



**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

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|---|---|
| Title of the project activity | Catalytic N ₂ O destruction project at the new nitric acid plant PANNA 4 of Enaex S.A. |
| Version number of the PDD | Version 1.4 |
| Completion date of the PDD | 17/09/2014 |
| Project participant(s) | Enaex S.A. Carbon Climate Protection GmbH Mitsubishi Corporation |
| Host Party(ies) | Republic of Chile |
| Sectoral scope and selected methodology(ies) | 05 Chemical Industry |
| Estimated amount of annual average GHG emission reductions | 243,437 |

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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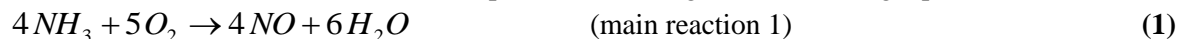
The sole purpose of the proposed project activity is to significantly reduce expected levels of N₂O emissions from the production of nitric acid at the PANNA 4 plant of Enaex S.A., Chile. The PANNA 4 nitric acid plant was erected in 2010 as part of the Enaex S.A. chemical complex site, Prillex®¹ América, at Mejillones. The new nitric acid plant, designed for a capacity of 925 metric tonnes of HNO₃ per day (100% of weight), has been commercially operational since November 5th, 2010 and produces nitric acid as an intermediate product for the ammonium nitrate plant within the complex. The plant was designed to operate with a dual pressure process, where the ammonia oxidation reactor is operated at a design pressure of 4.5 bar (medium pressure combustion plant) and the absorption tower at a pressure of 10.2 bar. The reactor is operated at a design temperature in zone 1 of 220°C, in zone 2 of 480°C, in zone 3 of 910°C and in zone 4 of 520°C. The proposed project activity (secondary N₂O destruction) will be implemented in the PANNA 4 nitric acid plant.

General Introduction

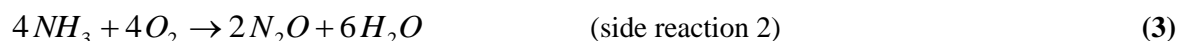
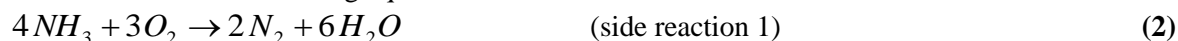
Nitrous oxide (N₂O) is an unwanted, invisible and previously neglected by-product of the manufacture of nitric acid. It is formed alongside the main, desired product nitric oxide (NO) during the catalytic oxidation of ammonia in air over noble metal gauzes. N₂O is a potent greenhouse gas with a Global Warming Potential (GWP) of 310. This value is valid for the current commitment period and was used for the ex-ante calculation of the emission reduction (also after 2012). The production of nitric acid takes place in three main process steps as indicated by the following reactions:

1. Ammonia (NH₃) combustion to form nitric oxide (NO):

Ammonia is reacted with air on noble metal catalyst in the oxidation section of nitric acid plants. Nitric oxide and water are formed in this process according to the following equation:

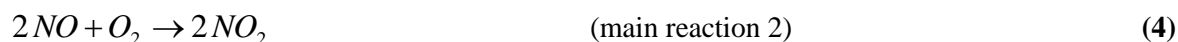


Simultaneously, nitrous oxide (N₂O), nitrogen (N) and water (H₂O) are formed as well, in accordance with the following equations:

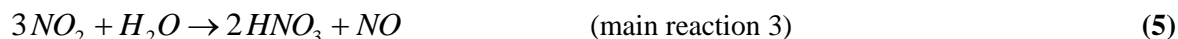


NO yield depends mainly on pressure and temperature in the ammonia oxidation process and usually is in a range of 95% to 97%.

2. NO is oxidised to nitrogen dioxide (NO₂):



3. (According to the technical process) Absorption of NO₂ in water to form nitric acid (HNO₃):



(NO is oxidised to NO₂ according to main reaction 2)

Nitric acid plants are, in the vast majority of cases, part of a chemical complex and are built and operated to supply acid for consumption in downstream process units. The most common use for nitric acid is for fertilisers, with smaller quantities going into the manufacture of organic compounds and mining explosives. In the case of PANNA 4, nitric acid is employed as a feed stock to produce ammonium nitrate

¹ Prillex® is a registered brand of Enaex S.A.

(NH_4NO_3), which is used as a raw material for mining and civil explosives, which are used in the mining and construction industries. The nitric acid is also used as raw material for other explosives (PETN and Nitro-glycerine), which are also used as civil and mining explosives.

Enaex has an internal policy not to sell ammonium nitrate for explosives that can be used for military purposes, however there are special corps inside the Military Forces in Chile that perform civil works as demolition, construction of secondary paths and also destruction of anti-personal mines in the north of the country.

On leaving the ammonia oxidation reactor, there is no relevant loss of N_2O in the tail gas section unless a N_2O destruction facility is installed. N_2O that leaves the ammonia oxidation reactor is thus discharged to atmosphere in the tail gas, and has no economic value.

Description of catalytic decomposition process

Under the project activity, a N_2O catalyst will be inserted below the primary catalyst (NH_3 catalyst) in the ammonia oxidation reactor. The N_2O catalyst will largely result in decomposition of N_2O to nitrogen (N_2) and oxygen (O_2) without any further energy, nor material inputs.

Catalytic decomposition of N_2O occurs when the N_2O is split into its constituent elements by contact with a catalyst. A catalyst is a material which accelerates the speed of the reaction without itself being transformed or consumed by the reaction.

Overall reaction:



Products of N_2O decomposition are the substances that result from decomposition reaction (N_2 and O_2).

The project's aim will be to reduce N_2O emissions at the nitric acid plant PANNA 4. The project activity won't result in any revenues except the income from the sale of CERs. The catalytic N_2O destruction project activity is expected to reduce more than 94 % of the N_2O emissions that would be emitted without the project activity.

A.2. Location of project activity

A.2.1. Host Party(ies)

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Republic of Chile

A.2.2. Region/State/Province etc.

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2nd Region (Region of Antofagasta), Province of Antofagasta

A.2.3. City/Town/Community etc.

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Planta Prillex® America

City: Mejillones

Address: Avenida Costanera Norte N°300

A.2.4. Physical/Geographical location

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The new PANNA 4 nitric acid plant is part of Enaex S.A.'s Prillex® América ammonia nitrate complex, located in Mejillones, Northern Chile (Province of Antofagasta, 2nd Region). Mejillones is located 65 km north of Antofagasta, the region's capital city and it is surrounded by the Pacific Ocean to the west and by one of the most arid deserts in the world (Desierto de Atacama) to the east. Since the past two centuries, the port of Antofagasta has been playing an important role for the export of raw materials extracted in the area, shifting from guano and sodium nitrate (saltpetre) to potassium nitrate and copper over the years. In

this field, the port of Mejillones has also playing an important role. Currently, the population of Mejillones is more than 8,500 and main economic activities are linked to the mining industry.



Figure 1: Location of the project

Enaex Prillex® América Plant
Avenida Costanera Norte N°300
Mejillones

Latitude: 23° 5' 50.64"S
Longitude: 70° 25' 48.55"W



Figure 2: Location of the project within the Prillex® América Plant (green arrow)

A.3. Technologies and/or measures

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The employed technology will be a secondary N₂O abatement technology. N₂O, once formed, is removed by a catalyst inside the ammonia oxidation reactor. The preferred position of choice for secondary methods is directly after the gauzes.

The new PANNA 4 nitric acid plant was designed to produce nitric acid as an intermediate product for the ammonium nitrate production plant in this complex with a designed capacity of 925 metric tonnes of HNO₃ per day (100% of weight). The plant is designed to operate as a dual pressure nitric acid plant, whereas the ammonia oxidation reactor is operated at a design pressure of about 4.5 bar (medium pressure combustion plant) and the absorption tower at a design pressure of 10.2 bar. The reactor is operated at a design temperature in zone 1 of 220°C, in zone 2 of 480°C, in zone 3 of 910°C and in zone 4 of 520°C.

The PANNA 4 nitric acid plant will be equipped with a secondary N₂O abatement, by installing baskets inside the ammonia oxidation reactor and equipping them with the N₂O decomposition catalyst right below the platinum gauze in the high temperature zone of the reactor.

The measurement devices for the monitoring of N₂O concentration and tail gas flow will be located directly in the stack.

A secondary approach offers a number of advantages:

- Reduction >94 % can be achieved
- No influence on NO_x yield
- Works with all Pt-gauzes
- Drop in solution with moderate investment costs
- Low operation cost

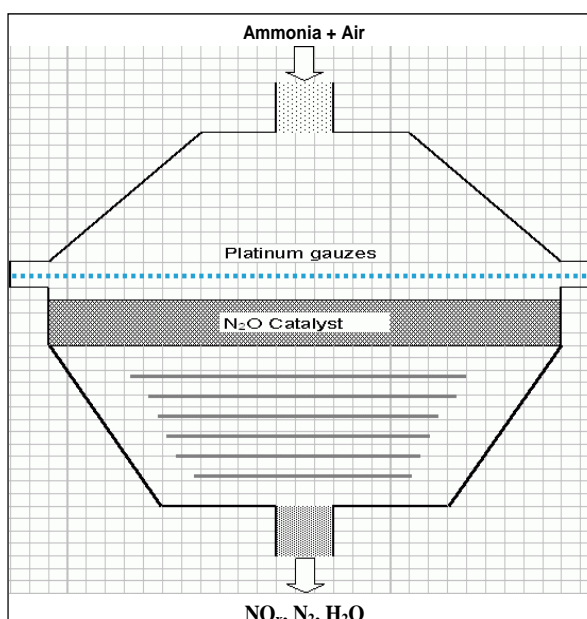


Figure 3: Location of a secondary catalyst inside the AOR reactor

A.4. Parties and project participants

| Party involved (host) indicates a host Party | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|--|--|
| Republic of Chile (Host) | Enaex S.A. | No |
| Republic of Austria | Carbon Climate Protection GmbH | No |
| Japan | Mitsubishi Corporation | No |
| (*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required. | | |

Host country is the **Republic of Chile**. Chile ratified the Kyoto Protocol on August 26, 2002.

Project applicant, sponsor and operator is Enaex S.A. (herein after called Enaex), a private owned entity registered under the laws of the Republic of Chile and an incorporated company listed on the Santiago stock exchange, major shareholder is Sigdo Koppers S.A. Enaex is a leading producer of ammonium nitrate to produce explosive that will be used in the mining industry. Based in Chile, the company's major customer is Enaex Servicios – an associated company of Enaex S.A. Other customers are the most important mining companies of South America, such as CODELCO, BHP Billiton, Anglo American, Antofagasta Minerals, Southern Perú Copper, Phelps Dodge and Placer Dome.

Enaex has well established people, management principles and practices that enable an integral development of its employees. Given the nature of its manufacturing and service operations, Enaex has a strict and high standard of selecting its workers throughout the organisation, which allows to have highly qualified personnel in all of its areas. Enaex's comprehensive people programs include performance management, health, well-being, training and development.



Some of the programs in place:

- Quality Assurance
- Continuous Education and Training
- Consulting on Drug and Alcohol addiction
- Health Plans
- Housing Plans
- Social Technical advising benefits
- Bonus and Equity participation systems
- Creativity Award
- Internal communications
- Sports, Recreation and integration of the family

In 2002, the company received “The Carlos Vial Espantoso Award” for best people management practices. The Prillex® América production facility of Enaex, of which PANNA 4 is one, is certified according to ISO 9001:2008 NCh 9001. Of 2009.

The proposed project activity will be installed in the PANNA 4 nitric acid plant and it is Enaex’ intention to include the PANNA 4 nitric acid plant as well as all CDM monitoring equipment in the quality management system.

Project participant, Carbon Climate Protection GmbH (herein after called CARBON), is a limited liability company located and registered in Austria under Austrian law. CARBON is responsible for the project development. The company is an experienced financing and investment company, focussing on the development and implementation of Greenhouse Gas reduction projects according to Article 6 of the Kyoto Protocol (Joint Implementation) and Article 12 of the Kyoto Protocol (Clean Development Mechanism). CARBON has experience with CDM project development in Africa, Latin America and Asia and is specialised in the catalytic N₂O destruction in the tail gas of nitric acid plants. It has developed the methodology for destruction of N₂O in the tail gas of nitric acid plants (AM0028) and has implemented the first N₂O destruction CDM project at nitric acid plants at Abu Qir Fertilizer Company in Egypt as well as similar CDM project at three nitric acid plants at Hu-Chems Fine Chemicals Corporation in Korea and Enaex S.A. in Chile.

Project participant, Mitsubishi Corporation (herein after called MITSUBISHI), has been involved as a possible buyer of Certified Emissions Reductions of the project. MITSUBISHI is a global integrated business enterprise that develops and operates businesses across virtually every industry including industrial finance, energy, metals, machinery, chemicals, foods, and environmental business. MITSUBISHI's current activities are expanding far beyond its traditional trading operations as its diverse business ranges from natural resources development to investment in retail business, infrastructure, financial products and manufacturing of industrial goods. With over 200 offices & subsidiaries in approximately 90 countries worldwide and a network of over 600 group companies, MITSUBISHI employs a multinational workforce of over 65,000 people.

A.5. Public funding of project activity

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No public funds are available for the financing of the project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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This Project Design Document is based on the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production” (Version 02.0) and according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0).

The applied methodology also stipulates that the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” is to be used when determining emissions from fossil fuel use in a tertiary abatement facility. Due to the fact, that no fossil fuels are used for the operation of the N₂O abatement facility in the project activity, this tool is not applicable to the project activity.

B.2. Applicability of methodology

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The proposed project activity destroys N₂O emissions by the catalytic reduction of N₂O by equipping already existing baskets inside the ammonia oxidation reactor with the N₂O decomposition catalyst right below the platinum gauze in the high temperature zone of the reactor of the new nitric acid plant PANNA 4 (secondary N₂O abatement).

The applicability criteria of the chosen methodology are met by the proposed project activity. These are:

- The PANNA 4 nitric acid plant started its commercial operation in November 5th, 2010. No secondary or tertiary abatement technology was installed in the PANNA 4 nitric acid plant before the implementation of the CDM project activity.
- Continuous real-time measurements of the N₂O concentration and the total gas volume flow can be carried out in the tail gas stream after the abatement of N₂O emissions throughout the crediting period of the project activity. A dedicated Automated Monitoring System (AMS) was installed in the plant prior to the beginning of the crediting period of the project activity in line with the requirements of the monitoring methodology.
- Currently, no laws or regulations exist, which mandate the complete or partial destruction of N₂O from nitric acid plants in the host country, the Republic of Chile.² In the absence of regulations on N₂O emissions in Chile it is obvious that there is no incentive for the plant operator to install N₂O abatement technologies in its nitric acid plant. This is due to the fact, that N₂O destruction facilities generate no financial or economic benefits (other than CDM related incomes).

From 19/03/2013 onwards methodology ACM0019 v02.0 is applicable.

B.3. Project boundary

² This was attested by a letter of the Ambient Evaluation Service of Chile sent to Enaex.

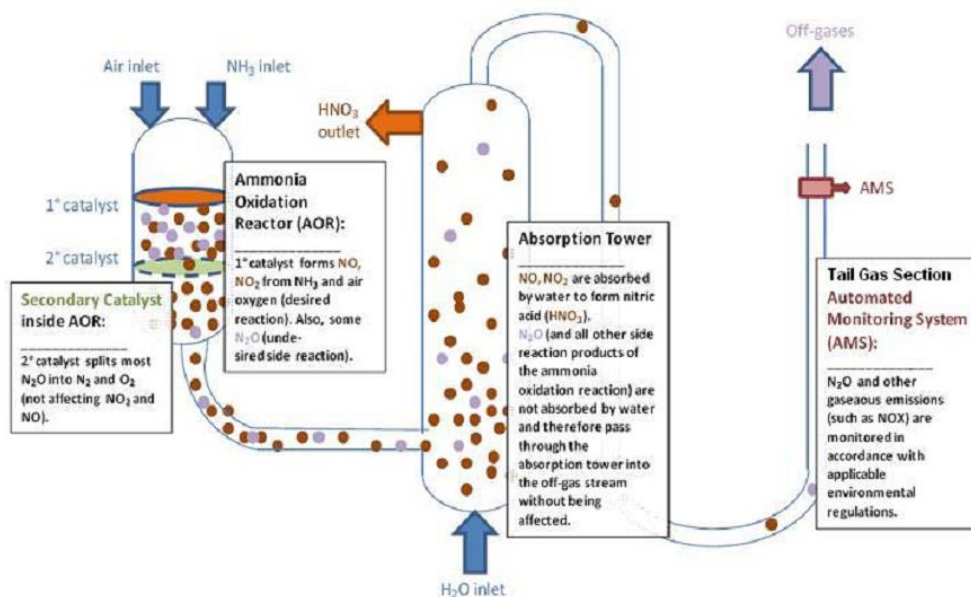


Figure 4: Project boundary if the Project Activity consists of the introduction of a secondary N_2O abatement measure (simplified standard nitric plant layout displaying the location of the N_2O abatement catalyst, process sources of N_2O and the sampling point location for the Automated Monitoring System (AMS))

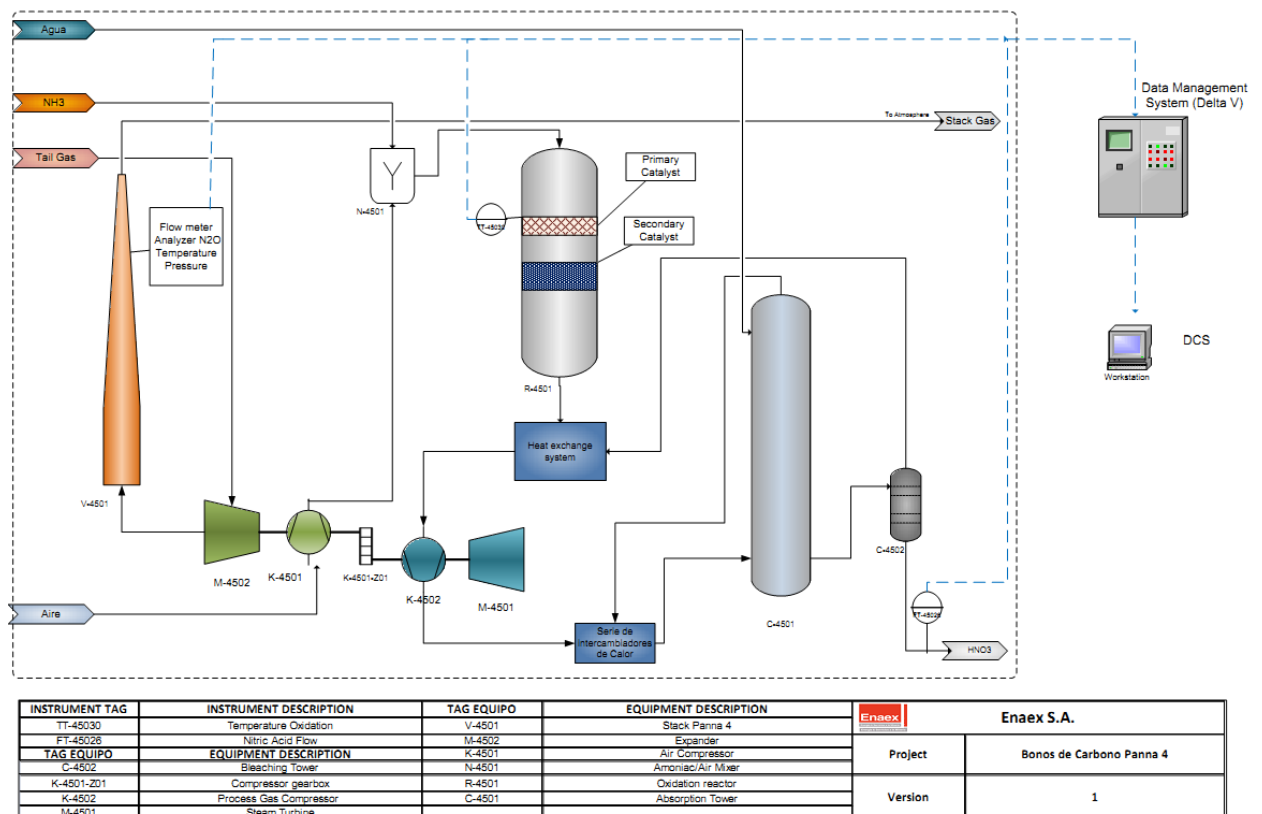


Figure 5: Panna 4 Generic Diagram: Equipment and instruments involved in the project

The spatial extent of the project boundary encompasses the facility and equipment for the nitric acid production process from the inlet of the ammonia burner to the outlet of the tail gas section.

Since the project activity introduces only secondary and no tertiary N_2O abatement, the only gas to be included as project emissions is the N_2O , which is not destroyed and still present in the tail gas stream of

the plant (see Figure 4 above). The following table illustrates in detail, which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

Table: GHG included in or excluded from the project boundary:

| Source | | Gas | Included? | Justification / Explanation |
|------------------|---|------------------|-----------|--|
| Baseline | NH ₃ oxidation at primary catalyst gauze | CO ₂ | No | The project activity has no influence on these types of emissions, if present |
| | | CH ₄ | No | |
| | | N ₂ O | Yes | Included, main emission source |
| Project activity | NH ₃ oxidation at primary catalyst gauze | CO ₂ | No | The project activity has no influence on these types of emissions, if present |
| | | CH ₄ | No | |
| | | N ₂ O | Yes | Included, main emission source |
| | Operation of a tertiary N ₂ O Abatement facility | CO ₂ | Yes | In some cases, fossil fuels are used as reducing agent and/or for decomposing the tail gas as part of a tertiary N ₂ O abatement facility. In this case the fossil fuels are mainly converted to CO ₂ . CO ₂ emissions arising from the production of ammonia are assumed to be small and not taken into account |
| | | CH ₄ | No | |
| | | N ₂ O | Yes | Included |

GHG emissions from the operation of a tertiary N₂O abatement facility are not included, since the proposed CDM project activity does not comprise the installation of a tertiary N₂O abatement technology.

B.4. Establishment and description of baseline scenario

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In the following section the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production” is applied to the “Catalytic N₂O destruction project at the nitric acid plant PANNA 4 of Enaex S.A.” in order to identify the baseline scenario:

There are no direct Chilean regulations applicable to NO_x emissions at new nitric acid plants. The actual voluntary commitment of Enaex is based on the Swiss regulation (reference: Swiss Confederation Federal Law, October 7, 1983). According to resolution Number 102/2006 (Antofagasta, 26th May 2006, Comisión Regional del Medio Ambiente – COREMA) the NO_x emission limit for Enaex’ Prillex® América nitric acid plants is 100 ppm and covers the new PANNA 4 nitric acid plant also.

Currently, no laws or regulations exist, which mandate the complete or partial destruction of N₂O from nitric acid plants in the host country, the Republic of Chile. This was attested by a letter of the Ambient Evaluation Service of Chile, which can be reviewed during validation. Therefore in accordance with the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production”, Enaex has no economic incentives to take any N₂O abatement measures in its nitric acid plants in the absence of regulations requiring such measures, as this would entail capital and operating costs, but no financial benefits. Consequently, the proposed CDM project “Catalytic N₂O destruction project at the new nitric acid plant PANNA 4 of Enaex S.A.” is considered additional and the baseline scenario is the N₂O emitted to the atmosphere with no N₂O abatement measure implemented.

B.5. Demonstration of additionality

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According to the applied methodology ACM0019 the CDM project activity is considered additional in case of the absence of regulations requiring the abatement of N₂O emissions, as the operator of the nitric acid plant has no economic incentives to take any N₂O abatement measures.

Since it was clearly demonstrated in section B.4 above that in Chile no regulations exist, which require the abatement of N₂O emissions in nitric acid plants, the proposed project activity “Catalytic N₂O destruction project at the new nitric acid plant PANNA 4 of Enaex S.A.” is considered additional.

It was not necessary to submit a prior consideration form for this project activity, since it was already submitted with the application for the new methodology NM340 in April 2010.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Since the proposed project activity didn't use AM0028 or AM0034 in the first crediting period, “Case 2: For other nitric acid plants” applies for the emission reduction calculation and “Case 1: For nitric acid plants that have used AM0028 or AM0034 in the first crediting period” has not to be considered.

BASELINE EMISSIONS

According to the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production” (Version 02.0), case 2 the baseline emissions are calculated as follows:

$$BE_y = P_{production,y} * EF_{new,y} * \frac{(h_y - h_{r,y})}{h_y} * GWP_{N_2O} * 10^{-3} \quad (7)$$

Where:

| | |
|-------------------------------|---|
| BE _y | Baseline emissions in year y (t CO ₂ e) |
| P _{production,y} | Production of nitric acid in year y (t HNO ₃) |
| EF _{new,y} | Baseline N ₂ O emission factor for nitric acid production in year y (kg N ₂ O/t HNO ₃) |
| GWP _{N₂O} | Global Warming Potential of N ₂ O valid for the commitment period |
| h _y | Number of hours in year y during which the plant was in operation (h) |
| h _{r,y} | Number of hours (h) in year y where: (a) For secondary N ₂ O abatement. Abatement system was not installed, underperforming or failed; (b) For tertiary N ₂ O abatement. The abatement system is by-passed, underperforming or failed |

Calculation of $h_{r,y}$

An abatement system is deemed to be bypassed, not working, underperform or failed in the hour h in year y if:

$$F_{N_2O, tail\ gas, h} > EF_{new, y} * P_{NA, h} \quad (8)$$

Where:

| | |
|--------------------------|--|
| $P_{NA, h}$ | Nitric acid produced in the hour h (t HNO_3) |
| $EF_{new, y}$ | Baseline N_2O emission factor for nitric acid production in year y (kg N_2O /t HNO_3) |
| $F_{N_2O, tail\ gas, h}$ | Mass flow of N_2O in the gaseous stream of the tail gas in the hour h (kg N_2O /h) |

PROJECT EMISSIONS

Project emissions include N_2O emissions, which have not been destroyed by the project activity and, in case of the installation of a tertiary N_2O abatement facility, CO_2 emissions resulting from the operation of the N_2O abatement facility. As the proposed CDM project activity does not comprise the installation of a tertiary N_2O abatement technology, no CO_2 emissions from the operation of such a facility need to be considered or monitored.

Project emissions are calculated as follows:

$$PE_y = PE_{N_2O, y} + PE_{CO_2, tertiary, y} \quad (9)$$

Where:

| | | |
|--------------------------|---|--|
| PE_y | = | Project emissions in year y (t CO_2e) |
| $PE_{N_2O, y}$ | = | Project emissions of N_2O from the project plant in year y (t CO_2e) |
| $PE_{CO_2, tertiary, y}$ | = | Project emissions of CO_2 from the operation of the tertiary N_2O abatement facility in year y (t CO_2) |

Project emissions of N_2O from the project plant ($PE_{N_2O, y}$)

The amount of N_2O emissions from the project activity are the emissions from the N_2O contained in the tail gas stream of the plant which is released to the atmosphere.

Accordingly, $PE_{N_2O, y}$ is determined as follows:

$$PE_{N_2O} = \sum_1^{h_y - h_{r, y}} F_{N_2O, tail\ gas, h} * GWP_{N_2O} * 10^{-3} \quad (10)$$

Where:

| | | |
|--------------------------|---|--|
| $PE_{N_2O, y}$ | = | Project emissions of N_2O from the project plant in year y (t CO_2e) |
| GWP_{N_2O} | = | Global Warming Potential of N_2O valid for the commitment period |
| $F_{N_2O, tail\ gas, h}$ | | Mass flow of N_2O in the gaseous stream of the tail gas in the hour h (kg N_2O /h) |
| h_y | | Number of hours in year y during which the plant was in operation (h) |
| $h_{r, y}$ | | Number of hours (h) in year y where: (a) For secondary N_2O abatement. Abatement system was not installed, underperforming or failed; |

- (b) For tertiary N₂O abatement. The abatement system is by-passed, underperforming or failed

Determination of $F_{N_2O, tail\ gas, h}$

The amount of N₂O emissions from the tail gas stream of the project plant shall be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. In applying the tool, the following provisions apply:

- Throughout the crediting periods of the project activity, the N₂O concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;
- The monitoring system should provide separate hourly average values for the N₂O concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These N₂O data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed;
- The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN14181 must be applied to both the N₂O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
- If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values;
- In the case that the N₂O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

According to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) the mass flow of greenhouse gas i in the gaseous stream in time interval t ($F_{i,t}$) is calculated based on measurements of (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gaseous stream and (c) the gas composition and water content. The flow and volumetric fraction may be measured on a dry basis or wet basis. The tool covers the possible measurement combinations, providing six different calculation options to determine the mass flow of a particular greenhouse gas (Option A to F).

Based on the currently available information Option A of the tool will be applied (measurement options for option A: volume flow of gaseous stream on dry basis, volumetric fraction on dry or wet basis), which states two ways how to demonstrate that the gaseous stream is dry. These are:

- a) Measure the moisture content of the gaseous stream ($C_{H_2O, t, db, n}$) and demonstrate that this is less or equal to 0.05 kg H₂O/m³ dry gas; or
- b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60°C (333.15 K) at the flow measurement point.

The mass flow of greenhouse gas i ($F_{i,t}$)³ is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (11)$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (12)$$

Where:

| | | |
|--------------|---|--|
| $F_{i,t}$ | = | Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h) |
| $V_{t,db}$ | = | Volumetric flow of the gaseous stream in time interval t on a dry basis (m ³ dry gas/h) |
| $v_{i,t,db}$ | = | Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m ³ gas i /m ³ dry gas) |
| $\rho_{i,t}$ | = | Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i /m ³ gas i) |
| P_t | = | Absolute pressure of the gaseous stream in time interval t (Pa) |
| MM_i | = | Molecular mass of greenhouse gas i (kg/kmol) |
| R_u | = | Universal ideal gases constant (Pa.m ³ /kmol.K) |
| T_t | = | Temperature of the gaseous stream in time interval t (K) |

Option A of the tool can be applied since currently available information shows that the moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) is less than 0.05 kg H₂O/m³ dry gas and therefore the gas is considered to be dry. The moisture content of the gaseous stream was lately measured according to “USEPA CF 42 method 4 – Gravimetric determination of water content”

- in September 2012 during AST (highest measured value: 0.0036 kg H₂O/m³ dry gas) and
- in October 2013 during QAL2 (highest measured value: 0.0028 kg H₂O/m³ dry gas).

Project emissions from the operation of the tertiary N₂O abatement facility ($PE_{CO_2,tertiary,y}$)

This emission source only needs to be estimated if a tertiary N₂O abatement facility is installed under the project activity and if fossil fuels are used to operate the facility or re-heat the gas after the facility.

Since the project activity applies only a secondary N₂O abatement facility the project emissions of CO₂ from the operation of the tertiary N₂O abatement facility in year y ($PE_{CO_2,tertiary,y}$) are considered to be zero.

LEAKAGE

According to the methodology any leakage emissions sources are deemed to be negligible.

EMISSION REDUCTION

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (13)$$

³ $F_{i,t}$ corresponds to the parameter $F_{N_2O,tail\ gas,h}$ of the methodology ACM0019 v02.0.

Where:

| | | |
|--------|---|---|
| ER_y | = | Emission reductions in year y (t CO ₂ e) |
| BE_y | = | Baseline emissions in year y (t CO ₂ e) |
| PE_y | = | Project emissions in year y (t CO ₂ e) |

B.6.2. Data and parameters fixed ex ante

Data / Parameter table 1.

| Data / Parameter | $EF_{new,y}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|--|------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|--------|------|
| Unit | kg N ₂ O/t HNO ₃ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Description | Baseline N ₂ O emission factor for nitric acid production in year y (related to 100 per cent pure acid) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Source of data | <p>The baseline N₂O emission factor for nitric acid production will vary every year. In year 2005 the emission factor will be 5.1 and then it will decrease every year until it reaches a final value of 2.5 in the year 2020. The value of 2.5 will remain constant after 2020, as provided in the following table:</p> <table> <tr> <th>Year</th><th>Emission factor (kg N₂O/t HNO₃)</th></tr> <tr><td>2005</td><td>5.10</td></tr> <tr><td>2006</td><td>4.90</td></tr> <tr><td>2007</td><td>4.70</td></tr> <tr><td>2008</td><td>4.60</td></tr> <tr><td>2009</td><td>4.40</td></tr> <tr><td>2010</td><td>4.20</td></tr> <tr><td>2011</td><td>4.10</td></tr> <tr><td>2012</td><td>3.90</td></tr> <tr><td>2013</td><td>3.70</td></tr> <tr><td>2014</td><td>3.50</td></tr> <tr><td>2015</td><td>3.40</td></tr> <tr><td>2016</td><td>3.20</td></tr> <tr><td>2017</td><td>3.00</td></tr> <tr><td>2018</td><td>2.80</td></tr> <tr><td>2019</td><td>2.70</td></tr> <tr><td>2020</td><td>2.50</td></tr> <tr><td>2021</td><td>2.50</td></tr> <tr><td>2022</td><td>2.50</td></tr> <tr><td>2023</td><td>2.50</td></tr> <tr><td>...</td><td>...</td></tr> <tr><td>Year n</td><td>2.50</td></tr> </table> | Year | Emission factor (kg N ₂ O/t HNO ₃) | 2005 | 5.10 | 2006 | 4.90 | 2007 | 4.70 | 2008 | 4.60 | 2009 | 4.40 | 2010 | 4.20 | 2011 | 4.10 | 2012 | 3.90 | 2013 | 3.70 | 2014 | 3.50 | 2015 | 3.40 | 2016 | 3.20 | 2017 | 3.00 | 2018 | 2.80 | 2019 | 2.70 | 2020 | 2.50 | 2021 | 2.50 | 2022 | 2.50 | 2023 | 2.50 | ... | ... | Year n | 2.50 |
| Year | Emission factor (kg N ₂ O/t HNO ₃) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2005 | 5.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2006 | 4.90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2007 | 4.70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2008 | 4.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2009 | 4.40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2010 | 4.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2011 | 4.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2012 | 3.90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2013 | 3.70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2014 | 3.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2015 | 3.40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2016 | 3.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2017 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2018 | 2.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2019 | 2.70 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2020 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2021 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2022 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2023 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ... | ... | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year n | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Value(s) applied | | <table><tr><th>Year</th><th>Emission factor (kg N₂O/t HNO₃)</th></tr><tr><td>2011</td><td>4.10</td></tr><tr><td>2012</td><td>3.90</td></tr><tr><td>2013</td><td>3.70</td></tr><tr><td>2014</td><td>3.50</td></tr><tr><td>2015</td><td>3.40</td></tr><tr><td>2016</td><td>3.20</td></tr><tr><td>2017</td><td>3.00</td></tr><tr><td>2018</td><td>2.80</td></tr><tr><td>2019</td><td>2.70</td></tr><tr><td>2020</td><td>2.50</td></tr><tr><td>2021</td><td>2.50</td></tr></table> | Year | Emission factor (kg N ₂ O/t HNO ₃) | 2011 | 4.10 | 2012 | 3.90 | 2013 | 3.70 | 2014 | 3.50 | 2015 | 3.40 | 2016 | 3.20 | 2017 | 3.00 | 2018 | 2.80 | 2019 | 2.70 | 2020 | 2.50 | 2021 | 2.50 |
|--|--|--|------|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Year | Emission factor (kg N ₂ O/t HNO ₃) | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | 4.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2012 | 3.90 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2013 | 3.70 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2014 | 3.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2015 | 3.40 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2016 | 3.20 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2017 | 3.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2018 | 2.80 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2019 | 2.70 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2020 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | |
| 2021 | 2.50 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Choice of data or Measurement methods and procedures | None | | | | | | | | | | | | | | | | | | | | | | | | | |
| Purpose of data | Calculation of baseline emissions | | | | | | | | | | | | | | | | | | | | | | | | | |
| Additional comment | The decrease in the value for the baseline emission factor over time is to reflect the technological development | | | | | | | | | | | | | | | | | | | | | | | | | |

Data / Parameter table 2.

| | |
|--|--|
| Data / Parameter | GWP _{N₂O} |
| Unit | tCO ₂ e/tN ₂ O |
| Description: | Global warming potential of N ₂ O valid for the commitment period |
| Source of data | Relevant decisions by the CMP |
| Value(s) applied: | 298 |
| Choice of data or Measurement methods and procedures | None |
| Purpose of data | Calculation of baseline and project emissions |
| Additional comment: | Not applicable (NA) |

Parameters from the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)

Data / Parameter table 3.

| | |
|--|--|
| Data / Parameter | R _u |
| Unit | Pa.m ³ /kmol.K |
| Description | Universal ideal gases constant |
| Source of data | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) |
| Value(s) applied | 8,314 |
| Choice of data or Measurement methods and procedures | Specified in the tool |
| Purpose of data | Calculation of project emissions |
| Additional comment | NA |

Data / Parameter table 4.

| | | | |
|--|--|------------------|--------------------------|
| Data / Parameter | MM _i | | |
| Unit | kg/kmol | | |
| Description | Molecular mass of greenhouse gas i | | |
| Source of data | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) | | |
| Value(s) applied: | Compound | Structure | Molecular mass (kg/kmol) |
| | Nitrous oxide | N ₂ O | 44.02 |
| Choice of data or Measurement methods and procedures | Specified in the tool | | |
| Purpose of data | Calculation of project emissions | | |
| Additional comment | NA | | |

B.6.3. Ex ante calculation of emission reductions

>>

Ex-ante estimation of emission reduction is made by projecting nitric acid output, N₂O formation and efficiency of the catalytic N₂O destruction process. Estimation is for reference purposes only, actual project and baseline emissions will be determined on measurement results on an ex-post basis.

The following data are applied for the ex-ante calculation of emission reduction:

- Nitric acid production of 925 tHNO₃/d (100% of weight)⁴;
- Tail gas mass flow rate of 153,705 kg/h (actual conditions)⁵;
- Concentration of N₂O prior to the N₂O abatement catalyst of about 1,200 ppmv⁶;
- Removal rate of 94 %⁷ of N₂O emissions, resulting in an outlet concentration of about 72 ppmv;
- Yearly operation is assumed to be 350 days⁸, which leads to yearly operating hours of 8,400.

Since the proposed project activity didn't use AM0028 or AM0034 in the first crediting period, “Case 2: For other nitric acid plants” applies for the emission reduction calculation and “Case 1: For nitric acid plants that have used AM0028 or AM0034 in the first crediting period” has not to be considered.

Please note: Ex-ante estimation of emission reductions was done for the period from 19/03/2013 onwards only, since from then onwards methodology ACM0019 v02.0 was applied. Values of emission reductions before that date are real emission reductions (already generated, verified and issued during Monitoring Periods # 1 – 4 of the CDM project). All data are based on continuous real-time measurements.

BASELINE EMISSIONS

Baseline emissions are calculated as below:

$$BE_y = P_{production,y} * EF_{new,y} * \frac{(h_y - h_{r,y})}{h_y} * GWP_{N_2O} * 10^{-3}$$

⁴ Source: “Operation manual Project Panna 4” of TR-ESPINDESA

⁵ Source: Mass balance

Tail gas volume flow rate (actual conditions): 181,899 m³ dry gas/h; parameter is considered to be dry.

⁶ Source: “Operation manual Project Panna 4” of TR-ESPINDESA

⁷ Source: “Technical details for HERAEUS secondary catalyst system” of contract between HERAEUS and Enaex

⁸ Source: “2014 Production Plan” and “Operation manual Project Panna 4”

| Year | BE _y t CO ₂ e | P _{production,y} t HNO ₃ | EF _{new,y} kg N ₂ O/t HNO ₃ | h _y h | h _{r,y} h | GWP _{N2O} t CO ₂ e/t N ₂ O |
|------------|--|---|---|---------------------|-----------------------|--|
| 12/2011 | 13,932 | 10,961 | NA | 267 | NA | 310 |
| 2012 | 404,173 | 334,304 | NA | 7,938 | NA | 310 |
| 2013 | 345,162 | 313,043 | NA / 3.7 | 8,281 | NA / 0 | 298 |
| 2014 | 337,671 | 323,750 | 3.5 | 8,400 | 0 | 298 |
| 2015 | 328,024 | 323,750 | 3.4 | 8,400 | 0 | 298 |
| 2016 | 308,728 | 323,750 | 3.2 | 8,400 | 0 | 298 |
| 2017 | 289,433 | 323,750 | 3.0 | 8,400 | 0 | 298 |
| 2018 | 270,137 | 323,750 | 2.8 | 8,400 | 0 | 298 |
| 2019 | 260,489 | 323,750 | 2.7 | 8,400 | 0 | 298 |
| 2020 | 241,194 | 323,750 | 2.5 | 8,400 | 0 | 298 |
| 01-11/2021 | 221,094 | 296,771 | 2.5 | 8,101 | 0 | 298 |

The operating hours (h_y) from 19/03/2013 onwards were calculated on the basis of 350 operating days per full year of operation: (1 h x 24 h / day x 350 days (number of intervals) = 8,400 h / year)

PROJECT EMISSIONS

Project emissions are calculated as below:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y}$$

| Year | PE _y t CO ₂ e | PE _{N2O} t CO ₂ e | PE _{CO2,tertiary,y} t CO ₂ |
|------------|--|--|---|
| 12/2011 | 1,242 | 1,242 | 0 |
| 2012 | 161,931 | 161,931 | 0 |
| 2013 | 66,312 | 66,312 | 0 |
| 2014 | 44,721 | 44,721 | 0 |
| 2015 | 44,721 | 44,721 | 0 |
| 2016 | 44,721 | 44,721 | 0 |
| 2017 | 44,721 | 44,721 | 0 |
| 2018 | 44,721 | 44,721 | 0 |
| 2019 | 44,721 | 44,721 | 0 |
| 2020 | 44,721 | 44,721 | 0 |
| 01-11/2021 | 43,128 | 43,128 | 0 |

$$PE_{N2O} = \sum_{h=1}^{h_y - h_{r,y}} F_{N2O,tail\ gas,h} * GWP_{N2O} * 10^{-3}$$

| Year | PE _{N2O} t CO ₂ e | F _{N2O,tail gas,h} kg N ₂ O/h | h _y h | h _{r,y} h | GWP _{N2O} t CO ₂ e/t N ₂ O |
|---------|--|--|---------------------|-----------------------|--|
| 12/2011 | 1,242 | 15.01 | 267 | NA | 310 |
| 2012 | 161,931 | 65.80 | 7,938 | NA | 310 |
| 2013 | 66,312 | 40.42 | 8,281 | NA / 0 | 298 |
| 2014 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 2015 | 44,721 | 17.87 | 8,400 | 0 | 298 |

| | | | | | |
|------------|--------|-------|-------|---|-----|
| 2016 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 2017 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 2018 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 2019 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 2020 | 44,721 | 17.87 | 8,400 | 0 | 298 |
| 01-11/2021 | 43,128 | 17.87 | 8,101 | 0 | 298 |

According to currently available information $F_{N_2O, tail\ gas, h}$ ⁹ was determined to 17.87 kgN₂O/h and was used for ex-ante determination.

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

| Year | $F_{N_2O, tail\ gas, h} = F_{i,t}$ | $V_{t,db}$ | $v_{i,t,db}$ | $\rho_{i,t}$ |
|------------|------------------------------------|--------------------------|--|-------------------------------|
| | kgN ₂ O/h | m ³ dry gas/h | m ³ gas i/ m ³ dry gas | kg gas i/m ³ gas i |
| 12/2011 | 15.01 | 179,813 | 5.11E-05 | 1.404 |
| 2012 | 65.80 | 169,319 | 2.43E-04 | 1.400 |
| 2013 | 40.42 | 174,336 | 1.48E-04 | 1.386 |
| 2014 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2015 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2016 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2017 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2018 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2019 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 2020 | 17.87 | 181,899 | 7.20E-05 | 1.364 |
| 01-11/2021 | 17.87 | 181,899 | 7.20E-05 | 1.364 |

LEAKAGE

Any leakage emissions sources are deemed to be negligible.

EMISSION REDUCTIONS

Project emissions are calculated as below:

$$ER_y = BE_y - PE_y$$

| Year | ER _y | BE _y | PE _y |
|------|-----------------|-----------------|-----------------|
|------|-----------------|-----------------|-----------------|

⁹ $F_{N_2O, tail\ gas, h}$ corresponds to the parameter $F_{i,t}$ of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0).”

| | t CO ₂ e | t CO ₂ e | t CO ₂ e |
|------------|---------------------|---------------------|---------------------|
| 12/2011 | 12,690 | 13,932 | 1,242 |
| 2012 | 242,242 | 404,173 | 161,931 |
| 2013 | 278,850 | 345,162 | 66,312 |
| 2014 | 292,950 | 337,671 | 44,721 |
| 2015 | 283,302 | 328,024 | 44,721 |
| 2016 | 264,007 | 308,728 | 44,721 |
| 2017 | 244,711 | 289,433 | 44,721 |
| 2018 | 225,416 | 270,137 | 44,721 |
| 2019 | 215,768 | 260,489 | 44,721 |
| 2020 | 196,473 | 241,194 | 44,721 |
| 01-11/2021 | 177,966 | 221,094 | 43,128 |

B.6.4. Summary of ex ante estimates of emission reductions

The anthropogenic emissions of the proposed project activity within the project boundary consist of the emissions of non-destroyed N₂O only. Estimation is for reference purposes only, actual project and baseline emissions will be determined on measurement results on an ex-post basis.

Starting date of the crediting period: 19/12/2011

The table below summarizes the project's emissions by sources.

| Year | Baseline emissions (t CO ₂ e) | Project emissions (t CO ₂ e) | Leakage (t CO ₂ e) | Emission reductions (t CO ₂ e) |
|---|--|---|-------------------------------|---|
| 12/2011 | 13,932 | 1,242 | 0 | 12,690 |
| 2012 | 404,173 | 161,931 | 0 | 242,242 |
| 2013 | 345,162 | 66,312 | 0 | 278,850 |
| 2014 | 337,671 | 44,721 | 0 | 292,950 |
| 2015 | 328,024 | 44,721 | 0 | 283,302 |
| 2016 | 308,728 | 44,721 | 0 | 264,007 |
| 2017 | 289,433 | 44,721 | 0 | 244,711 |
| 2018 | 270,137 | 44,721 | 0 | 225,416 |
| 2019 | 260,489 | 44,721 | 0 | 215,768 |
| 2020 | 241,194 | 44,721 | 0 | 196,473 |
| 01-11/2021 | 221,094 | 43,128 | 0 | 177,966 |
| Total | 3,020,036 | 585,663 | 0 | 2,434,373 |
| Total number of crediting years | 10 years | | | |
| Annual average over the crediting period | 302,004 | 58,566 | 0 | 243,437 |

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter table 5.

| | |
|---|--|
| Data / Parameter | P_{production,y} |
| Unit | t HNO ₃ |
| Description | Production of nitric acid in year y |
| Source of data | Production log |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | The nitric acid flow is measured with a “coriolis” type mass flow meter. The coriolis can also measure the fluid density. These two parameters are sent to the DCS (control room), where the concentration with tabulated values is calculated. Finally, the nitric acid at 100% is calculated by multiplying the mass flow with the concentration. Automatically monitored. |
| Monitoring frequency | Every monitoring period |
| QA/QC procedures | Periodic calibration will be performed according to supplier’s recommendations. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | The parameter P _{NA,h} (Nitric acid produced in the hour h) represents the hourly value of P _{production,y} and is used for determining h _{r,y} as described in section 5.3.3 of the applied methodology (Equation 5). |

Data / Parameter table 6.

| | |
|---|---|
| Data / Parameter | h_y |
| Unit | h |
| Description | Number of hours of operation in year y |
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | The operation temperature of the oxidation burner ranges from 850 – 905°C (as defined by the technology supplier) and this range corresponds to the real operation hours of the reactor. The temperature is reported automatically by three independent measurement points (TAG numbers TT45030 A – C) measuring the temperature at the same time. The value of the instrument with the TAG number TT45030 A was selected as main signal for monitoring the operation temperature; TT45030 B and TT45030 C are used as back-up signals in case TT45030 A is not fully functional. The information will be stored in electronic records and paper during whole project’s lifetime. |
| Monitoring frequency | Every monitoring period |
| QA/QC procedures | Periodic calibration will be performed according to manufacturer’s recommendation. |
| Purpose of data | Calculation of baseline and project emissions |
| Additional comment | Records to be maintained during project’s lifetime |

Data / Parameter table 7.

| | |
|---|---|
| Data / Parameter | $h_{r,y}$ |
| Unit | h |
| Description | Number of hours (h) in year y where for secondary N ₂ O abatement: Abatement system was not installed, underperforming or failed |
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | <p>Since the proposed project activity didn't use AM0028 or AM0034 in the first crediting period, "Case 2: For other nitric acid plants" applies for the emission reduction calculation. Accordingly the abatement system is deemed to be not installed, underperforming or failed in the hour h in year y if:</p> $F_{N_2O, tail\ gas, h} > EF_{new, y} * P_{NA, h}$ <p>The parameters mentioned above will be determined and monitored as explained in the respective sections of this PDD ($P_{NA, h} \rightarrow$ Parameter table 5; $F_{N_2O, tail\ gas, h} \rightarrow$ Parameter table 8 – 12; $EF_{new, y} \rightarrow$ Parameter table 1 (need not to be monitored)).</p> |
| Monitoring frequency | Every monitoring period |
| QA/QC procedures | Periodic calibration will be performed according to manufacturer's recommendation. |
| Purpose of data | Calculation of baseline and project emissions |
| Additional comment | Records to be maintained during project's lifetime |

Parameters from the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)

Data / Parameter table 8.

| | |
|---|--|
| Data / Parameter | $V_{t,db}$ |
| Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval t on a dry basis |
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | Volumetric flow measurement will refer to the actual pressure and temperature. Calculated based on the dry basis flow measurement plus water concentration measurement (according to Option A of the tool). Continuous monitoring. |
| Monitoring frequency | Continuous monitoring |
| QA/QC procedures | Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer's specifications. |
| Purpose of data | Calculation of project emissions |
| Any comment: | Periodic calibration will be performed according to manufacturer's recommendation. |

Data / Parameter table 9.

| | |
|-------------------------|---|
| Data / Parameter | $V_{i,t,db}$ |
| Unit | m ³ gas i/m ³ dry gas |
| Description | Volumetric fraction of greenhouse gas i in a time interval t on a dry basis |

| | |
|---|---|
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | Continuous gas analyser operating in dry-basis. Volumetric flow measurement refers to the actual pressure and temperature. Continuous monitoring. |
| Monitoring frequency | Continuous monitoring |
| QA/QC procedures | According to European Norm 14181 |
| Purpose of data | Calculation of project emissions |
| Any comment | NA |

Data / Parameter table 10.

| | |
|---|--|
| Data / Parameter | $C_{H_2O,t,db,n}$ |
| Unit | mg H ₂ O/m ³ dry gas |
| Description | Moisture content of the gaseous stream at normal conditions, in time interval t |
| Source of data | Measurements according to the USEPA CF42 method 4 – Gravimetric determination of water content |
| Value(s) applied | Discrete measurement procedure Latest measurements: <ul style="list-style-type: none"> • 0.0028 kg H₂O/m³ dry gas (highest measured value in October 2013 during QAL2) • 0.0036 kg H₂O/m³ dry gas (highest measured value in September 2012 during AST) |
| Measurement methods and procedures | The mean value among three consecutive measurements performed in the same day (at least 2 hours each) will be considered. Measurements will coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream. |
| Monitoring frequency | Measurements will coincide with the Annual Surveillance Test (associated with requirements of the EN 14181 standard) or the calibration of the flow meter for the gaseous stream. |
| QA/QC procedures to be applied: | According to the USEPA CF42 method 4 |
| Purpose of data | Calculation of project emissions |
| Any comment: | Option A parameter for proving that the gaseous stream is dry. |

Data / Parameter table 11.

| | |
|---|---|
| Data / Parameter | T_t |
| Unit | K |
| Description | Temperature of the gaseous stream in time interval t |
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | Instruments with recordable electronic signal |
| Monitoring frequency | Continuous monitoring |
| QA/QC procedures | Periodic calibration against a primary device provided by an independent accredited laboratory. Calibration and frequency of calibration is according to manufacturer's specifications. |
| Purpose of data | Calculation of project emissions |
| Any comment | Periodic calibration will be performed according to manufacturer's |

recommendation.

Data / Parameter table 12.

| | |
|---|--|
| Data / Parameter | P_t |
| Unit | Pa |
| Description | Pressure of the gaseous stream in time interval t |
| Source of data | Measured |
| Value(s) applied | The assumptions for Emission Reductions calculations can be found in respective section B.6.1 and B.6.3. |
| Measurement methods and procedures | Instruments with recordable electronic signal |
| Monitoring frequency | Continuous monitoring |
| QA/QC procedures | Periodic calibration against a primary device will be performed periodically and records of calibration procedures will be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) will be calibrated monthly using digital communication between transducer and control or monitoring system (e.g. via Highway Addressable Remote Transducer Protocol). |
| Purpose of data | Calculation of project emissions |
| Any comment | Periodic calibration will be performed according to manufacturer's recommendation. |

B.7.2. Sampling plan

>>

Not applicable for the project activity.

B.7.3. Other elements of monitoring plan

>>

The emission reductions achieved by the project activity will be monitored using the requirements of the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production” (Version 02.0) and of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0).

Enaex has been operating chemical complex' incl. nitric acid plants since the commissioning of the plants 1-3 and has sufficient and well-experienced staffs. Enaex has been in production of the nitric acid for more than 90 years and measurement of various production parameters including operation of analysers, which are managed by the production team.

Measurement of the N₂O concentration and the total gas volume flow

The project will employ the latest state of the art monitoring and control equipment that measures, records and reports all key parameters to determine the GHG emission reductions. The plant will be equipped with an Automated Monitoring System (AMS) in order to allow continuous real-time measurements of the N₂O concentration and the total gas volume flow, which is required by the methodology.

The amount of N₂O emissions from the tail gas stream of the project plant shall be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”. In applying the tool, the following provisions apply:

- Throughout the crediting periods of the project activity, the N₂O concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be

installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;

- The monitoring system should provide separate hourly average values for the N₂O concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These N₂O data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed;
- The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN14181 must be applied to both the N₂O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
- If data for either the N₂O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N₂O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N₂O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values;
- In the case that the N₂O concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters P_t and T_t do not need to be monitored except, if applicable, for the purpose of determining the moisture content in the gaseous stream.

The European Norm EN 14181 stipulates three levels of quality assurance tests and one annual functional test for AMS, which are recommended to be used as guidance regarding the selection, installation and operation of the AMS under the applied monitoring methodology. The three quality assurance levels (QAL) are as follows:

1. Quality assurance of tested AMS. AMS will have performance certificate with calculation of uncertainty before installation. The specific performance characteristics of the monitoring system chosen by the project will be listed in the Monitoring Reports.
2. Quality assurance of installation and calibration of the Automated Measuring System according to the Standard Reference Measurement Method (SRM) for concentration measurements, determination of the measurement uncertainty/variability of the AMS and inspection of the compliance with the prescribed measurement uncertainties. Such tests will be carried out by organisations that have an accredited quality assurance system.
3. Continuous quality assurance through the local operator/manager (drift and accuracy of the AMS, verification management and documentation).
 - a) Permanent quality assurance during the plant operation by the operating staff;
 - b) Assurance of reliable and correct operation of the monitoring equipment (maintenance evidence);
 - c) Regular controls as scheduled by the manufacturer (maintenance intervals);

In addition, annual functionality tests including SRM measurements to check for uncertainties in the data measured by the AMS are planned. Such tests will be carried out by organisations that have an accredited quality assurance system.

Quality Management

The monitoring procedures will be integrated in Enaex quality management system. All monitoring equipment will be serviced, calibrated and maintained according to the manufacturers' instructions and international standards. Parameters to be monitored are described above.

It is the responsibility of the Project Operator to ensure that experienced staff is available and that the operational staff is able to operate the monitoring system properly. It is also the responsibility of the Project Operator to organize and implement a quality management system that ensures the integrity of the data.

Operation and maintenance

The data measured by the installed monitoring system is sent directly to the Delta V System. This system has a historian that will archive the data without the need of human intervention. This will ensure data integrity. Malfunction of system components will be indicated on the operator console in the control room as an alarm. The occurrence of such an alarm requires the operator to immediately take measures to remedy the problem. This is normally done by informing the instrument department, which then decides whether the problem can be fixed immediately by themselves, or whether external support from manufacturer is required. In such a case it is important to act immediately in order to avoid loss of valuable data.

Enaex will perform a visual inspection of system on a regular basis by the operating staff. Such an inspection can give indications on oncoming problems and allow to be prepared for them. Internal review of project performance and calculation of emission reductions will be executed by Enaex and CARBON on a regular basis.

The operation and maintenance of the N₂O monitoring system will be incorporated to the ISO 9001:2008 quality management system. The production team will be appointed to be responsible for the operation of the N₂O monitoring system. The production team will follow the monitoring plan and report the data on regular intervals to the management team and Plant Manager in ascending order.

Find below the responsibilities and corresponding tasks for the CDM Project.

| Responsibility | Tasks | Company |
|--------------------------------------|--|---------|
| CDM Project Management | Needs to report to the ENAEX Board and communicates with the UNFCCC to achieve project goals | Enaex |
| Project Administration | Ensures that the project proceeds according to the schedule and budget | Enaex |
| Project Communication DOE | Provides the DOE with all required information for the validation and verification process | Enaex |
| Project Operation | Ensures that the on-site operative activities of the project runs according the project plan | Enaex |
| Project Maintenance | Provides support to the Project Operation and ensures that all quality procedures are accomplished | Enaex |
| Project Construction | Ensures that the project will be implemented technically according to the design and all relevant laws, prevailing methodology and tools | Enaex |
| Project Review: Monitoring Reports | Review and approval of monitoring reports before they are sent to DOE/UNFCCC | Carbon |
| Project Monitoring (data collection) | Collects all relevant parameters required for monitoring the project | Enaex |

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

Starting date of the project activity: 07/07/2011

This date is the date, when INECO was assigned with the monitoring system.

C.1.2. Expected operational lifetime of project activity

>>

25 years

C.2. Crediting period of project activity**C.2.1. Type of crediting period**

>>

Fixed crediting period

C.2.2. Start date of crediting period

>>

Starting date of first crediting period: 19/12/2011

C.2.3. Length of crediting period

10 years, 0 months

SECTION D. Environmental impacts**D.1. Analysis of environmental impacts**

>>

The catalytic N₂O destruction project at the PANNA 4 Nitric Acid Plant is a sustainable project that contributes to the environmental, economic and social benefits in the Republic of Chile.

Environmental Impacts

The ex-ante GHG emission reduction is estimated to be about 2.7 million tonnes of CO₂e over the ten year crediting period.

No transboundary impacts are expected.

Since the CDM project won't cause any environmental impact, it was not necessary to carry out an Environmental Impact Study. This was officially approved by authority COREMA with the letter No. 221/2006.

D.2. Environmental impact assessment

>>

Not applicable, as no significant environmental impacts are considered.

SECTION E. Local stakeholder consultation**E.1. Solicitation of comments from local stakeholders**

>>

A local stakeholder consultation was carried out by Enaex S.A. in the Antofagasta region on July 14th, 2011. The stakeholder conference took place in the auditorium of the "Mutual de Seguridad C.Ch.C" in Antofagasta city and its purpose was to inform local stakeholders about the CDM project of catalytic reduction of N₂O at the nitric acid plant PANNA 4 in Mejillones, Chile.

More than 180 invitations were prepared and sent to different stakeholders. Internally, a letter to the General Managers and e-mails were sent to the staff of the entire company:

LANZAMIENTO PROYECTO BONOS DE CARBONO-ENAEX S.A.

Juan Andrés Errázuriz Domínguez, Gerente General de Enaex S.A., invita cordialmente a Ud. a la presentación del proyecto "Bonos de Carbono PANNA 4" desarrollado en la Planta Prillex América de Mejillones.

La conferencia abordará el fenómeno del cambio climático, las medidas que se están implementando a nivel mundial, las consecuencias para Chile y los proyectos que la Empresa desarrolla actualmente como parte de su compromiso con la comunidad y el cuidado del medio ambiente.

El evento se realizará el **jueves 14 de julio** a las 10 hrs., en el Auditorio de la Mutual de Seguridad C.Ch.C. ubicado en Washington 2701, tercer piso, Antofagasta.

Para la comunidad de Mejillones se dispondrá de movilización especial. La salida será desde el Municipio de la ciudad a las 08:30 hrs y el regreso una vez finalizado el cóctel.

Atentamente,

RSVP:
jdiaz@enaex.cl o al teléfono (562) 8377648

Gerente General

COMUNICÁNDONOS

En confianza

LANZAMIENTO PROYECTO BONOS DE CARBONO-ENAEX S.A.

Comunicamos que el **jueves 14 de julio** se realizará en la ciudad de Antofagasta el Lanzamiento del proyecto "Bonos de Carbono PANNA 4" desarrollado en la Planta Prillex® América de Mejillones.

Para Enaex este es un proyecto trascendente, ya que a través de su implementación se podrá reducir más de 300.000 TM CO2 eq. al año que sumado a las 800.000 TM reducidas en PANNA 3, transforma a Enaex en uno de los complejos de producción de Ácido Nítrico más eficientes a nivel global en la lucha contra el cambio climático.

El programa será el siguiente:

El evento comienza a las 10:00 hrs., en el Auditorio de la Mutual de Seguridad C.Ch.C. ubicado en calle Jorge Washington 2701, tercer piso. Para los trabajadores de la planta Prillex se dispondrá de bus para el regreso una vez finalizada la actividad.

Cordialmente,

Juan Andrés Errázuriz Domínguez

07 de Julio de 2011

| Horario | Presenta | Tema |
|---------------|---|--|
| 10:00 - 10:15 | Sr. Marcelino Carvajal Alcalde de Mejillones | Bienvenida |
| 10:15 - 10:45 | Sr. Alex Illge Gerente Planta Prillex | Enaex S.A. - Planta Prillex América: 90 años de Crecimiento y Comprometidos con el Futuro |
| 10:45 - 11:15 | Sr. Rafael Visedo Gerente RSE Enaex S.A. | Responsabilidad Social Empresarial Un Compromiso de Todos |
| 11:15 - 11:45 | Srta. Úrsula Bustamante Ingeniero de Proyectos | Huella de Carbono Enaex S.A. Proyecto Bonos de Carbono en Panna 4 |
| 11:45 - 12:15 | Sr. Jorge Saffie Subgerente Innovación | Cambio Climático: Perspectivas a Futuro |

cóctel

In addition, an announcement was published in the regional newspaper in Antofagasta, El Mercurio (<http://edicionimpresa.soychile.cl/antofagasta/?c>).

The meeting covered three main subjects:

1. Enaex and its role with Social Responsibility

2. Global Warming with its current and future impacts and
3. PANNA4 CDM Project with an insight on the carbon market and the future perspectives of the Kyoto Protocol

A total of 86 people from different sectors attended the meeting. A variety of sectors were represented among the attendants, as shown on the following table:

| Organization/Company | Number |
|----------------------|-----------|
| General Public | 40 |
| Local Companies | 19 |
| Enaex S.A. | 16 |
| Government | 7 |
| Communication Media | 3 |
| Army | 1 |
| Total | 86 |

E.2. Summary of comments received

>>

A questionnaire containing the following 10 questions was handed out to the attendees:

1. Has the presentation improved your understanding of Global Warming?
2. Has the presentation improved your understanding of this CDM Project?
3. Do you have a positive attitude to this CDM Project?
4. Do you believe that this CDM Project has environmental benefits for the local surrounding?
5. Do you believe that this CDM Project has environmental benefits for the global climate?
6. Do you believe that local people will benefit from this CDM Project (i.e. job opportunities, air quality improvement etc.)?
7. Do you believe that the image of the region will benefit from this environmental friendly CDM Project?
8. Do you believe that this CDM Project contributes to sustainable development in the region?
9. Do you believe that this CDM Project has economic benefits for the local surrounding?
10. Do you believe that the Government of Chile should support this CDM Project?

A total of 71 attendees answered the questionnaire with the following results:

| Question Number | Answer | | No Answer | Total |
|-----------------|--------|----|-----------|-------|
| | Yes | No | | |
| 1 | 64 | 6 | 1 | 71 |
| 2 | 68 | 2 | 1 | 71 |
| 3 | 69 | 2 | | 71 |
| 4 | 67 | 4 | | 71 |
| 5 | 68 | 3 | | 71 |
| 6 | 59 | 12 | | 71 |
| 7 | 64 | 7 | | 71 |
| 8 | 65 | 6 | | 71 |
| 9 | 59 | 12 | | 71 |
| 10 | 67 | 4 | | 71 |

E.3. Report on consideration of comments received

>>

The survey shows that the project has strong support amongst local people. According to the response received from questionnaires, almost all local stakeholders support the CDM Project Activity and believe



that the Government of Chile should support the CDM Project. Therefore there has been no need to modify the plans due to comments received.

Nevertheless, the project participants will consider potential input which could arise during the national approval process, besides following CDM Rules & Procedures. No direct action is necessary according to the comments received. However, in order to further address additional questions from local stakeholders, the project participants intend to provide a reasonable level on transparency on the CDM Project Activity development.

SECTION F. Approval and authorization

>>

The Letters of Approval of the following Parties are available at the time of submitting the PDD to the DOE:

- Chile (Host)
- Austria
- Japan.

- - - - -



Appendix 1: Contact information of project participants

| | |
|--------------------------|--|
| Organization name | Enaex S.A. |
| Street/P.O. Box | Renato Sánchez # 3859, Las Condes |
| Building | |
| City | Santiago |
| State/Region | Región Metropolitana |
| Postcode | 7550282 |
| Country | Chile |
| Telephone | +56-2-8377600 |
| Fax | +56-2-2066752 |
| E-mail | |
| Website | www.enaex.cl |
| Contact person | Ms. Josefina Diaz Fresno |
| Title | Project Manager |
| Salutation | |
| Last name | Diaz Fresno |
| Middle name | |
| First name | Josefina |
| Department | |
| Mobile | +56-9-93465064 |
| Direct fax | +56-2-2066752 |
| Direct tel. | +56-2-8377648 |
| Personal e-mail | josefina.diaz@enaex.com |

| | |
|--------------------------|--|
| Organization name | Carbon Climate Protection GmbH |
| Street/P.O. Box | Am Südblick 5/2 |
| Building | |
| City | Langenlois |
| State/Region | |
| Postcode | A-3550 |
| Country | Austria |
| Telephone | +43 2734 322 70 |
| Fax | +43 2734 322 70 99 |
| E-mail | office@carbon-austria.com |
| Website | www.carbon-austria.com |
| Contact person | Mr. Ferdinand Heilig |
| Title | Managing Director |
| Salutation | |
| Last name | Heilig |
| Middle name | |
| First name | Ferdinand |
| Department | |
| Mobile | |



| | |
|------------------------|--|
| Direct fax | +43 2734 322 70 99 |
| Direct tel. | +43 2734 322 70 10 |
| Personal e-mail | heilig@carbon-austria.com |

| | |
|--------------------------|--|
| Organization name | Mitsubishi Corporation |
| Street/P.O. Box | 3-1 Marunouchi 2-Chome, Chiyoda-Ku |
| Building | |
| City | Tokyo |
| State/Region | Tokyo |
| Postcode | 100-8086 |
| Country | Japan |
| Telephone | +81-3-3210-8759 |
| Fax | |
| E-mail | mc-focal-point@mitsubishicorp.com |
| Website | www.mitsubishi.com |
| Contact person | Yousuke Kuroda |
| Title | Project Team North & Latin Americas |
| Salutation | Mr. |
| Last name | Kuroda |
| Middle name | |
| First name | Yousuke |
| Department | |
| Mobile | |
| Direct fax | |
| Direct tel. | +81-3-3210-6361 |
| Personal e-mail | yousuke.kuroda@mitsubishicorp.com |

Appendix 2: Affirmation regarding public funding

No public funds are available for the financing of the project activity.

Appendix 3: Applicability of selected methodology

No additional information on the applicability of the methodology is to be mentioned.

Appendix 4: Further background information on ex ante calculation of emission reductions

No additional information on the ex-ante calculation of emission reductions is to be mentioned.

Appendix 5: Further background information on monitoring plan

The project activity will apply an Automated Monitoring System (AMS), which is in line with the requirements of the approved consolidated baseline and monitoring methodology ACM0019 “N₂O abatement from nitric acid production” (Version 02.0) and of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) to monitor the N₂O concentration as well as the tail gas flow volume. Therefore continuous real-time measurements of the N₂O concentration and the total gas volume flow will be carried out in the tail gas stream after the abatement of N₂O emissions throughout the crediting period of the project activity.

The Monitoring Plan describes the procedures for data collection, storage and reporting required for the project in order to determine and verify the emission reductions achieved by the project activity. All required data are automatically transferred to the digital process control system, where they are displayed, evaluated and stored.

The monitoring procedures for the project activity will be fully in compliance with the applied approved monitoring methodology ACM0019 version 02.0 and of the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) and will be fully integrated in Enaex quality management system. All monitoring equipment will be serviced, calibrated and maintained according to the prevailing methodology and tools as well as to manufacturers’ instructions and international standards.

Monitoring equipment

In order to be able to calculate the greenhouse gas emission reductions a direct measurement of the quantity of tail gas flowing through the tail gas stack is necessary. A differential pressure bar will be installed in the vertical section of the tail gas stack according to the standard EN 15259. The measuring system operates according to the differential pressure principle. The probe has two separate chambers, between which the flow builds up a differential pressure.

The analyser is located in an instrument container located at the floor near the stack. The concentration of N₂O is measured at using non-dispersive infrared photometry. Measured data is stored and evaluated in a digital process control system. Data storage is redundant and manipulation-proof.

The measurement site was selected according to EN 14181:2004 and EN 15259. All sample points will be in the same sample plane at the measurement site. All instruments and standard reference method (SRM) openings are located at 0.5 m between them.

The gas sample extracted at the sample point is delivered to the conditioning system via an electrical tracing line that maintains the sample in gas phase. The sample line is electrically heated and insulated with fiberglass. The conditioning system is located in the instrument container. The sample, before being fed to the analyser, is conditioned.

In the tail gas, the concentration of nitrogen dioxide (N₂O) is analysed continuously (range 0 – 500 ppm). Analysis is done by using non-dispersive infrared photometry for N₂O. The analyser will take readings continuously. These readings will be stored and based on the raw data’s average value hourly figures will be calculated, reported and stored at the data storage system. Sample handling includes provisions for pressure reduction, separation of residual solids, sample flow adjustment, and supply with test gases. The analysers are, as far as technically possible, corrected for any applicable cross sensitivity.

The actual nitric acid production is measured with a coriolis flow meter. The instrument signals will be recorded in the control room.

The operation temperature of the oxidation burner ranges from 850 – 905°C and this range corresponds to the actual operation hours of the reactor. The temperature is reported automatically by three independent measurement points measuring the temperature at the same time.

The actual temperature of the ammonia oxidation reactor is monitored using the existing instruments. The instrument signals will be recorded in the control room and used to determine whether the nitric acid plant is in operation or not.

Data acquisition and storage

The measured values are transferred to a digital process control system, where they are displayed, evaluated and stored. Data storage for raw data as well as for evaluated data is done automatically on a computer network, which is directly connected to the process control system. The software for data storage is designed in a way that falsification of data is excluded. Time stamps are generated by a GPS clock.

The instrument containers include the analyser, parts of the sample handling system, and the controllers of the DCS. Data logging is carried out with redundant storage on two computers and operating data will be selected from the nitric acid plant as required by the relevant CDM methodology ACM0019 (Version 02.0). These are the operating parameters of the ammonia oxidation burners and nitric acid production.

The mass flow of N₂O in the gaseous stream needs to be calculated according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0). The tool provides six different calculation options to determine the mass flow of a particular greenhouse gas (Option A to F). Option A can be applied for the catalytic N₂O destruction project at the PANNA 4 Nitric Acid Plant. If Enaex S.A. is forced by unforeseen circumstances to change parameters of the catalytic N₂O destruction project at the PANNA 4 Nitric Acid Plant it might be required to apply a different option of the tool.

Operation of the monitoring system

The system is designed for automatic operation so that activities by operation personnel are not required during normal operation. However, it is required to observe the system for possible failures, and to perform required maintenance activities on a regular basis.

It is Enaex responsibility to ensure that required and experienced capacity is available and that their operational staffs are able to operate the monitoring system properly. It is also Enaex responsibility to organize and implement a quality management system that ensures the integrity of the data.

Malfunction of system components is indicated on the operator console in the control room as an alarm. The occurrence of such an alarm requires the operator to take measures to remedy the problem. This is normally done by informing the instrument department, which then decides whether the problem can be fixed immediately by them or if the manufacturer's support is required. In such a case it is important to act immediately in order to avoid loss of valuable data.

The analysers need a calibration on a regular basis. This calibration procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis. Since calibration is done with test gases, it is essential that availability of test gases is ensured. Enaex instrument technicians are responsible for the availability of test gas. Stock of test gases will be controlled regularly, and spare supply is made available in proper time.

Enaex will perform a visual inspection of system on a regular basis by the operating staff (e.g. once every week). Such an inspection can give indications on oncoming problems and allow to be prepared for them.

Data export from the data storage is to be done manually upon operational requests, but at least once a month. Detailed instructions are given by the manufacturer. Internal review of project performance and calculation of emission reductions will be executed by Enaex with the support of CARBON on a regular basis.

Appendix 6: Summary of post registration changes

Following the response of the Meth Panel to the Request for Clarification AM-CLA_0255 an updated PDD including a Post Registration Change (Permanent Change) was elaborated. The Meth Panel clarified in its response that the project participants can use a later version of the methodology as per § 89 of the “Procedure for development, revision and clarification of baseline and monitoring methodologies and methodological tools”. ‘...If the project participants or coordinating/managing entity wish to use a later version of the methodology or methodological tool for the purpose of monitoring of emission reductions or removals after the registration of the project activity or PoA, or a DOE, when performing a verification, determines that permanent changes to the monitoring plan as described in the registered PDD or PoA-DD, generic CPA-DD, or the monitoring methodology have occurred or expected to occur, the DOE shall submit a request for approval by the Board prior to the submission of the request for issuance in accordance with the relevant provisions of the “Clean development mechanism project cycle procedure” (EB 70, annex 36).

The adaptations of the PDD, which arouse from the change of methodology ACM0019 version 01.0 to version 02.0, can be summarized as follows:

- Change of methodology version throughout the whole document
- Section B.6.1 equations have been updated
- Section B.6.2 and B.7.1 parameter tables have been updated
- Section B.6.3 and B.6.4 ex-ante calculation of the emission reductions have been updated for the years 2013 until 2021 based on current input data verified during last 4 Monitoring Periods (Ex-ante estimation of emission reductions was done for the period from 19/03/2013 onwards only, since from then onwards methodology ACM0019 v02.0 was applied. Values of ER before that date are real emission reductions, which are already generated, verified and issued during Monitoring Periods # 1 – 4 of CDM project.)
- Information about project participants and starting date of crediting period has been updated
- Editorial and other changes were done due to the PDD being upgraded to PDD form version 04.1



History of the document

| Version | Date | Nature of revision |
|--|---------------------------------------|--|
| 04.1 | 11 April 2012 | Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b. |
| 04.0 | EB 66 13 March 2012 | Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8). |
| 03 | EB 25, Annex 15 26 July 2006 | |
| 02 | EB 14, Annex 06b 14 June 2004 | |
| 01 | EB 05, Paragraph 12 03 August 2002 | Initial adoption. |
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