-plant off gas (AOG) after

procedures (if any):	removing ammonia by using gas-chromatography or an equivalent method. To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” is applied.
Monitoring frequency:	Daily
QA/QC procedures:	Check the consistency of the data by comparing the data from previous days/months/years.
Any comment:	Methane component is used for calculation of $w_{CH4,y}$, hydro-carbon components, H_2 components and others are used to calculate $EF_{AOG,y}$ and $NCV_{AOG,y}$.

Data / Parameter:	$w_{CH4,y}$
Data unit:	m^3CH_4/m^3AOG
Description:	Methane fraction in the ammonia-plant off gas (AOG) after removing ammonia in the project scenario in a reporting interval y
Source of data:	Specified in the data of chemical composition of AOG as the methane component.
Measurement procedures (if any):	Laboratory analysis (gas-chromatography).
Monitoring frequency:	Daily.
QA/QC procedures:	Check the consistency of the data by comparing the data with those for previous days/months/years.
Any comment:	–

Data / Parameter:	T_y
Data unit:	°C
Description:	Temperature of the ammonia-plant off gas (simultaneously with $Vol_{AOG,y}$) in a reporting interval y
Source of data:	Temperature sensor
Measurement procedures (if any):	Measured to determine $Vol_{AOG,y}$. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing ammonia-plant off gas (AOG) volumes after removing ammonia in normalized cubic meters.
Monitoring frequency:	Continuously
QA/QC procedures:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards.
Any comment:	–

Data / Parameter:	P_y
Data unit:	Pa
Description:	Pressure of the ammonia-plant off gas (simultaneously with $Vol_{AOG,y}$) in a reporting interval y
Source of data:	Pressure meter
Measurement procedures (if any):	Measured to determine $Vol_{AOG,y}$. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure,

	expressing ammonia-plant off gas (AOG) volumes (after pre-cleaning) in normalized cubic meters.
Monitoring frequency:	Continuously
QA/QC procedures:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance with appropriate national/international standards.
Any comment:	–

Data / Parameter:	$NCV_{AOG,y}$
Data unit:	MJ /Nm^3/reporting interval
Description:	Net calorific value (energy content) of the ammonia-plant off gas (AOG) after removing ammonia in a reporting interval *y*
Source of data:	Calculated based on the chemical composition of AOG from laboratory analysis
Measurement procedures (if any):	Calculated based on chemical formula (*esp*., heat of reaction) of each components if all of them are oxidized (combusted).
Monitoring frequency:	Daily
QA/QC procedures:	Check the consistency of the data by comparing the data with those for previous days/months/years. Ensure that the *NCV* is determined on the basis of dry gas.
Any comment:	–

<table>
<tr><td>Data / Parameter:</td><td>NCV_{BL fuel,y}</td></tr>
<tr><td>Data unit:</td><td>MJ / mass or volume unit</td></tr>
<tr><td>Description:</td><td>Net calorific value of baseline fossil fuel type after removing ammonia) in a reporting interval y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>Preferred source of data</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national average default values</td><td>If (a) is not available.
These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>(d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards. This value is obtained once before implementation of the project and fixed during the crediting</td></tr>
</table>

	period.

Monitoring frequency:	For (a) and (b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
	For (c): Review appropriateness of the values annually.
	For (d): Any future revision of the IPCC Guidelines should be taken into account.

QA/QC procedures:	Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values are over this range, collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (a), (b) or (c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	This parameter is monitored to identify η_{BL_boiler} and EF_{CO2,BL_fuel}. Note that for the *NCV*, the same basis (pressure and temperature) should be used as for the fuel consumption.

<table>
<tr><td>Data / Parameter:</td><td>EF_{CO2,BL_fuel}</td></tr>
<tr><td>Data unit:</td><td>tCO_2/MJ</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of the baseline fuel type that would be combusted to generate steam in the absence of the project in a reporting interval y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>Preferred source of data</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national average default values</td><td>If (a) is not available.
These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>(d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.3 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards. This value is obtained once before implementation of the project and fixed during the crediting period.</td></tr>
<tr><td>Monitoring frequency:</td><td>For (a) and (b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.</td></tr>
</table>

	For (c): Review appropriateness of the values annually. For (d): Any future revision of the IPCC Guidelines should be taken into account.
QA/QC procedures:	Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.3, Vol. 2 of the 2006 IPCC Guidelines. If the values are over this range, collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (a), (b) or (c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	–

Data / Parameter:	$EF_{CO2,AOG,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of the ammonia-plant off gas (AOG) after removing ammonia in a reporing interval *y*
Source of data:	Calculated by laboratory componential analysis.
Measurement procedures (if any):	Calculated by laboratory analysis of the ammonia-plant off gas (AOG) based on chemical formula for oxidization (combustion) after removing ammonia. To obtain a rate for this parameter, Option A (based on chemical component) specified in the latest version of “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” is applied.
Monitoring frequency:	Daily
QA/QC procedures:	Check the consistency of the data by comparing the data with those for previous days/months/years.
Any comment:	–

Data / Parameter:	$Q_{project\,,y}$
Data unit:	MJ/reporting interval
Description:	Net quantity of heat generated from firing project fuel in an interval *y*. In case of steam, this is expressed as difference in energy content of the steam supplied to the recipient plant and feed water to the boiler. The enthalpy of feed water to the boiler takes into account the enthalpy of condensate returned to the boiler (if any) and any other waste heat recovery (including economiser, blow down heat recovery etc). In case of hot water generator, this is expressed as difference in energy content of the hot water supply and return from the recipient plant(s) to the element process of cogeneration plant.
Source of data:	Actual measurement records
Measurement procedures (if any):	Heat generation is determined as the enthalpy of the steam or hot water generated by the boiler(s) minus the enthalpy of the feed-water. The enthalpy of feed water to the boiler takes into account the enthalpy of condensate returned to the boiler (if any) and any other waste heat recovery (including economiser, blow down heat recovery etc). It should be noted that no additional fuel outside the boiler or the hot water generator should be combusted to heat the feed water. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate

	thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency:	Continuously, to be aggregated annually
QA/QC procedures:	The consistency of metered net heat generation should be cross-checked by comparing the measurement results with measurements in the previous years
Any comment:	For boilers, it is expressed as the difference in the steam supplied and the feed water to the boiler, both in energy units.

Data / Parameter:	$EC_{\mathrm{AA},y}$
Data unit:	MWh/reporting interval
Description:	Quantity of electricity consumed by ammonia absorber in a reporting interval *y*
Source of data:	Electricity meter
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	Continuously
QA/QC procedures:	Regular maintenance and testing regime.
Any comment:	This parameter is monitored if ammonia absorber is installed as a component of the project activity. Only aggregated value for the period of verification (typically one year) counts.

Data / Parameter:	$EC_{\mathrm{DeNOx},y}$
Data unit:	MWh/reporting interval
Description:	Quantity of electricity consumed by De-NOx equipment in a reporting interval *y*
Source of data:	Electricity meter
Measurement procedures (if any):	Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
Monitoring frequency:	Continuously
QA/QC procedures:	Regular maintenance and testing regime.
Any comment:	This parameter is monitored if De-NOx equipment is installed as a component of the project activity. Only aggregated value for the period of verification (typically one year) counts.

IV. REFERENCES AND ANY OTHER INFORMATION

47. – IPCC Guidelines for National Greenhouse Gas Inventories Volume 2, Energy.

48. – ACM0001, Version 9.1.

[Note] We did not change the following Section D at this stage because all what we addressed were incorporated in the main text as well as between the comments by the Meth Panel.

Section D. Explanations / justifications to the proposed new baseline and monitoring methodology

Selected approach from paragraph 48 of the CDM modalities and procedures

49. The underlying situation of the methodology is that the waste gas is emitted without recovery. The methodology is applicable if the baseline is identified to be continuation of current practice. Therefore, the first baseline approach is the most suitable one.

Definitions

50. No specific explanation / justification are required.

Applicability conditions

51. First, the following condition is needed to identify that "continuation of current practice (release of the ammonia-plant off gas to the atmosphere without recovery and flaring)" would be the baseline scenario during the crediting period:

52. (1) "Regulations of the host country do not prohibit current practice to release the off gas without flaring, recovery or other treatments".

53. The methodology is limited to the case where ammonia is cleared off from the AOG by the project activity as fuel. This case may be universal for this technology. Therefore, the associated condition (2) as well as the related formula is included in the methodology.

54. Next, in case of modification of the existing boiler (*e.g.*, changing burner) or installation of new boiler for the ammonia-plant off gas (AOG), the lifetime of the boiler prior to the project activity may be different from the one after the project activity. So according to ACM0009 which is the approved methodology for fuel switch, the following condition is incorporated to the proposed methodology as well as the associated guidance on the lifetime.

55. (3) "The project activity does not increase the lifetime of the boiler prior to the project activity during the crediting period (i.e. emission reductions are only accounted up to the end of the lifetime of the boiler for the existing fossil fuel prior to the project activity)." The options specified in the latest guideline "Treatment of the lifetime of plants and equipment in proposed new baseline methodologies" is applied to assess the lifetime.

56. For consistency to calculate the emission reductions, the following condition is inputted for the proposed methodology as well as ACM0009.

57. (4) “The proposed project activity does not result in integrated process change for the chemical complex”.

58. Finally, the methodology specifies how to utilize the AOG to the steam generation case only in (5). This may be universal for this kind of technology.

Project boundary

59. The purpose of the proposed project is to only utilize all amount of generated ammonia-plant off gas (AOG) instead of a part of existing consumed amount of the fossil fuel. There may be some production processes using steams generated by the existing fossil fuel in the chemical complex. However there is no production plant except for the ammonia plant affected by the project activity except for the ammonia plant, because as already above-mentioned, the following element is incorporated to an applicability condition for the proposed methodology:

60. “The proposed project activity does not result in integrated process change for the chemical complex”.

61. It is reasonable to assume that the methane is no more released because the AOG is combusted in a boiler (under closed and controlled combustion condition) by the project activity.

Identification of the baseline scenario

62. Identification of the baseline scenario is mainly demonstrated based on providing evidences what and how efforts for the plant have been carried out and why these efforts have not been realized yet.

63. The current practice of the plant is as follows;

- The ammonia-plant off gas (AOG) has been released to the atmosphere without recovery, flaring or other treatment; and
- Although the ammonia-plant off gas (AOG) has been tried to use effectively, it has been failed many times to make it into practice because of prohibitive barriers.

64. For the purpose of demonstrating the existence of these barriers, the chronological table for historic events/evidences for the plant should be prepared.

65. Furthermore, for the selection of the most plausible baseline scenario, Step 1 of the latest version of the “Tool for the demonstration and assessment of additionality”, should be used to identify all realistic and credible baseline alternatives. In doing so, relevant policies and regulations related to the management of ammonia-plant off gas (AOG) should be taken into account.

66. For this proposed methodology, baseline alternatives are identified, being divided into two elements as follows;

(a) treatment/utilization of the ammonia-plant off gas (AOG), and

(b) heat supply for the steam generation.

67. This method is referring to ACM0001 which is related to methane emissions for the baseline. By doing so, it is widely considerable to take into account local economic and technological circumstances as well as relevant policies and regulations related to the management of ammonia-plant off gas (AOG).

68. Then, the following steps which eliminate alternatives are referring to ACM0009 which is similar to this project activity are applied for this methodology.

Additionality

69. For barrier analysis, the proposed methodology incorporated the related part of AM0035 as well as additional elements which may be considered in the case of the proposed project activity. The added items are:

- There are other activities which are much more attractive. They make the priority of the project activity lower. Written document of the list shall be submitted.
- Technology supplier is lacking considering the specific situation of the host country, *e.g.*, under sanction or other politically and/or economically constrained environment;
- The host company (or companies in similar situation in the host country) has experiences to try to utilize the waste gas, but failed. The history of the trial shall be provided;
- The management of the host company does not have an incentive to increase energy efficiency institutionally, which may be seen in state-owned companies. Such institutional reasons shall be explained;
- Real and perceived insignificance of many investments – for example, if energy efficiency projects are relatively small and the value of the savings achieved typically is only a small percentage of enterprise operating costs.

70. For the proposed project activity, the host company cannot access to the original manufacturer (UK company) of the plant as the host country Syria has politically isolated.

71. The host company GFC is state-owned company and does not have any intension to improve the energy efficiency due to the lack of economical incentives to do so.

72. In reality, the World Bank undertook a comprehensive study of the GFC in 1990. It identified many measures in a priority order. However, most of such measures have not yet realized. For the proposed project activity, although it is rated “3” among prioritized measures rated as “1A, 2A, 1B, 2B, 1C, or 3”.

Baseline emissions

73. Since the project boundary is limited to “the site of the project activity where the off gas is captured and the recovered off gas and the baseline fuel are used for the boiler fuel in the chemical complex”, baseline emissions are limited to only the following sources;

– CO_2 emissions due to burning the ammonia-plant off gas (AOG) combustion for fuel, and

– CO_2 emissions due to electricity consumption for removing ammonia contained in the ammonia-plant off gas (AOG),and

– The amount of methane that would have been destroyed/combusted by the project activity [11]

74. For notation of 'variables', the CDM methodologies have utilized the suffix *y* to specify that the parameter varies over time (even for the case that the parameter may vary continuously or at least take different values for each monitoring interval). This is OK if the aggregation over a year makes sense. However, if the variable can be represented as a product of two variables, this expression may provide mathematically wrong expression. Mathematically, it is more strict to use the expression of integration such as $C_y = \int dt\, A(t)*B(t)$ over the duration during the year *y*, if *C* is expressed as the product of *A* and *B*. Or equivalently, $C_y = \sum_{\text{interval}} (A_{\text{interval}} * B_{\text{interval}})$ in case of discrete monitoring interval. We have a concern that the expression using y may mislead the result as $C_y = (\sum_{\text{interval}} A_{\text{interval}}) * (\sum_{\text{interval}} B_{\text{interval}})$.

Project emissions

75. The emission reductions are simply calculated by subtracting the project emissions from the baseline emissions. Project emissions include:

– CO_2 emissions due to burning the ammonia-plant off gas (AOG) combustion for fuel, and

– CO_2 emissions due to electricity consumption for removing ammonia contained in the ammonia-plant off gas (AOG).

Leakage

76. It is concluded that no leakage effects need to be accounted under this methodology.

77. The project activity for submitting this methodology encompasses recovering ammonia in the ammonia-plant off gas (AOG) before utilization for fuel. And the recovered ammonia will be used for resources of other processes in the chemical complex. However, this is not considerable to be leakage. (Although this may just a little decrease the operation rate of the ammonia plant).[12]

78. Furthermore, there is no steam generated by waste heat utilization than the existing boiler.

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[11] AOG purged to outside of the loop in NH_3 synthesis contains CH_4 content. Although CH_4 content contained in the natural gas which is a raw material of ammonia is almost-totally consumed in secondary reforming which is the middle process of ammonia production. Because the small amounts of CO and CO_2, remaining in the synthesis gas, can poison the ammonia synthesis catalyst and must be removed usually by conversion to CH_4 by hydrogenation. (As for explanation of the ammonia production process, please see Section A.4.3 in attached PDD.)

[12] The amount of recovered NH_3 will be less than 0.5% of total NH_3 production.

Emission reductions

79. For this methodology, the baseline emissions and the project emissions are separately identified. (The emission reductions cannot directly be identified). And no leakage effects need to be accounted under this methodology

80. Therefore, the emission reductions are simply calculated by subtracting the project emissions from the baseline emissions

Changes required for methodology implementation in 2nd and 3rd crediting periods

81. As per CDM_NM Guidelines as well as the latest guidance by the Board.

Monitoring methodology, including data and parameters not monitored

82. Parameters for calculation of the emission reductions should be fundamentally monitored by automatic measurement, laboratory analysis and by the fuel supplier. However, a part of them may not measure directly due to unreasonable cost (or creditable data may not be acquired). In such cases, measurement procedures are set in conservative manner.

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