**JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM**
**Version 01 - in effect as of: 15 June 2006**

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## Annexes

## SECTION A. General description of the project

### A.1. Title of the project:

"Realisation of a complex of energy saving activities at the JSC "Odessa Port Plant"

Sector Scope: 1 Energy industries[1] and 5 Chemical industries.

Version: 02

Date: 25 September 2010

### A.2. Description of the project:

Joint Stock Company "Odessa Port Plant" is one of the largest Ukrainian enterprises producing ammonia and urea. The main advantage of JSC "OPP", in comparison to other chemical enterprises, is the export terminal availability to provide chemical products of Ukrainian and the near abroad enterprises lading onto vessels for the export purpose.

The Plant started it's activity in 1978 by putting into operation the first stage of the transport complex in the ammonia terminal. The department was built using equipment of "Occidental Petroleum Corporation" USA. In 1978-1979 two ammonia production plants were put into operation. Technological process was developed by "Kellogg Brown & Root" USA. In 1984-1985 two urea production plants were put into operation. The technological process was developed by "Stamicarbon", Netherlands.

Before the project introduction, during 1994-1996 a complex modernization of the process control system was implemented at the plant, equipment supplier was "Honeywell" USA. During 1995-1996 the reconstruction of the ammonia reactors and primary reformers was implemented on the ammonia production plants, as well as the units for extracting hydrogen out of blow gases were put into operation.

The management of JSC "OPP" continuously pays special attention to environmental activities and improvement in power efficiency of the plant. Company specialists constantly take part in seminars, conferences and other events related to energy saving and ecology issues. The Company efforts were repeatedly honoured by awards, honourable diplomas, letters of commendation and certificates.

The project history starts when the "JSC "OPP" energy saving program for the period of 1998-2005" was approved at the enterprise. Within the program, the reconstruction of secondary reformer was implemented on the ammonia production plants during 1999-2000, and the engines "Avon" made by "Rolls-Roys", Great Britain were replaces by new more effective gas-turbine engines "DG-90" made by NVP "Mashproekt", Ukraine in the ammonia terminal.

[1] http://cdm.unfccc.int/DOE/scopes.html

Concerning the opportunity to attract finances for production modernization at the cost of Kyoto mechanisms, the management of JSC "OPP" initiated a joint implementation project of "Realisation of a complex of energy saving activities at the JSC "Odessa Port Plant" in 2001.

Due to lack of joint implementation project activity, the baseline for JSC "OPP" had lied in maintenance of the existing in the beginning of 2001 process equipment in a due condition, at the same time the natural gas and electric power consumption for ammonia and urea production and as its result greenhouse gases emissions to the atmosphere would stay equal to consumptions and emissions in 2000.

Despite the world economic crisis and shortages in own funds the Company has started "JSC "OPP" energy saving program for the period 2006-2020". Environmental legislation is not yet perfect in Ukraine, so far it is not fully adapted to the current requirements of international environmental bodies and European Union standards. There are no committed state politics in Ukraine requiring to reduce greenhouse gases emissions by chemical industry enterprises.

Project activities are aimed at improvement in power efficiency of the plant by the implementation of 3 subprojects. The main purpose of the planned activities implementation, in order to improve power efficiency of the production in JSC "OPP", is to decrease natural gas volumes burnt for ammonia production and heat energy for manufacturing and heating needs of the plant that will lead to greenhouse gases emissions reduction.

**1. Installation of waste heat boilers for the flue gases** – as a result of this subproject implementation, during 2001-2004 the waste heat boilers were installed, allowing to recover heat of the flue gases from gas-turbine engines. The main purpose of this activity is to decrease natural gas volumes burnt by the boiler shop of JSC "OPP" to generate heat energy for production and heating needs of the plant. The flue gas heat recovery by waste heat boilers will allow to generate steam necessary for urea production and to heat up the water in the network of the plant. This heat energy partly substitutes one that is generated by the boiler shop leading to the reduction of natural gas volumes burnt by the boiler shop for heat energy production.

**2. Modernization of two urea production units** – as a result of this subproject implementation, in 2001 a phased modernization of two urea production units started. The aim of the modernization is to install highly efficient equipment permitting to decrease amounts of heat and electric energy used for urea production, at the same time allowing to reduce the amounts of fossil fuel burning for the energy production. Reduction in volume of heat energy for the urea production will lead to the decrease in amounts of heat energy generated by the boiler shop and, as a result, reducing consumption of natural gas by the boiler shop. Reduction of the electric power consumption will permit to reduce its consumption from Ukraine's Electricity Transmission Grid leading to the decrease of the burning volume of fossil fuel for electric energy production by pwoer enterprises in Ukraine.

**3. Modernization of two ammonia production units –** as a result of this subproject implementation, in 2004 a phased modernization of two ammonia production units started. The purpose of modernization is to reduce consumption of natural gas for ammonia production. Natural gas, used for ammonia production, has two functions:

- technological purposes – the natural gas is used directly for the chemical ammonia synthesis providing necessary chemical elements for the process. Data on consumption of technological gas is used to calculate amounts of ammonia produced;

- fuel purposes – this natural gas is necessary to provide required temperatures for chemical synthesis. It is the fuel gas which is planned to reduce in natural gas consumption for ammonia production.
It is possible to reduce natural gas intake in results of power efficient equipment installation allowing to reduce the rate of natural gas specific consumption for ammonia production.

## A.3. Project participants:

| Party involved* | Legal entity project participant (as applicable) | Please indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Ukraine (the country of the project implementation) | • JSC "OPP"<br>• "Center TEST" LLC | No<br>No |
| Great Britain | • "RETON SOLUTION LLP" Company | No |
| *Please indicate if the Party involved is a host Party. | | |

## A.4. Technical description of the project:

### A.4.1. Location of the project:

The project is located on the territory of JSC "OPP". JSC "OPP" is located on the west bank of Adzhalikskiy estuary, 18 km from Odessa and 9 km from Yuzhne town. Geographic location of the project is indicated in figure 1.


**Figure 1 –** Geographic location of the project

Geographic coordinates of JSC "OPP" location:

- $46^0$ 36' 42.37" North latitude
- $31^0$ 00' 33.66" East longitude

#### A.4.1.1. Host Party(ies):

Ukraine

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

Odessa region

#### A.4.1.3. City/Town/Community etc.:

Yuzhne city

**A.4.1.4. Detail of physical location, including information allowing unique identification of the project (maximum one page):**

The project is located on the territory of JSC "OPP". The enterprise is located on the south-east part of Odessa region, on the west bank of Adzhalikskiy estuary, 18 km from a building border of Odessa and 9 km from Yuzhne town. Total area of the enterprise is 253 Ha. Total number of employees is approximately 4000 persons.

The enterprise borders upon Sea Trade Port Yuzhny, where the chemical products are shipped for export. Product shipment for export is loaded to vessels on 4 loading berths.

Chemical products from other enterprises arrive to the shipment terminal by railway and ammonia pipeline of 2417 km length.

The area of JSC "OPP" production is shown on figure 2.

**Figure 2 -** Area of JSC "OPP" production

**A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:**

Project activities are aimed at improvement in power efficiency of the plant by the implementation of 3 subprojects. The planned activities implementation for the power efficiency improvement of the production in JSC "OPP" will lead to the decrease of natural gas volumes burnt for ammonia production and to generate heat energy for production and heating needs of the plant that will impel greenhouse gases emissions to reduce.

**1. Installation of waste heat boilers for the flue gases**

In order to maintain the necessary technological parameters of the JSC "OPP" chemical and transport complexes, two ammonia compressors with gas-turbine engines driving function in the ammonia terminal. Natural gas is used as a fuel for gas-turbine engines. The temperature of the flue gases from ammonia compressor gas turbines in the ammonia terminal is 360-430 $^{o}$C. To implement this subproject

for recovering the heat of the flue gases from gas-turbine engines, two waste heat boilers were installed during 2001-2004. Waste heat boiler has all elements of the boiler unit excluding fusible and other items connected to the fuel combustion. The flue gases from gas turbine engine are fed to waste heat boiler, where the heat is used to generate steam. The waste heat boilers installation allows to generate steam of 18 bar pressure, which is necessary for urea production and the heating network of the enterprise. For the subproject implementation, the following waste heat boilers for the flue gases were installed:

- a KUP-2500M waste heat boiler co-designed by NVP "Mashproekt" (Mykolaiv, Ukraine) and JSC "Inproekservice" (Ukraine), and manufactured by "Chernomorskiy mashinobudivniy zavod" (Mykolaiv, Ukraine);

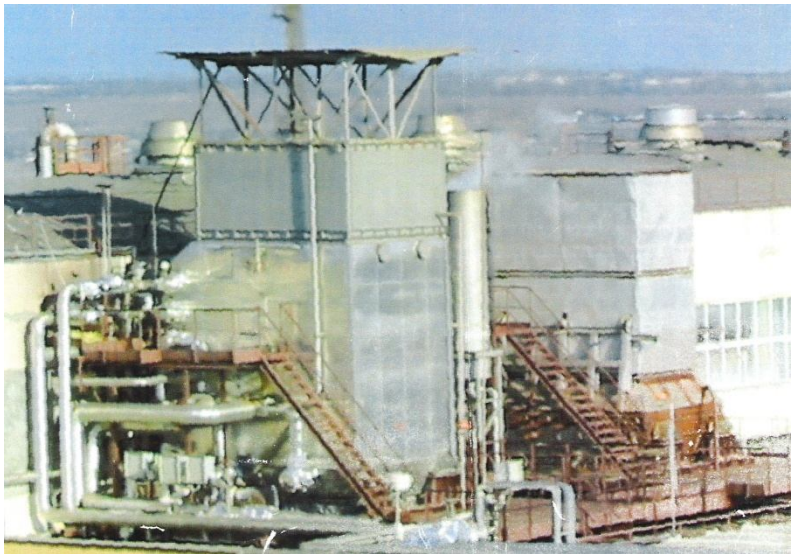
- a KUP-26-1,8-230 waste heat boiler designed by JSC NTP "Ukrpromenergo" (Kharkiv, Ukraine), and manufactured by "Krasniy kotel'shchik" enterprise (Taganrog, Russia).

Utilization of the flue gas heat by waste heat boilers will allow to generate steam for urea production and to heat up the water for the plant heating system avoiding the combustion of additional natural gas. The proposed subproject will allow to reduce the consumption of heat energy generated by the boiler shop of the plant. Estimated reduction in natural gas combustion by the boiler shop of the plant is 14.8 mln $m^3$/year.

Schedule of this subproject implementation is shown below:

| Name of the phase | Beginning of work | End of work |
|---|---|---|
| Installation of KUP-2500M waste heat boiler for the flue gases | 14/11/2001 | 28/02/2002 |
| Installation of KUP-26-1,8-230 waste heat boiler | 25/03/2003 | 25/03/2004 |

Figures 3 and 4 show the gas turbine waste heat boilers for the flue gases.



**Figures 3** – a KUP-2500M waste heat boiler

**Figure 4** – a KUP-26-1,8-230 waste heat boiler

## 2. Modernization of two urea production units

Urea production runs in the urea production department by means of ammonia and carbon dioxide synthesis in the urea production units. The units belong to urea production department. In accordance with the process scheme, these units are the main consumers of heat energy generated by the boiler shop of the plant, as well as consumers of electric power coming from Ukraine's Electricity Transmission Grid.

Technological process of urea production was developed by "Stamicarbon", Netherlands and consists of the following phases:

- condensation of the gaseous carbon dioxide to 150 atm. and its feeding to the synthesis section of the liquid ammonia under pressure of 150 atm.;
- urea synthesis with $NH_3$ and $CO_2$ under pressure of 150 atm. and temperature of 185 °C;
- two-step distillation of the obtained urea stream returning the unreacted substances back to the synthesis section;

- two-step vacuum-vaporizing of obtained 70% urea solution till the 99,5-99,8% concentration.

The proposed subproject will allow to reduce the rate of heat and electric energy specific consumption per ton of produced urea in result of the following modernizations, that were implemented from 2002 to 2008:

- installation of new internals, high efficient trays, in R201 reactors of both units (design and supply of equipment by JSC"NIIK", Dzerzhinsk, Russia);

- installation of reactors for high pressure burning-out of inflammable gases (design by UkrDIAP, Dniprodzerzhinsk, Ukraine);

- taking measures on stabilization of urea production units operation (design by JSC"NIIK" (Dzerzhinsk, Russia).

In future following modernizations are planned to implement on urea production units:

- revamp of a synthesis section with replacement of E201 stripper in #1 urea production unit;

- revamp of a synthesis section with replacement of a high pressure E202 condenser in both units.

It is expected that the implementation of urea production units modernization will allow to reduce specific consumption of heat energy for 0,2 Gkal per 1 ton of produced urea and electric power for 0,006 MW·hour per 1 ton of urea.

The proposed subproject will allow to reduce the volume of heat energy production by the boiler shop of the plant, that will lead to the reduction of natural gas combustion by the boiler shop for the heat energy production and will reduce consumption of the electric power from Ukraine's Electricity Transmission Grid, and will allow to decrease the volume of fossil fuel burning for the electric power production in the Ukrainian power plants.

Schedule of this subproject implementation is shown below:

| Name of the phase | Beginning of work | End of work |
|---|---|---|
| 1 | 2 | 3 |
| Installation of new internals (high efficient trays) in R201 reactors on urea production unit №1 | 18/01/2001 | 01/10/2002 |
| Installation of new internals (high efficient trays) in R201 reactors on urea production unit №2 | 13/12/2002 | 03/10/2003 |
| Installation of reactors for high pressure burning-out of inflammable gases on urea production unit №1 | 12/07/2002 | 15/07/2002 |
| Installation of reactors for high pressure burning-out of inflammable gases on urea production unit №2 | 09/12/2002 | 21/07/2003 |
| Taking measures on operation stabilization of urea production unit №1 | 24/03/2005 | 14/10/2008 |

| 1 | 2 | 3 |
|---|---|---|
| Taking measures on operation stabilization of urea production unit №2 | 24/03/2005 | 05/12/2006 |
| Revamp of a synthesis section with replacement of stripper in №1 urea production unit | 10/01/2011 | 20/12/2011 |
| Revamp of a synthesis section with replacement of a high pressure E202 condenser in №2 urea production unit | 10/01/2013 | 20/12/2013 |
| Revamp of a synthesis section with replacement of a high pressure E202 condenser in №1 urea production unit | 10/01/2014 | 01/09/2014 |

Expected reduction of heat energy and electric power specific consumption for urea production according to the design scenario, concerning the basic scenario, is shown on the figures below. Figure 5 indicates data concerning expected reduction of specific heat energy consumption for urea production, and figure 6 indicates reduction of electric power consumption for urea production.

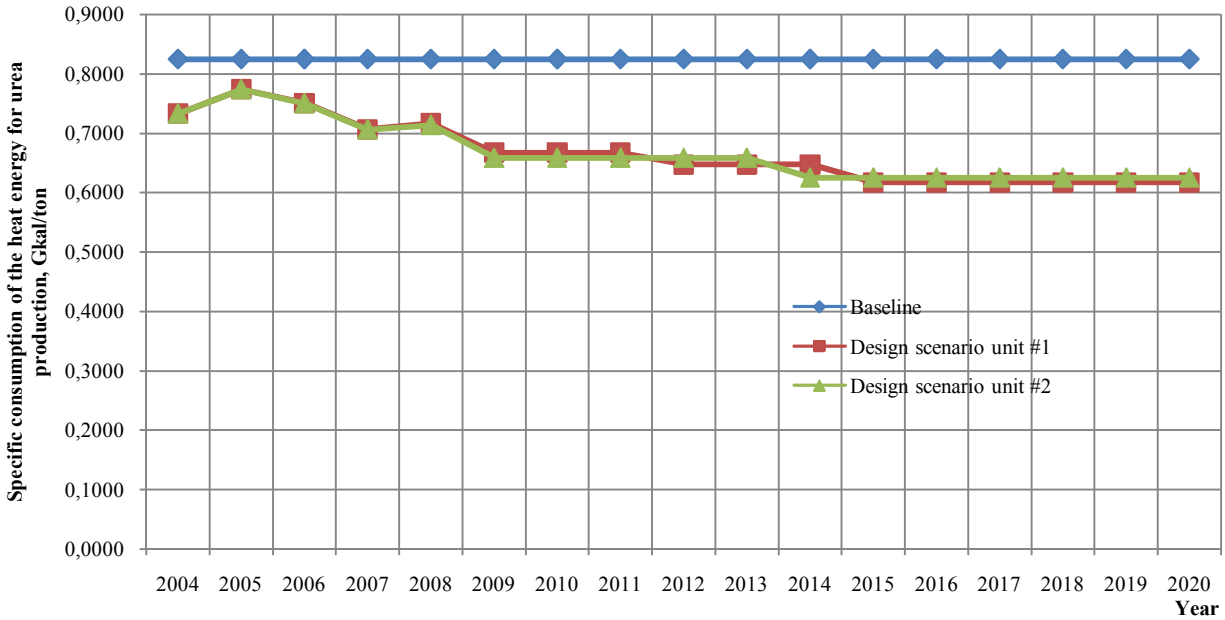



**Figure 5** – A diagram of expected reduction of specific heat energy consumption for urea production

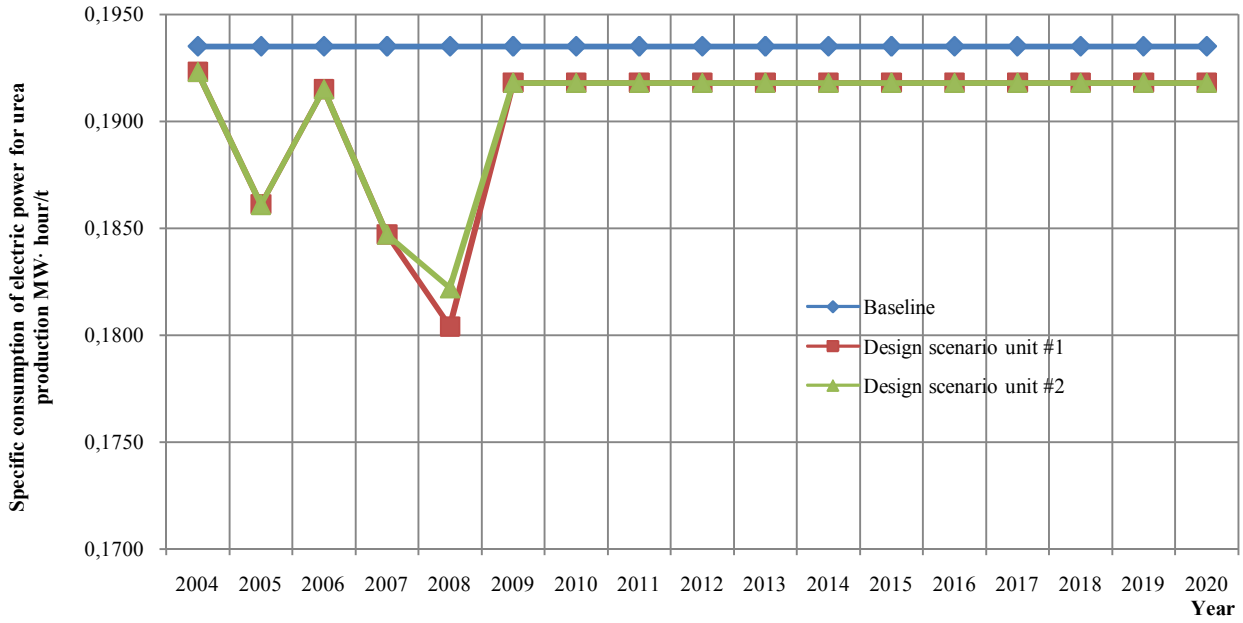



**Figure 6** – A diagram of expected reduction of specific electric power consumption for urea production

## 3. Modernization of two ammonia production units

The units belong to ammonia production department. The purpose of modernization is to reduce consumption of natural gas for ammonia production. Technological process and equipment used before the project introduction was developed by "Kellogg Brown & Root", USA. Natural gas is used as a feedstock for ammonia production. Ammonia production process consists of the following steps:

- natural gas compression;
- hydrogenation and purifying the gas from sulfur;
- steam-gas conversion of the natural gas in the reactor of the primary reformer with the temperature of approx. 800 °C and pressure of 32 atm;
- technological air compression;
- steam-gas conversion of the natural gas in the reactor of the secondary reformer with the temperature of approx. 1200 °C and pressure of 30 atm;
- two-step $CO_2$ conversion;
- $CO_2$ removal out of converted gas;
- fine CO and $CO_2$ removal out of converted gas;
- synthesis gas compression;
- ammonia synthesis under pressure of approx. 320 atm.

The proposed subproject will allow to decrease the rate of natural gas consumption per ton of produced ammonia as a result of the following modernizations performed in each production unit during 2004-2009:

- installation of make-up gas drying system (design and supply of equipment by CEAMAG, France);

- revamp of CO2 removal system (design and supply of equipment by "Ammonia Casale", Switzerland);

- modernization of turbine for 103-JT syngas compressor (design and supply of equipment by "UTE", Poland);

- modernization of 103-J syngas compressor (design and supply of equipment by "DRESSER RAND", France);

- revamp of low-temperature convection part of the reformer (design and supply of equipment by "CEAMAG", France);

In future, the following steps of modernization are planned to be taken:

- revamp of reaction part of a reformer.

After implementation of mentioned measures it is expected to obtain specific consumption reduction of natural gas per 1 ton of ammonia in amount of approx. 120m$^3$ per 1 ton of ammonia produced for each production unit.

Schedule of this subproject implementation is shown below:

| Name of the phase | Commencement date | Completion date |
|---|---|---|
| Installation of make-up gas drying system in the ammonia production unit №1 | 09/01/2004 | 15/11/2004 |
| Installation of make-up gas drying system in the ammonia production unit №2 | 02/12/2004 | 14/11/2005 |
| Revamp of CO2 removal system in the ammonia production unit №1 | 06/02/2004 | 20/11/2004 |
| Revamp of CO2 removal system in the ammonia production unit №2 | 20/12/2004 | 04/11/2005 |
| Modernization of turbine for 103-JT syngas compressor in the ammonia production unit №1 | 20/01/2005 | 25/12/2006 |
| Modernization of turbine for 103-JT syngas compressor in the ammonia production unit №2 | 14/02/2008 | 25/11/2009 |
| Modernization of 103-J syngas compressor in the ammonia production unit №1 | 23/12/2005 | 26/06/2008 |
| Modernization of 103-J syngas compressor in the ammonia production unit №2 | 23/12/2005 | 30/12/2009 |
| Revamp of low-temperature convection part of the reformer in the ammonia production unit №2 | 20/05/2008 | 14/04/2010 |
| Revamp of low-temperature convection part of the reformer in the ammonia production unit №1 | 10/01/2012 | 20/12/2012 |
| Revamp of reaction part of a reformer in the ammonia production unit №1 | 10/01/2015 | 01/09/2015 |
| Revamp of reaction part of a reformer in the ammonia production unit №2 | 10/01/2014 | 01/09/2014 |

Expected reduction of natural gas specific consumption for ammonia production according to the design scenario concerning the basic scenario is shown on the figures below. Figure 7 indicates data of ammonia production unit №1 and figure 8 indicates data of ammonia production unit №2.

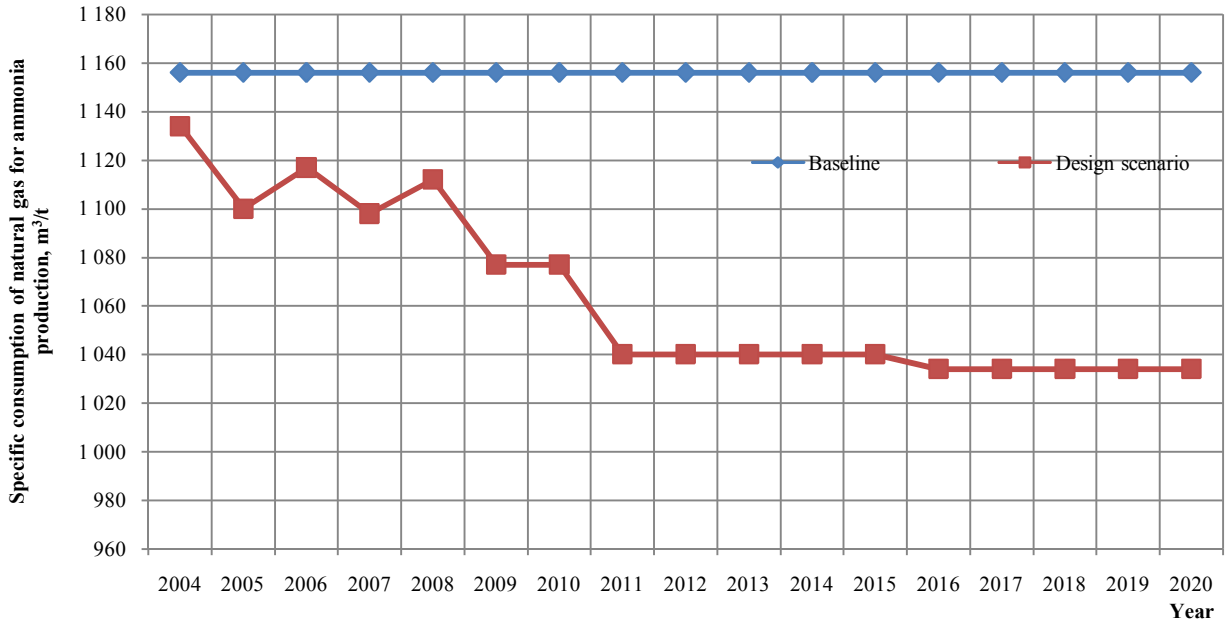



**Figure 7** – Expected reduction diagram of natural gas specific consumption for ammonia production unit #1

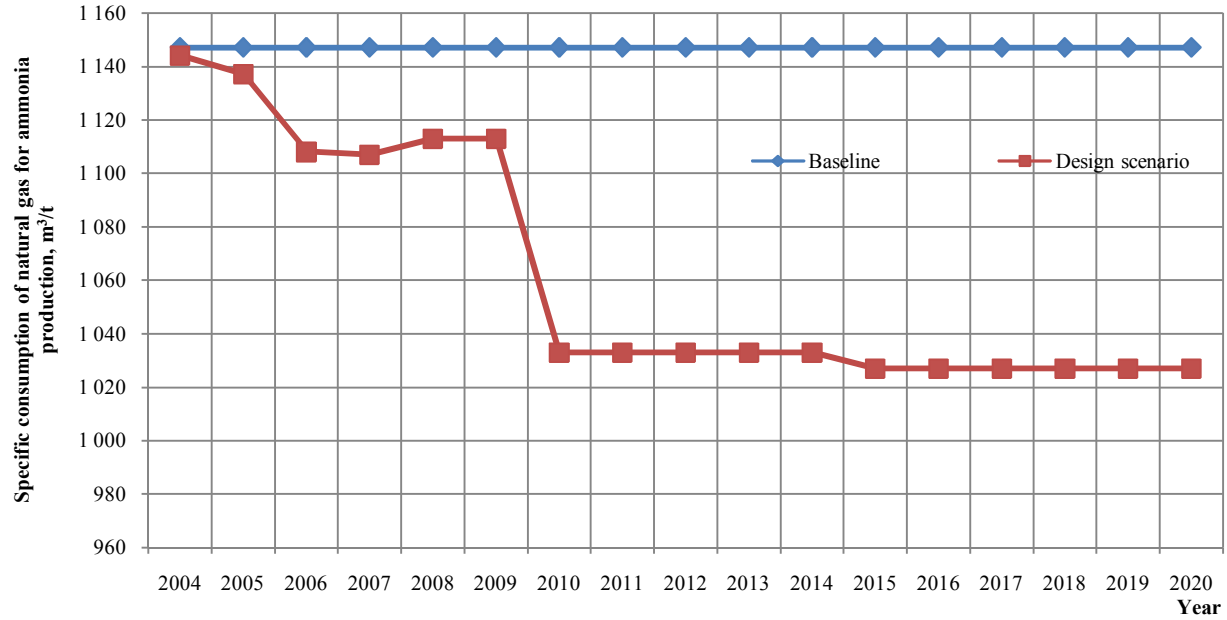



**Figure 8** – Expected reduction diagram of natural gas specific consumption for ammonia production unit #2

The project presumes the installation of a new, technically complex equipment with a high level of automatization which, in order to reach planned indices on power efficiency, requires the high qualification of maintenance staff.

Experts of the leading European companies: "DRESSER RAND" (France), "CEAMAG" (France), "Ammonia Casale" (Switzerland), "UTE" (Poland), as well as Ukrainian and Russian companies: NVP"Mashproekt" (Ukraine), JSC NTT "Ukrpromenergo" (Ukraine), JSC "NIIK" (Russia) were involved in consultations and revamp designs.

To minimize potential problems related to the lack of experience, specialists of the company regularly take extension training courses, participate in industry seminars and conferences.

High qualification of JSC "OPP" personnel and interest of the Company management in the implementation of specified project are the guarantee for successful realization of the project.

**A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:**

The main activities of JSC "OPP" are the production of ammonia and urea, provision of services to other chemical enterprises of Ukraine and the near abroad on export trade shipment of their produce. The major part of JSC "OPP" technological equipment operates, mainly, on natural gas. Significant part of natural gas is used in the production processes of the plant to heat up technological flows, to generate water steam, as well as a fuel for gas turbine engines.

Greenhouse gas emission occurs as a result of natural gas combustion during the heat energy generation for production and heating needs of the plant. The decrease of the emission is possible due to 3 subprojects implementation that allows to reduce the volume of fossil fuel burning for the heat energy and electric power production.

**1. Installation of waste heat boilers for the flue gases**

Utilization of the flue gas heat by waste heat boilers will allow to generate steam for urea production and to heat up the water for the plant heating system avoiding the combustion of additional natural gas volumes. Greenhouse gas emission is reduced due to heat energy production by the waste heat boilers without fossil fuel used. The proposed subproject allows to reduce the volume of natural gas combustion for heat energy production by the boiler shop of the plant, at the same time allowing to reduce the greenhouse gas emission.

**2. Modernization of two urea production units**

In accordance with the process scheme, urea production units are the main consumers of heat energy generated by the boiler shop of the plant, as well as consumers of electric power coming from Ukraine's Electricity Transmission Grid. The proposed subproject will allow to reduce the rate of heat and electric energy consumption per ton of produced urea. The drawdown of heat energy consumption rate will lead to a volume reduction of natural gas burning for the heat energy production by the boiler shop of the plant. The volume reduction of natural gas burning allows to decrease greenhouse gases emission to the atmosphere. The consumption rate reduction of electric power will decrease consumption rate of the electric power from Ukraine's Electricity Transmission Grid, that will allow to decrease the volume of fossil fuel burning for the electric power production on the Ukrainian power plants.

### 3. Modernization of two ammonia production units

This subproject will allow to decrease the rate of natural gas consumption for ammonia production. Main emission under this subproject is $CO_2$ emission as a result of ammonia production in two units. Emission decrease will occur as a result of a consumption rate reduction of the natural gas for 1 ton of ammonia produced. A decrease of natural gas consumption for ammonia production will allow to reduce greenhouse gas emission to the atmosphere.

Environmental legislation is not yet perfect in Ukraine, so far it is not fully adapted to the current requirements of international environmental bodies and European Union standards. There are no committed state politics in Ukraine requiring to reduce greenhouse emissions by chemical industry enterprises.

Significant financial resources are required to implement all activities scheduled according to the project. Project-related costs are planned to be partly compensated at the expense of reduction in natural gas volumes used by technological equipment and thus, by the decrease of production cost. However, this mechanism of investment return allows to implement only minor low cost revamps.

To implement planned energy-saving measures in full, both own funds of the Company and credit resources of Ukrainian banks are used. The latter source has being disadvantageous because of high interest rates. The possibility to attract investments using mechanism of joint implementation allows the Company management to perform measures which could not be implemented without funds that JSC "OPP" plans to receive from selling emission reduction units.

**A.4.3.1. Estimated amount of emission reductions over the crediting period:**

Beginning of crediting period starts in 2004. From the beginning of crediting period till the end of 2007, the assigned amount units (AAUs) will be generated.

| | Years |
|---|---|
| Duration of the crediting period | 4 |
| Year | Number of the assigned amount units, t $CO_{2\,e}$ |
| 2004 | 73 021 |
| 2005 | 121 761 |
| 2006 | 136 270 |
| 2007 | 171 150 |
| Total emission reduction during the crediting period (t $CO_{2\,e}$) | 502 201 |
| Average annual emission reduction during the crediting period (t $CO_{2\,e}$) | 125 550 |

First stage of obligations of Kyoto Protocol is from 2008 till 2012.

| | Years |
|---|---|
| Duration of the crediting period | 5 |
| Year | Number of the assigned amount units, t $CO_{2\,e}$ |
| 2008 | 147 223 |
| 2009 | 133 030 |
| 2010 | 261 461 |
| 2011 | 288 712 |
| 2012 | 290 723 |
| Total emission reduction during the crediting period (t $CO_{2\,e}$) | 1 121 149 |
| Average annual emission reduction during the crediting period (t $CO_{2\,e}$) | 224 230 |

In case if after the first stage of obligations under Kyoto Protocol it will be prolonged, the crediting period may be extended till the finalization of expected project operational lifetime.

| | Years |
|---|---|
| Duration of the crediting period | 8 |
| Year | Number of the assigned amount units, t $CO_{2\,e}$ |
| 2013 | 291 098 |
| 2014 | 294 721 |
| 2015 | 303 834 |
| 2016 | 309 648 |
| 2017 | 310 023 |
| 2018 | 309 648 |
| 2019 | 310 023 |
| 2020 | 309 648 |
| Total emission reduction during the crediting period (t $CO_{2\,e}$) | 2 438 642 |
| Average annual emission reduction during the crediting period (t $CO_{2\,e}$) | 304 830 |

## A.5. Project approval by the Parties involved:

Justification materials for the potential joint implementation project, intending to obtain a letter of endorsement by the owner of the source, were sent to National Environmental Investment Agency of Ukraine. National Environmental Investment Agency of Ukraine has issued for this purpose a letter of endorsement dated as of 02.08.2010 №1149/23/7.

After the procedure of project determination the final version of documentation and the determination statement will be submitted to the National Environmental Investment Agency of Ukraine in order to obtain a letter of approval.

## SECTION B. Baseline

### B.1. Description and justification of the baseline chosen:

The baseline for this project was chosen according to "Guidance on criteria for baseline setting and monitoring" (version 02)[1]. Correspondently to the document request, the selection of the baseline can be stated on a certain approach that is used only for a specific project of joint implementation, or on a standard approach with a use of methodologies including small-scaled that are approved by the Joint Implementation Supervisory Committee.

Since this project consists of several subprojects that are aimed at different key factors allowing to reduce greenhouse gas emission, the baseline was determinated on the basis of certain approach. According to "Guidance on criteria for baseline setting and monitoring" (version 02) for such projects, based on the certain approach, specific methodological parts can be included into the baseline determination, that are approved by the Joint Implementation Supervisory Committee. For the baseline determination of this project, specific elements of consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2)[2] were use. One out of three subprojects, namely "Installation of waste heat boilers for the flue gases", completely conforms to the object of this methodology, therefore, to determine basic emissions of this subproject, the indicated methodology requirements were used. Subproject "Modernization of two urea production units" presumes calculation of the heat and electric energy consumption for urea production, and methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) states the requirements for calculation of the heat and electric energy amounts, therefore, separate parts of the indicated methodology were used for this subproject.

Baseline selection established on the most reliable among the alternative scenarios that are acceptable for the project participants and are able to secure output production quality, without reducing the produced volume, and meets the requirements of the effective legislation in Ukraine.

Baseline of this project was selected by following implementation steps:
1. Identification of realistic and effective alternatives;
2. Rejection of alternatives that do not comply with active legislations and regulations;
3. Rejection of alternatives that include difficulties for their achievement.

[1] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf
[2] http://cdm.unfccc.int/UserManagement/FileStorage/0M4N9567GH1J7UAJ89YNQ299K1MYSI

***Step 1. Identification of realistic and effective alternatives***

To determine the baseline, four the most probable alternatives were selected for the project activity.

| | |
|---|---|
| Alternative 1.1 | Extension of current situation at the plant without activities to improve power efficiency |
| Alternative 1.2 | The boiler shop at the plant uses alternative type of fuel, different from natural gas, for example, biomass for heat energy production |
| Alternative 1.3 | Another use of the flue gases heat of gas-turbine engines excluding project activities |
| Alternative 1.4 | Performance of project activities without joint implementation mechanisms |

*1.1 Extension of current situation at the plant without activities to improve power efficiency*

According to this alternative the plant will not perform the modernization of urea and ammonia production units, and will not install waste heat boiler for the flue gases. The boiler shop of JSC "OPP" will continue to generate heat energy for production and heating needs of the plant.

*1.2 For heat energy production, the boiler shop at the plant uses another alternative type of fuel, different from natural gas, for example, biomass*

According to this alternative, the boiler shop of the plant is suggested to convert to an alternative fuel use, such as biomass, in order to produce heat energy for production and heating needs of the plant. Heat energy production using alternative fuel can allow to reduce greenhouse gases emission to the atmosphere relatively to heat energy production using natural gas.

*1.3 Another use of the flue gases heat of gas-turbine engines excluding project activities*

According to this alternative it is suggested not to install waste heat boilers for the flue gases under the project. Production process at the JSC "OPP" does not presume to use the heat of the flue gases of gas-turbine engines, the heat of the flue gases according to the process scheme releases to the atmosphere. Another use of the flue gas heat (heat energy), besides project activities, is not reasonable for the plant, therefore this alternative is not realistic and can be excluded.

*1.4 Performance of project activities without joint implementation mechanisms*

This alternative presumes to implement all the modernization activities at the plant, but not using joint implementation mechanisms.

***Step 2. Rejection of alternatives that do not comply with active legislations and regulations***

All the abovementioned alternatives comply with active legislation requests and corresponding regulations.

***Step 3. Rejection of alternatives that include restrictions in their achievement***

*Substep 3a. Financial restrictions*

Alternative 1.1 does not include significant financial issues, the plant does not require modernizations and can continue to purchase the natural gas and electric power for production and heating needs of the plant.

For alternative 1.2 it is important to evaluate financial constituent. In Ukraine, on big enterprises the use of biomass in big volumes for production needs is not developed. Also, there is no statistical data on the necessary biofuel availability and its quality, that can respond to the plant needs by its specifications. In Ukraine the scheme of production and delivery of the biofuel is not yet established.

Alternative 1.3 was declared unrealistic on the step 1.

Alternative 1.4 is not financially attractive without engaging in the joint implementation mechanisms. Introduction of this alternative requires significant plant modernization and financial investments that are possible to obtain by joint implementation project performance.

*Substep 3b. Process restrictions*

Alternative 1.1 does not include technical restrictions, the plant does not require modernization and can continue to use technical equipment, following corresponding instructions of the exploitation and planned maintenance work.

Besides barriers mentioned in substep 3a, alternative 1.2 confronts with significant technological restrictions. First of all, since natural gas is the main component in ammonia production, it is connected to the production process scheme.

Alternative 1.3 was declared unrealistic on the step 1.

Alternative 1.4 requires significant plant modernization. The project presumes the installation of a new , technically complex equipment having a higher level of automatization which, in order to achieve planned goals on power efficiency, requires the high qualification of maintenance staff.

***Selection of baseline***

After the fulfilling the three steps, only one realistic scenario was chosen, i.e. continuation of the current situation at the plant without modernization according to the project (alternative 1.1) is the baseline of the joint implementation project. The alternative 1.3 was proved unrealistic at the step 1. The alternatives 1.2 and 1.3 were set aside at step 3, as there are too many restrictions (technical and financial) for their implementation.

Key parameters for baseline establishment are given in the following table.

| **Data/Parameter** | $EF_{co2,elec}$ |
|---|---|
| Data unit | t $CO_{2\ e}$/MW·hour |
| Description | Emission factor for Electricity Transmission Grid of Ukraine |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5)[1] |
| Value of data applied (for ex ante calculations/determinations) | 0,807 – for joint implementation projects on electric power generation;<br>0,896 – for joint implementation projects on energy efficiency |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The research for determination of this factor for Electricity Transmission Grid of Ukraine was conducted by Global Carbon B.V. and defined byTUEV SUED company |
| QA/QC procedures (to be) applied | This parameter is calculated according to "Tool to calculate the emission factor for an electricity system" (version 02)[2] |
| Any comment | - |

Global Carbon B.V. (Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5, 02 February 2007) developed by Global Carbon B.V.)

[2] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

| Data/Parameter | $\eta_{boiler}$ |
|---|---|
| Data unit | % |
| Description | Power efficiency (Efficiency Factor) of the boiler shop |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01)[1] |
| Value of data applied (for ex ante calculations/determinations) | 87 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | This parameter is determined according to the requirements of "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01) |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| Data/Parameter | $OXID_{NG}$ |
|---|---|
| Data unit | % |
| Description | Natural gas oxidation factor |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "IPCC Guidelines for National Greenhouse Gas Inventories" |
| Value of data applied (for ex ante calculations/determinations) | 100 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "IPCC Guidelines for National Greenhouse Gas Inventories" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf
[2] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

| Data/Parameter | $W_{NG}$ |
|---|---|
| Data unit | t C/TJ |
| Description | Carbon content of natural gas combustion |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of anthropogenic emissions from the sources and capture by absorbers of greenhouse gases in Ukraine during 1990-2008"[1] (hereinafter "National Cadastre of Ukraine") |
| Value of data applied (for ex ante calculations/determinations) | 15,3 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| Data/Parameter | $\rho_{NG}$ |
|---|---|
| Data unit | t/million $m^3$ |
| Description | Natural gas density |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of Ukraine" |
| Value of data applied (for ex ante calculations/determinations) | 693 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

[1] http://www.menr.gov.ua/cgi-bin/go?node=Nac%20kadastr%20parn%20gaz

| **Data/Parameter** | $m_c$ |
|---|---|
| Data unit | t C/t NG |
| Description | Natural gas carbon content |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of Ukraine" |
| Value of data applied (for ex ante calculations/determinations) | 0,738 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| **Data/Parameter** | $HG_{boilers}$ |
|---|---|
| Data unit | Tcal |
| Description | Amount of heat energy generated by waste heat boiler for flue gases |
| Time off determination/monitoring | Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | Measurement |
| Value of data applied (for ex ante calculations/determinations) | Expected amount of heat energy is calculated according to predictional data on JSC "OPP" production |

| Year | Tcal |
|---|---|
| 2004 | 113,156 |
| 2005 | 113,637 |
| 2006 | 128,530 |
| 2007 | 118,375 |
| 2008 | 117,498 |
| 2009 | 71,892 |
| 2010 | 121,468 |
| 2011 | 121,468 |
| 2012 | 121,468 |
| 2013 | 121,468 |
| 2014 | 121,468 |
| 2015 | 121,468 |
| 2016 | 121,468 |
| 2017 | 121,468 |
| 2018 | 121,468 |
| 2019 | 121,468 |
| 2020 | 121,468 |

| | |
|---|---|
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Amount of heat energy is measured by heat energy measuring section accordingly |
| QA/QC procedures (to be) applied | Measuring equipment used for measurements is subject to periodic state inspection |
| Any comment | - |

<table>
<tr><td>Data/Parameter</td><td>$P_{urea}$</td></tr>
<tr><td>Data unit</td><td>t</td></tr>
<tr><td>Description</td><td>Amount of produced urea</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>"Technical and production reports"</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of produced urea is calculated according to predictional data on JSC "OPP" production
<table>
<tr><td rowspan="2">Year</td><td colspan="2">t</td></tr>
<tr><td>Urea production unit #1</td><td>Urea production unit #2</td></tr>
<tr><td>2004</td><td>422 467</td><td>413 713</td></tr>
<tr><td>2005</td><td>447 595</td><td>421 250</td></tr>
<tr><td>2006</td><td>427 541</td><td>460 781</td></tr>
<tr><td>2007</td><td>452 110</td><td>472 431</td></tr>
<tr><td>2008</td><td>442 184</td><td>500 189</td></tr>
<tr><td>2009</td><td>423 849</td><td>424 705</td></tr>
<tr><td>2010</td><td>461 000</td><td>424 000</td></tr>
<tr><td>2011</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2012</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2013</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2014</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2015</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2016</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2017</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2018</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2019</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2020</td><td>450 000</td><td>450 000</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>The amount of produced urea is calculated on the basis of technical and production data</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| **Data/Parameter** | $SEC_{urea,elec}$ |
|---|---|
| Data unit | MW·hour/t |
| Description | Specific electric power consumption for urea production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based on chronological data on urea production unit operation was accepted for this parameter within 3 years before the project implementation, namely from 1999 to 2001. |
| Value of data applied (for ex ante calculations/determinations) | 0,1935 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |

| **Data/Parameter** | $SEC_{urea,term}$ |
|---|---|
| Data unit | Tcal/t |
| Description | Specific heat energy consumption for urea production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based on chronological data on urea production unit operation was adopted for this parameter within 3 years before the project implementation, namely from 1999 to 2001. |
| Value of data applied (for ex ante calculations/determinations) | $0,8242 \cdot 10^{-3}$ |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |

<table>
<tr><td>Data/Parameter</td><td>$P_{ammonia}$</td></tr>
<tr><td>Data unit</td><td>t</td></tr>
<tr><td>Description</td><td>Amount of produced ammonia</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>"Technical and production reports"</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of produced ammonia is calculated according to predictional data on JSC "OPP" production
<table>
<tr><td rowspan="2">Year</td><td colspan="2">t</td></tr>
<tr><td>Ammonia production unit #1</td><td>Ammonia production unit #2</td></tr>
<tr><td>2004</td><td>515 750</td><td>-</td></tr>
<tr><td>2005</td><td>613 159</td><td>522 150</td></tr>
<tr><td>2006</td><td>533 678</td><td>594 155</td></tr>
<tr><td>2007</td><td>554 482</td><td>572 568</td></tr>
<tr><td>2008</td><td>487 525</td><td>591 219</td></tr>
<tr><td>2009</td><td>466 635</td><td>106 127</td></tr>
<tr><td>2010</td><td>437 000</td><td>583 000</td></tr>
<tr><td>2011</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2012</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2013</td><td>550 000</td><td>450 000</td></tr>
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<tr><td>2018</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2019</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2020</td><td>450 000</td><td>550 000</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>The amount of produced ammonia is calculated on the basis of technical and production data</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| Data/Parameter | $SEC_{ammonia}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific natural gas consumption for ammonia production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based of chronological data on ammonia production unit operation was adopted for this parameter within 3 years before the project implementation: from 2001 to 2003 for ammonia production unit №1; from 2002 to 2004 for ammonia production unit №2 |
| Value of data applied (for ex ante calculations/determinations) | 1 156 – for ammonia production unit №1;<br>1 147 – for ammonia production unit №2 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |

**B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:**

Emission sources of this project were determined separately for each subproject. Sources of greenhouse gases emissions are:

**1. Installation of waste heat boilers for the flue gases** – according to the baseline, the JSC "OPP" boiler shop is a source of emissions. According to this scenario, direct emissions are caused by combustion of natural gas to generate heat energy for production needs. According to the project scenario, WH boilers are the source of emissions. In accordance with the project scenario, emissions are caused by the use of electric power from Electricity Transmission Grid of Ukraine to support operational modes of waste heat boilers. The reduction in greenhouse gas emissions will be achieved due to the decrease in the consumption of heat energy generated by the JSC "OPP" boiler shop allowing this shop to reduce the combustion of natural gas for heat generation. Decrease in fuel combustion will allow reducing greenhouse gas emissions into the atmosphere;

**2. Modernization of two urea production units** – according to the baseline and project scenario, the JSC "OPP" boiler shop is the source of emissions caused by the heat energy consumption of urea production units; and Ukrainian power plants generating power for Electricity Transmission Grid of Ukraine are the sources of emissions caused by the electric power consumption from the Grid. Emission reductions will be achieved in result of decrease in the rate of heat and electric energy consumption for urea production. Reduction of the specific heat energy consumption will allow to reduce emissions related to natural gas combustion in the OPP boiler shop to generate water steam. Decrease in fuel combustion will allow to reduce greenhouse gas emissions into the air. Reduction in the use of electric power will allow to decrease the consumption of electric power from Electricity Transmission Grid of Ukraine, leading to the respective reduction in amounts of fuel used to generate electric power and, correspondingly, to the reduction in greenhouse gas emissions by Ukrainian power plants;

**3. Modernization of two ammonia production units** – according to the baseline and project scenario of this subproject, ammonia production units are the emission sources. Emissions are caused by the natural gas consumption for ammonia production. Emissions will be decreased in result of reduction of the rate of natural gas consumption for ammonia production. Reduction in the rate of specific natural gas consumption will allow to reduce emissions resulted from natural gas consumption in ammonia production. Reduction in the natural gas consumption will allow to decrease greenhouse gas emissions into the atmosphere.

It is important to note that the implementation of measures mentioned above will allow to reduce greenhouse gas emissions into the atmosphere, that cannot be achieved if this project will not be introduced. JSC "OPP" has no financial benefits from the reduction of greenhouse emissions into the atmosphere. Therefore any reduction of harmful emissions to the atmosphere achieved within the range of joint implementation project, will be additional.

Complimentarity of proposed joint implementation project was estimated by the "Tool for the demonstration and assessment of additionality" (version 05.2)[1]. This technique presumes a step-by-step estimation of project complimentarity.

***Step 1. Identification of alternative activities within the project that comply with Ukrainian law in force***

*Sub-step 1a. Determination of alternative activities within the project:*

As mentioned in section B.1, four more activities were determined besides the joint implementation project:
1 To continue current situation without implementation of energy-saving measures;
2 The boiler shop at the plant uses alternative type of fuel, different from natural gas, for example, biomass for heat energy production;
3 To use heat of flue gases of gas turbine engines differently due to lack of project activity;
4 To implement project activity without joint implementation mechanism advantages.

For alternative 2 there are many restrictions related to the process scheme of production. Since the natural gas is the basic component of ammonia production, the application of alternative fuel is unrealistic and inefficient, thus it is not considered further.

The process of production at JSC "OPP" does not imply to use heat of flue gases of gas turbine engines, according to the process scheme it is emitted to the atmosphere. Other application of flue gases heat (heat energy), except project activity, is not rational for the plant, thus the alternative 3 is unrealistic and is not considered further.

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

*Sub-step 1b. Correspondence with the law in force:*

Remained alternatives which were accepted as realistic are 1 and 5. These alternatives do not contradict the requirements of the law in force.

According to the Ukrainian law in force the reduction of greenhouse gases emissions into the atmosphere is not obligatory. The national policy according this subject is determined by the Ukrainian law "On the atmosphere protection"[1] №2707-XII dated 16.10.1992. This law does not implement exact demands according to industrial emissions of greenhouse gases. The demands according to permitted emissions into the atmosphere is determined by the order of Ministry for environmental protection of Ukraine "On adoption of standards for permitted harmful pollutant emissions out of stationary sources"[2] №309 dated 27.06.2006.

***Step 2.Investment analysis***

*Sub- step 2a.Choice of appropriate analysis method.*

"Tool for the demonstration and assessment of additionality" (version 05.2) provides three options of investment analysis:
Option I. Application of simple inputs analysis;
Option II. Application of comparative investment analysis;
Option III. Application of analysis by reference points.

The suggested project gives and other advantages besides incomes from realization of emission reduction units according to the joint implementation mechanism, so the option I is not applied for this project.

The accepted baseline "To continue current situation without implementation of energy-saving measures" does not suppose investment, so the option II is not applied for this project.

Regarding mentioned above, the option III was chosen as appropriate.

*Sub-step 2b.Option I. Application of simple analysis of costs*

Not applied.

*Sub-step 2b.Option II. Application of comparative investment analysis*

Not applied.

[1] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2707-12
[2] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0912-06

*Sub-step 2b. Option III. Application of analysis by reference points.*

For all modernization activities according to the project, investments of 109.443 million Euro are necessary, including:

| Activity name | Cost, million Euro |
|---|---|
| Installation of waste heat boilers for flue gases of gas turbine engines | 2,938 |
| Modernization of urea reactors at urea production units №1 and №2 | 8,856 |
| Installation of reactors for high pressure burning-out of inflammable gases | 2,244 |
| Taking measures on stabilization of urea production units operation | 10,318 |
| Revamp of synthesis section with replacement of stripper at urea production unit №1 | 4,577 |
| Revamp of synthesis section with replacement of high pressure E202 condenser at urea production units №1 and №2 | 9,469 |
| Installation of raw synthesis gas drainage system at ammonia production unit №1 and №2 | 6,405 |
| Modernization of process gas $CO_2$ removal system at ammonia production units №1 and №2 | 7,706 |
| Modernization of synthesis gas compressor turbine at ammonia production units №1 and №2 | 7,890 |
| Modernization of synthesis gas compressor at ammonia production units №1 and №2 | 9,005 |
| Revamp of low temperature convection section of reformer at ammonia production unit №2 | 9,003 |
| Revamp of low temperature convection section of reformer at ammonia production unit №1 | 8,919 |
| Revamp of reaction section of reformer at ammonia production units №1 and №2 | 22,113 |
| **Total** | **109,443** |

Such modernizations will allow to reduce consumption of following energy sources:
- natural gas;
- electric power.

Due to realization of all three subprojects the expected saving of natural gas will be within the limits of 30 million $m^3$ at the start of project realization and 160 million $m^3$ at the end of all planed modernization activities. According to financial documents of JSC "OPP" the cost of natural gas during the crediting period was varying from 60 to 165 euro per one thousand $m^3$ of natural gas. So expected income of JSC "OPP" from natural gas saving is from 1,8 million euro per year at the start of project realization to 25 million euro per year at the end of all planned modernization activities.

Due to realization of subproject on two urea production units modernization the expected saving of electric power is within the limits from 1000 MW·hour per year to 10000 MW·hour per year. According to financial documents of JSC "OPP" the cost of electric power during the crediting period was varying from 26 to 40 euro per 1 MW·hour. So expected average annual income of JSC "OPP" from electric power saving is near to 150 thousand euro per year.

The herein costs, rates and investments are listed without value added tax.

Interest rate of Ukrainian banks of foreign currency crediting according to the reports of National Bank of Ukraine was chosen as a reference point. Static average annual rate for crediting period makes up 11.4%[1].

On the basis of data mentioned above the internal rate of return (IRR) for the project was calculated for expected crediting period. It made up 9.8%. So the reference project point is lower than the reference point chosen. It indicates that the project is not financially attractive.

During the calculation of internal rate of return a liquidation value of project assists was taken into account when developing a flow of financial expenses during the last project year.

To predict the value of energy resources in future a forecasted inflation rates were used based on retrospective data of the past years.

*Sub-step 2c.Calculation and comparison of financial indexes (applied only for options II and III)*

Financial indices, Net Present Value (NPV) and Internal Rate of Return (IRR), were calculated for two options: with and without joint implementation mechanisms.

Discount rate of 11.4% was used for calculation. It corresponds to integral interest rate of Ukrainian banks for the foreign currency according to the reports of National Bank of Ukraine. The financial indexes were calculated for the expected crediting period.

Expected income from emission reduction units sale with the price of 10 euro per 1 ton of $CO_{2e}$ was calculated to count financial indexes for project activities with application of joint implementation mechanism advantages.

As a result of joint implementation activities connected to project modernization the enterprise was forced to have unscheduled shutdowns of urea and ammonia production units in order to implement the modernization, which have led to the unscheduled urea and ammonia output reduction. The unreached profit due to equipment stops was referred to the expenses part when financial indices were calculated. Due to lack of joint implementation project urea and ammonia production units would be working by the ordinary schedule that does not presume units' shutdown.

Simple pay-back period without application of joint implementation mechanisms is 21 years, with their application it makes up 19 years.

The calculations of NPV and IRR for both variants are given in the following table.

| | With application of joint implementation mechanisms | Without implementation of joint implementation mechanisms |
|---|---|---|
| NPV, million euro | -4,865 | 4,169 |
| IRR, % | 9,8 | 12,7 |

[1] http://www.bank.gov.ua/

As calculation shows, the project is not financially attractive without application of joint implementation mechanisms, however their application makes the project more attractive for investment. So we can conclude, that the project is supplementary.

*Sub-step 2d. Perceptibility analysis (applied only for options II and III)*

The suggested project mainly depends on the cost of energy sources in Ukraine. The income from electric power saving makes up less than 10% of the income from natural gas saving, thus the perceptibility of the project basically depends on varying of natural gas prices in Ukraine. For the project profitability without application of joint implementation mechanisms to reach the same level with application of such mechanisms the cost of natural gas must increase greatly. But increase of natural gas cost is not profitable for the JSC "OPP", because it will result in an increase of production cost, as natural gas is the basic component for ammonia production. Possible increase of energy sources cost was considered in calculation of financial indices. New long term agreement on the natural gas supply between Ukraine and Russia gives an opportunity to expect that natural gas price will not increase dramatically for Ukrainian enterprises.

Project perceptibility was estimated at range of ±10% of energy resources value changes.

| | -10% | 0% | +10% |
|---|---|---|---|
| NPV, million euro | -9,541 | -4,865 | -0,189 |
| IRR, % | 8,1 | 9,8 | 11,3 |

As the estimation shows the project does not become attractive for investments even if the energy resources price increase in future. So we can conclude, that the project is not supplementary.

***Step 3. Restriction analysis***

*Sub-step 3a. Identification of restrictions impeding the realization of joint implementation project.*

1. Financial restrictions

The project activities are not financially attractive without application of joint implementation mechanisms. The realization of this project requires considerable modernization of the plant and financial investments, which can be obtained only through the realization of the joint implementation project.

2. Technical restrictions

The project activities require considerable modernization of the plant. The project presumes the installation of a new , technically complex equipment having a higher level of automatization which, in order to achieve planned goals on power efficiency, requires the high qualification of maintenance personnel.

*Sub-step 3b. Inquiring if revealed restrictions will not prevent the implementation of any scenarios (except the suggested project)*

Neither financial nor technical restrictions will prevent the baseline. The JSC "OPP" will not need investments for modernization, it can continue to buy natural gas and electric power from the state for production and heating needs. According to the baseline the plant does not need modernization and can continue to use its technical equipment following operational instructions and turnarounds.

Joint implementation mechanisms allow to obtain funds for planned project modernization, which allows to eliminate the financial restrictions for the suggested project. Many high-qualified specialists from leading European firms: "DRESSER RAND", France, "CEAMAG", France, "Ammonia Casale", Switzerland, "UTE", Poland; Ukrainian and Russian enterprises: NVP"Mashproekt", Ukraine, JSC NTT "Ukrpromenergo", Ukraine, JSC "NIIK", Russia are involved in the realization of the project. It allows to minimize technological restrictions mentioned.

***Step 4. Analysis of extended practices***

*Sub-step 4a.Analysis of other projects similar to the suggested joint implementation project.*

In Ukraine there were no projects on energy-saving activities at chemical enterprises, namely at ammonia and urea plants.

*Sub-step 4b. Discussion of other similar active projects*

Other similar projects are not being realized.

**Conclusion:** the realization of the project will allow to reduce greenhouse gas emissions into the atmosphere, that cannot be achieved otherwise. Any reduction of harmful emissions into the atmosphere achieved within the range of joint implementation project will be additional

## B.3. Description of how the definition of the project boundary is applied to the project:

Limits of the project were defined for each subproject separately.

### 1. Installation of waste heat boiler for flue gases

The limits of this subproject according to the baseline involve emissions connected to natural gas combustion for heat energy generation in boiler shop. The boundaries of this subproject according to the project scenario are situated beyond the limits of emission object. In accordance with the project scenario, emissions are caused by the consumption of electric power from Ukraine's Electricity Transmission Grid to support operational modes of waste heat boilers.

### 2. Modernization of two urea production units

The boundaries of this subproject according to the baseline and project scenario involve:
- emissions connected with natural gas combustion for heat energy generation in boiler shop;

- emissions connected with the consumption of electric power from Ukraine's Electricity Transmission Grid.

**3. Modernization of two ammonia production units**

The boundaries of this subproject according to the baseline and project scenario involve emissions connected with the natural gas consumption for ammonia production.

Spatial boundaries of the project according to the baseline and project scenario involve physical (geographic) location of an emission source. The boundaries of the project coincide with physical boundaries of the JSC "OPP" and a power plant generating electric power for production needs of the JSC "OPP". The boundaries are pertained to the region where these plants are located.

| | Source | Gas | Included? | Justification/Explanation |
|---|---|---|---|---|
| **Subproject "Installation of waste heat boilers for the flue gases"** | | | | |
| **Baseline** | Natural gas combustion for heat energy generation | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| **Subproject "Modernization of two urea production units"** | | | | |
| **Baseline** | Natural gas combustion for heat energy generation | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| | Electricity consumption from Electricity Transmission Grid of Ukraine | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| **Subproject "Modernization of two ammonia production units"** | | | | |
| **Baseline** | Natural gas consumption for ammonia production | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| **Subproject "Installation of waste heat boilers for the flue gases"** | | | | |
| **Project scenario** | Electricity consumption from Electricity Transmission Grid of Ukraine | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| **Subproject "Modernization of two urea production units"** | | | | |
| **Project scenario** | Natural gas combustion for heat energy generation | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| | Electricity consumption from Electricity Transmission Grid of Ukraine | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |
| **Subproject "Modernization of two ammonia production units"** | | | | |
| **Project scenario** | Natural gas consumption for ammonia production | $CO_2$ | Yes | Main source of emissions |
| | | $CH_4$ | No | Insufficient emissions |
| | | $N_2O$ | No | Insufficient emissions |

**B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:**

Date of baseline setting: 02/08/2010.

Persons setting the baseline:

| | |
|---|---|
| Name of the entity: | "Center TEST Ltd." – project participant |
| Address: | office 611, Marshall Tymoshenko street 13a |
| City: | Kyiv |
| Country: | Ukraine |
| Contacted person: | Kolesnikov Victor Victorovitch |
| Position: | Director |
| Telephone: | +380 44 5692404 |
| Fax: | +380 68 1292233 |
| E-mail: | vicv@bigmir.net |

## SECTION C. Duration of the project / crediting period

### C.1. Starting date of the project:

The proposed joint implementation project consists of 3 subprojects, every subproject includes several staged.

Starting date of the joint implementation project is 28 February 2002

### C.2. Expected operational lifetime of the project:

Expected operational lifetime of the project is at least 20 years (240 months)

### C.3. Length of the crediting period:

17 (seventeen) years, that is 204 (two hundred and four) months.

Beginning of the crediting period is 01 January 2004. During the period from 01 January 2004 till December 2007 the assigned amount units (AAUs) will be generated, the duration of period is 4 years (48 months).

Emission reduction units (ERU) are referred to the first stage of obligations under Kyoto Protocol that is 5 years (60 months), from 01 January 2008 till 31 December 2012

In case if after the first stage of obligations under Kyoto Protocol it will be prolonged, the crediting period may be extended till the finalization of expected project operational lifetime.

## SECTION D. Monitoring plan

### D.1. Description of monitoring plan chosen:

The monitoring plan for this project was chosen according to the"Guidance on criteria for baseline setting and monitoring" (version 02). In accordance with the requirements of this document, the choice of the monitoring plan was based on the specific approach, applied only for this particular joint implementation project, as it consists of several subprojects aimed at different key factors allowing greenhouse emissions reduction. Separate elements of approved consolidated methodology ACM0012 "Combined main methodology for energy waste greenhouse emissions reduction in innovative projects" (version 3.2) were used to set the monitoring plan for this project.

The monitoring plan, accepted for this joint implementation project, is aimed to ensure all data necessary for the determination of emission level according to the baseline and project scenario, and corresponding to the scope of greenhouse reduction due to this joint implementation project. The information about this project is set above.

The following documentations were used to establish the monitoring plan and emission level according to the baseline and project scenario:

- Subproject "Installation of the waste heat boilers for flue gases" - the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2).
- Subproject "Modernization of two urea production units" the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) and "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01)[1].
- Subproject "Modernization of two ammonia production units" - "National Cadastre of Ukraine"

Measuring equipment registered in the Measuring equipment state list of Ukraine is used for the monitoring. This equipment is subject to periodic state inspection.

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

**D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:**

| D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Portion of data to be monitored | How will the data be archived? (electronic / paper) | Comment |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. $EF_{co2,elec}$ | emission factor for Electricity Transmission Grid of Ukraine | Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5) | t $CO_2$ $_e$/MW·h | e | annually | 1 | electronic/paper | Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| 2. $W_{boilers}$ | Electric power of the equipment maintaining operational modes of waste-heat boilers for flue gases | Equipment certificate | MW | e | fixed data | 1 | electronic/paper | The same |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 3. $T_{boilers}$ | Operational time of waste heat boilers for flue gases | Time recorder | hour | m | monthly | 1 | electronic/paper | The same |
| 4. $EC_{urea}$ | Amount of electric power consumed by urea production units | Electricity meter | MW·hour | m | monthly | 1 | electronic/paper | The same |
| 5. $HC_{urea}$ | Amount of heat energy consumed by urea production units | Heat energy measuring section | Tcal | m | monthly | 1 | electronic/paper | The same |
| 6. $\eta_{boiler}$ | Power efficiency (Efficiency Factor) of the boiler shop | "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01)[1] | % | e | annually | 1 | electronic/paper | The same |
| 7. $OXID_{NG}$ | Natural gas oxidation factor | "2006 IPCC Guidelines for National Greenhouse Gas Inventories"[2] | % | e | annually | 1 | electronic/paper | The same |

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf
[2] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 8. $W_{NG}$ | Carbon content of natural gas combustion | "National Cadastre of Ukraine" | t C/TJ | e | annually | 1 | electronic/paper | The same |
| 9. $FC_{NG,ammonia}$ | Amount of natural gas consumed by ammonia production units | Gas measuring section | million $m^3$ | m | monthly | 1 | electronic/paper | The same |
| 10. $\rho_{NG}$ | Natural gas density | "National Cadastre of Ukraine" | t/million $m^3$ | e | annually | 1 | electronic/paper | The same |
| 11. $m_c$ | Natural gas carbon content | "National Cadastre of Ukraine" | t C/t NG | e | annually | 1 | electronic/paper | The same |

**D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

The project scenario emissions will be estimated according the following formula:

$$PE_y = PE_{boilers,y} + PE_{urea,y} + PE_{ammonia,y}, \quad (1)$$

where:
$PE_y$ – total emission levels during a year according to the project scenario, t $CO_{2\,e}$;
$PE_{boilers,y}$ – emission level during a year according to the project scenario of subproject "Installation of waste heat boilers for flue gases", t $CO_{2\,e}$;
$PE_{urea,y}$ – emission level during a year according to the project scenario of subproject "Modernization of two urea production units", t $CO_{2\,e}$;
$PE_{ammonia,y}$ – emission level during a year according to the project scenario of subproject "Modernization of two ammonia production units", t $CO_{2\,e}$.

The formulas of the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) were used for emission calculation according to the design scenario of subproject "Installation of the waste heat boilers for flue gases".

$$PE_{boilers,y} = EC_{boilers} \cdot EF_{co2,elec}, \quad (1.1)$$

where:
$EC_{boilers}$ – electric power needed for maintaining operational modes of waste heat boilers for flue gases, MW·hour;
$EF_{co2,elec}$ – emission factor for Electricity Transmission Grid of Ukraine, t $CO_{2\,e}$/MW·hour.

$$EC_{boilers} = W_{boilers} \cdot T_{boilers}, \quad (1.1.1)$$

where:
$W_{boilers}$ – electric power of the equipment, maintaining operational modes of waste-heat boilers for flue gases, MW;
$T_{boilers}$ – operational time of waste heat boilers for flue gases, year.

$$PE_{urea,y} = PE_{urea,elec,y} + PE_{urea,term,y}, \quad (1.2)$$

The formulas of the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) and "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) were used for emission calculation according to the design scenario of subproject "Modernization of two urea production units".

where:
$PE_{urea,elec,y}$ – emissions caused by electric power consumption according to the project scenario, t $CO_{2\,e}$;
$PE_{urea,term,y}$ –emissions caused by heat energy consumption according to the project scenario, t $CO_{2\,e}$.

$$PE_{urea,elec,y} = EC_{urea} \cdot EF_{co2,elec}, \quad (1.2.1)$$

where:
$EC_{urea}$ – amount of electric power consumed by urea production units,MW hour;
$EF_{co2,elec}$ – emission factor for Electricity Transmission Grid of Ukraine, t $CO_{2\,e}$/MW·hour.

$PE_{urea,term,y} = HC_{urea} \cdot 4,187\ EF_{co2,NG}/\eta_{boiler}$, (1.2.2)

where:
$HC_{urea}$ – amount of heat energy consumed by urea production units, Tcal;
$EF_{co2,NG}$ – emission factor for natural gas combustion, t $CO_{2\,e}$/TJ;
$\eta_{boiler}$ – power efficiency (Efficiency Factor) of the boiler shop.
4,187 – standard rate for conversion of Tcak into TJ, TJ/Tcal.

$EF_{co2,NG} = OXID_{NG} \cdot W_{NG} \cdot 44/12$, (1.2.2.1)

where:
$OXID_{NG}$ – natural gas oxidation factor;
$W_{NG}$ – carbon content of natural gas combustion, t C/TJ;
44/12 – stoichiometric ratio between molecular masses of carbon dioxide and carbon, t $CO_2$/t C.

The formulas that are indicated in the "National Cadastre of Ukraine" were used for emission calculation according to the design scenario of subproject "Modernization of two ammonia production units".

$PE_{ammonia,y} = FC_{NG,ammonia} \cdot \rho_{NG} \cdot m_c \cdot 44/12$, (1.3)

where:
$FC_{NG,ammonia}$ – amount of natural gas consumed by ammonia production units, million $м^3$;
$\rho_{NG}$ –natural gas density, thousand t/million $m^3$.
$m_c$ – natural gas carbon content, t C/t NG;
44/12 – stoichiometric ratio between molecular masses of carbon dioxide and carbon, t $CO_2$/t C.

| D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Portion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. $HG_{boilers}$ | Amount of heat energy generated by waste heat boiler for flue gases | Heat energy measuring section | Tcal | m | monthly | 1 | electronic/paper | Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| 2. $\eta_{boiler}$ | Power efficiency (Efficiency Factor) of the boiler shop | "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01) | % | e | annually | 1 | electronic/paper | The same |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 3. $OXID_{NG}$ | Natural gas oxidation factor | "2006 IPCC Guidelines for National Greenhouse Gas Inventories" | % | e | annually | 1 | electronic/paper | The same |
| 4. $W_{NG}$ | Carbon content in natural gas combustion | "National Cadastre of Ukraine" | t C/TJ | e | annually | 1 | electronic/paper | The same |
| 5. $EF_{co2,elec}$ | Emission factor for Electricity Transmission Grid of Ukraine | Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5) | t $CO_2$ e/MW·hour | e | annually | 1 | electronic/paper | The same |
| 6. $P_{urea}$ | Amount of produced urea | "Technical and production reports" | t | c | monthly | 1 | electronic/paper | The same |
| 7. $SEC_{urea,elec}$ | Specific electric power consumption for urea production | Fixed value based on chronological data | MW·hour/t | c | fixed data | 1 | electronic/paper | The same |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 8. $SEC_{urea,term}$ | Specific heat energy consumption for urea production | Fixed value based on chronological data | Tcal/t | c | Fixed data | 1 | electronic/paper | The same |
| 9. $\rho_{NG}$ | Natural gas density | "National Cadastre of Ukraine" | thousand. t/million. $m^3$ | e | annually | 1 | electronic/paper | The same |
| 10. $m_c$ | Natural gas carbon content | "National Cadastre of Ukraine" | t C/t NG | e | annually | 1 | electronic/paper | The same |
| 11. $P_{ammonia}$ | Amount of produced ammonia | "Technical and production reports" | t | c | monthly | 1 | electronic/paper | The same |
| 12. $SEC_{ammonia}$ | Specific natural gas consumption for ammonia production | Fixed value based on chronological data | $m^3$/t | c | fixed data | 1 | electronic/paper | The same |

**D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

Baseline emissions will be estimated according the following formula:

$$BE_y = BE_{boilers,y} + BE_{urea,y} + BE_{ammonia,y}, \quad (2)$$

where:
$BE_y$ – total emissions during a year according to the baseline, t $CO_{2\,e}$;
$BE_{boilers,y}$ – emissions during a year according to the baseline of "Installation of waste heat boilers for flue gases" subproject, t $CO_{2\,e}$;
$BE_{urea,y}$ –emissions during a year according to the baseline of "Modernization of two urea production units" subproject, t $CO_{2\,e}$;
$BE_{ammonia,y}$ – emissions during a year according to the baseline of "Modernization of two ammonia production units" subproject, t $CO_{2\,e}$.

The formulas of the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) were used for emission calculation according to the design scenario of "Installation of the waste heat boilers for flue gases" subproject.

$$BE_{boilers,y} = HG_{boilers}\ 4{,}187 \cdot EF_{co2,NG}/\eta_{boiler}, \quad (2.1)$$

where:
$HG_{boilers}$ – amount of heat energy generated by waste heat boilers for flue gases, Tcal;
$EF_{co2,NG}$ – emission factor of natural gas combustion, t $CO_{2\,e}$/TJ;
$\eta_{boiler}$ – power efficiency (Efficiency Factor) of the boiler shop.
4,187 – standard factor for conversion of Tcal into TJ, TJ/Tcal.

$$EF_{co2,NG} = OXID_{NG} \cdot W_{NG} \cdot 44/12, \quad (2.1.1)$$

where:
$OXID_{NG}$ – natural gas oxidation factor;
$W_{NG}$ –carbon content of natural gas combustion, t C/TJ;
44/12 – stoichiometric ratio between molecular masses of carbon dioxide and carbon, t $CO_2$/t C.

The formulas of the approved consolidated methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" (version 3.2) and "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) were used for emission calculation according to the design scenario of subproject "Modernization of two urea production units".

$$BE_{urea,y} = BE_{urea,elec,y} + BE_{urea,term,y}, \quad (2.2)$$

where:
$BE_{urea,elec,y}$ –emissions caused by electric power consumption according to the baseline scenario, t $CO_{2\,e}$;
$BE_{urea,term,y}$ – emissions caused by heat energy consumption according to the baseline scenario, t $CO_{2\,e}$.

$BE_{urea,elec,y} = EC_{urea} \cdot EF_{co2,elec}$, (2.2.1)

where:
$EC_{urea}$ – amount of electric power consumed by urea production units, MW hour;
$EF_{co2,elec}$ – emission factor for Electricity Transmission Grid of Ukraine, t $CO_{2\,e}$/MW·hour.

$EC_{urea} = P_{urea} \cdot SEC_{urea,elec}$, (2.2.1.1)

where:
$P_{urea}$ – amount of produced urea, t;
$SEC_{urea,elec}$ – specific electric power consumption for urea production, MW·hour/t.

$BE_{urea,term,y} = HC_{urea} \cdot EF_{co2,NG}/\eta_{boiler}$, (2.2.2)

where:
$HC_{urea}$ – amount of heat energy consumed by urea production units, TJ;
$EF_{co2,NG}$ – emission factor of natural gas combustion, t $CO_{2\,e}$/TJ;
$\eta_{boiler}$ – power efficiency (Efficiency Factor) of the boiler shop.

$HC_{urea} = P_{urea} \cdot SEC_{urea,term} \cdot 4{,}187$, (2.2.2.1)

where:
$P_{urea}$ – amount of produced urea, т;
$SEC_{urea,term}$ – specific heat energy consumption for urea production, Tcal/t;
4,187 – standard rate for conversion Tcal into TJ, TJ/Tcal.

$EF_{co2,NG} = OXID_{NG} \cdot W_{NG} \cdot 44/12$, (2.2.2.2)

where:
$OXID_{NG}$ – natural gas oxidation factor;
$W_{NG}$ –carbon content of natural gas combustion, t C/TJ;
44/12 – stoichiometric ratio between molecular masses of carbon dioxide and carbon, t $CO_2$/t C.

The formulas that are indicated in the "National Cadastre of Ukraine" were used for emission calculation according to the design scenario of subproject "Modernization of two ammonia production units".

$$BE_{ammonia,y} = FC_{NG,ammonia} \cdot \rho_{NG} \cdot m_c \cdot 44/12, \quad (2.3)$$

where:
$FC_{NG,ammonia}$ – amount of natural gas consumed by ammonia production units, million м$^3$;
$\rho_{NG}$ –natural gas density, thousand t/million m$^3$.
$m_c$ – natural gas carbon content, t C/t NG;
44/12 – stoichiometric ratio between molecular masses of carbon dioxide and carbon, t $CO_2$/t C.

$$FC_{NG,ammonia} = P_{ammonia} \cdot SEC_{ammonia}, \quad (2.3.1)$$

where:
$P_{ammonia}$ – amount of produced ammonia, t;
$SEC_{ammonia}$ – specific natural gas consumption for ammonia production, m$^3$/t.

**D.1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):**

**D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:**

| ID number *(Please use numbers to ease cross-referencing to D.2)* | Data variable | Source of data | Data indicating unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/paper) | Comment |
|---|---|---|---|---|---|---|---|---|

Not applied to this project.

**D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of $CO_2$ equivalent):**

Not applied to this project.

**D.1.3. Treatment of leakage in the monitoring plan:**

| D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/paper) | Comment |

Not applied to this project. No leakage is expected since energy sources consumption is decreasing under the project activities, according to the baseline. The leakage from gas-transport system of Ukraine is expected to reduce during the implementation of the project. According to the requirements of the "Guidance on criteria for baseline setting and monitoring" (version 02) conservative approach is used for this project, where the leakage reduction is not applied for emission calculation.

**D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

Not appliquéd to this project.

**D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of $CO_2$ equivalent):**

Annual emission reduction for the project will be estimated according to the following formula:

$$ER_y = BE_y - PE_y, \quad (3)$$

where:
$ER_y$ – emissions reduction during a year due to project activities, t $CO_{2\,e}$;
$PE_y$ – emissions during a year according to the project scenario, t $CO_{2\,e}$;
$BE_y$ – emissions during a year according to the baseline, t $CO_{2\,e}$.

**D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:**

This project will facilitate the reduction of energy sources consumption for the JSC "OPP" production: namely, natural gas for heat energy generation and ammonia production, and electric power for urea production.The decrease in energy sources consumption will allow to reduce greenhouse gas emissions. Thus general environmental impact of the project is positive. According to requirements of relevant state services, the JCS "OPP" reports on ecological characteristics from time to time. It reports on NOx, SOx and dust emissions.

Under the order of Ministry for environmental protection of Ukraine №108 dated 09.03.2006[1] the Administration of ecological resources in Odessa region issues the permit for emissions after the scope of pollutant emissions is justified according to the instructions approved by the order. The development of such documents, where scopes of emissions are justified, is made by institutions, organizations and agencies granted for such work and registered in relevant list of Ministry for environmental protection of Ukraine.

Relevant documentation and permits for pollutant emissions are archived at the department for labour and environmental protection of the JSC "OPP".

| **D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:** | | |
|---|---|---|
| Data *(Indicate table and ID number)* | Indetermination level of data (high/medium/low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary |
| 1 | 2 | 3 |
| $EF_{co2,elec}$ (D.1.1.1 – 1, D.1.1.3 – 5) | low | Emission factor for Electricity Transmission Grid of Ukraine is standardized. The search for determination of this factor was conducted by Global Carbon B.V. company and is described in details in "Standardized emission factors for the Ukrainian electricity grid" (Version 5) |
| $W_{boilers}$ (D.1.1.1 – 2) | low | The electric power of the equipment maintaining operational modes of waste-heat boilers for flue gases has fixed value and is determined according to the equipment certificate of the relevant equipment. |

[1] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0341-06

| 1 | 2 | 3 |
|---|---|---|
| $T_{boilers}$ (D.1.1.1 – 3) | low | Operational time of waste heat boilers for flue gases is determined by taking direct measurements at the plant by responsible operators with the data registration in respective journal. Additionally the data is registered by APM Mechanics software that carries out corresponding calculations as to operational time of waste heat boilers |
| $EC_{urea}$ (D.1.1.1 – 4) | low | Amount of electric power consumed by urea production units is determined by direct measurement at the plant with the help of electricity meter. Section of electric power measurements (SEM-1 and SEM-2) that measure the amount of electric power out is subject to periodic state inspection[1] |
| $HC_{urea}$ (D.1.1.1 – 5) | low | Amount of heat energy consumed by urea production units is determined by direct measurements at the plant with the help of section of heat energy measurements. Section of heat (steam) energy measurements at the input of urea production unit #1 (SHM-3), section of heat (steam) energy measurements at the input of urea production unit #2 (SHM-4), section of heat (steam) energy measurements after waster heat boilers unto urea production unit #1 (SHM-6), section of heat (steam) energy measurements after waster heat boilers unto urea production unit #2 (SHM-7) are subject to periodic state inspection |
| $\eta_{boiler}$ (D.1.1.1 – 6, D.1.1.3 – 2) | low | Power efficiency (Efficiency Factor) of the boiler shop has fixed value and is determined with the help of "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01). This document is subject to periodic revision and submission of relevant corrective data |
| $OXID_{NG}$ (D.1.1.1 – 7, D.1.1.3 – 3) | low | Natural gas oxidation factor is determined according to "2006 IPCC Guidelines for National Greenhouse Gas Inventories". This document is subject to periodic revision and submission of relevant corrective data |
| $W_{NG}$ (D.1.1.1 – 8, D.1.1.3 – 4) | low | Carbon content of natural gas combustion is determined according to the "National Cadastre of Ukraine". This document is subject to periodic revision and submission of relevant corrective data |
| $FC_{NG,ammonia}$ (D.1.1.1 – 9) | low | Amount of natural gas consumed by ammonia production units is determined by direct measurements at the plant with the help of gas measuring section. Gas measuring section at the input of the ammonia production unit #1 (GMS-6) and gas measuring section at the input of the ammonia production unit #2 (GMS-8) are subject to periodic state inspection |
| $\rho_{NG}$ (D.1.1.1 – 10, D.1.1.3 – 9) | low | Natural gas density is determined according to the "National Cadastre of Ukraine". This document is subject to periodic revision and submission of relevant corrective data |

[1] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=113%2F98-%E2%F0

| 1 | 2 | 3 |
|---|---|---|
| $m_c$ (D.1.1.1 – 11, D.1.1.3 – 10) | low | Natural gas carbon content is determined according to the "National Cadastre of Ukraine". This document is subject to periodic revision and submission of relevant corrective data |
| $HG_{boilers}$ (D.1.1.3 – 1) | low | Amount of heat energy generated by the waste heat boiler for flue gases is determined by direct measurements at the plant with the help of section of heat energy measurement. Section of heat(steam) energy measurement after the waste heat boiler C1A (SHM-5(A)), section of heat(steam) energy measurement after the waste heat boiler C1B (SHM-5(B)), section of heat energy measurement for hot water supply and heating after the waste heat boiler C1A (SHM-12 (A)), section of heat energy measurement for hot water supply and heating after the waste heat boiler C1B (SHM-12 (B)) are subject to periodic state inspection |
| $P_{urea}$ (D.1.1.3 – 6) | low | Amount of produced urea is determined according to "Technical and production reports" |
| $SEC_{urea,elec}$ (D.1.1.1 – 7) | low | Specific electricity consumption for urea production has fixed value and is determined on the basis of chronological data on urea production unit operation 3 years before the project implementation |
| $SEC_{urea,term}$ (D.1.1.1 – 8) | low | Specific heat energy consumption for urea production has fixed value and is determined on the basis of chronological data on urea production unit operation 3 years before the project implementation |
| $P_{ammonia}$ (D.1.1.3 – 11) | low | Amount of produced urea is determined according to "Technical and production reports" |
| $SEC_{ammonia}$ (D.1.1.1 – 7) | low | Specific natural gas consumption for ammonia production has fixed value and is determined on the basis of chronological data on ammonia production unit operation 3 years before the project implementation |

**D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:**

The monitoring of data determined in the previous section will be performed within the limits of general operation of the project on energy-saving measures at the JSC "OPP".

Technical personnel read the monitored data which are subject to measurements from measuring sections of exact energy source and make relevant notes in the technological registers. General data on energy resources consumption during a month is given in "Technical and production reports" which are documents of official accounting. Monthly "Technical and production reports" are archived in E-copy and written form at the Technical and production department of the plant.

Location scheme of heat, gas and electric power sections concerning the project are shown on the figure 9, 10 and 11 correspondently.

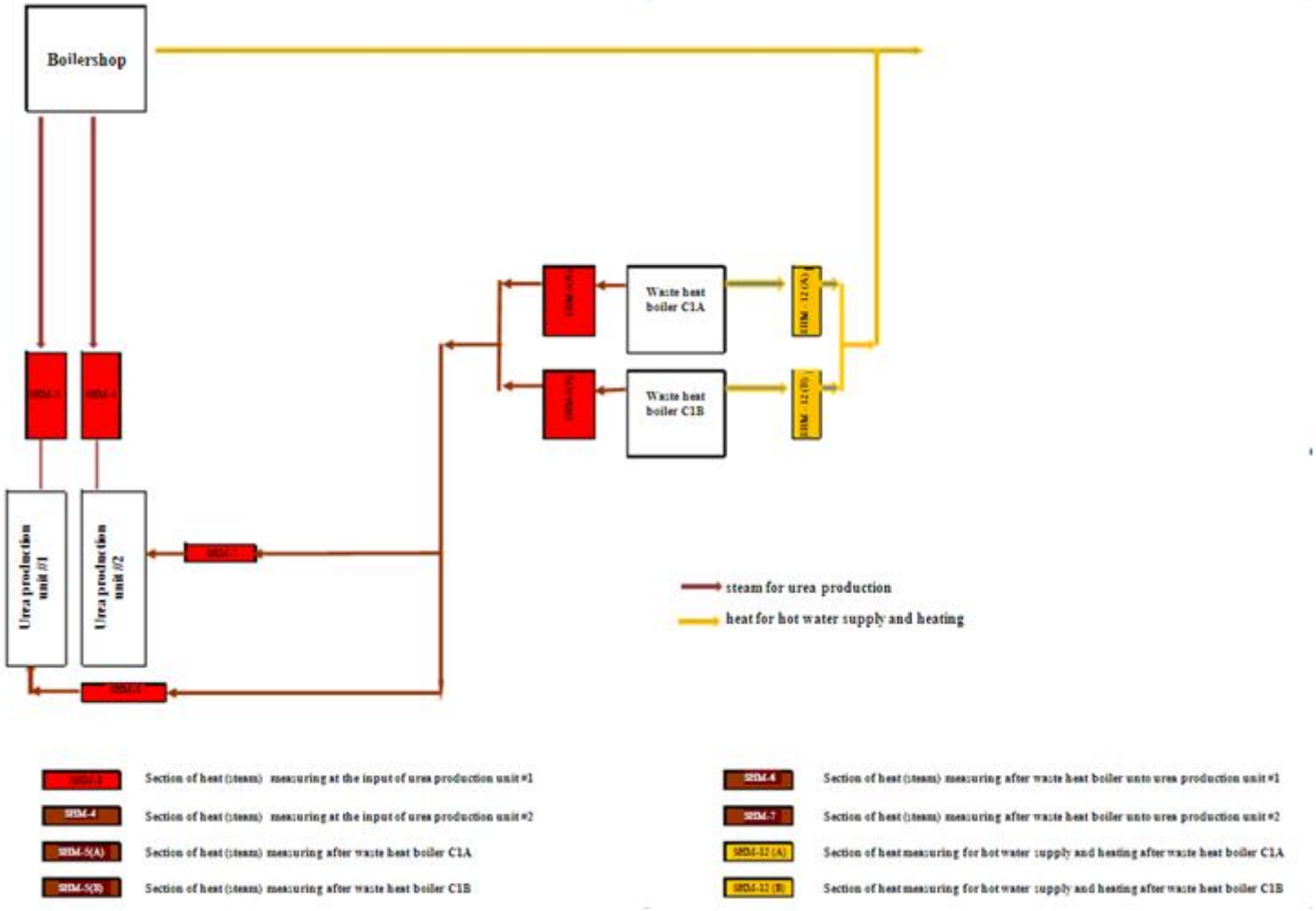


**Figure 9** – Location scheme of the sections of heat measurement concerning the project.

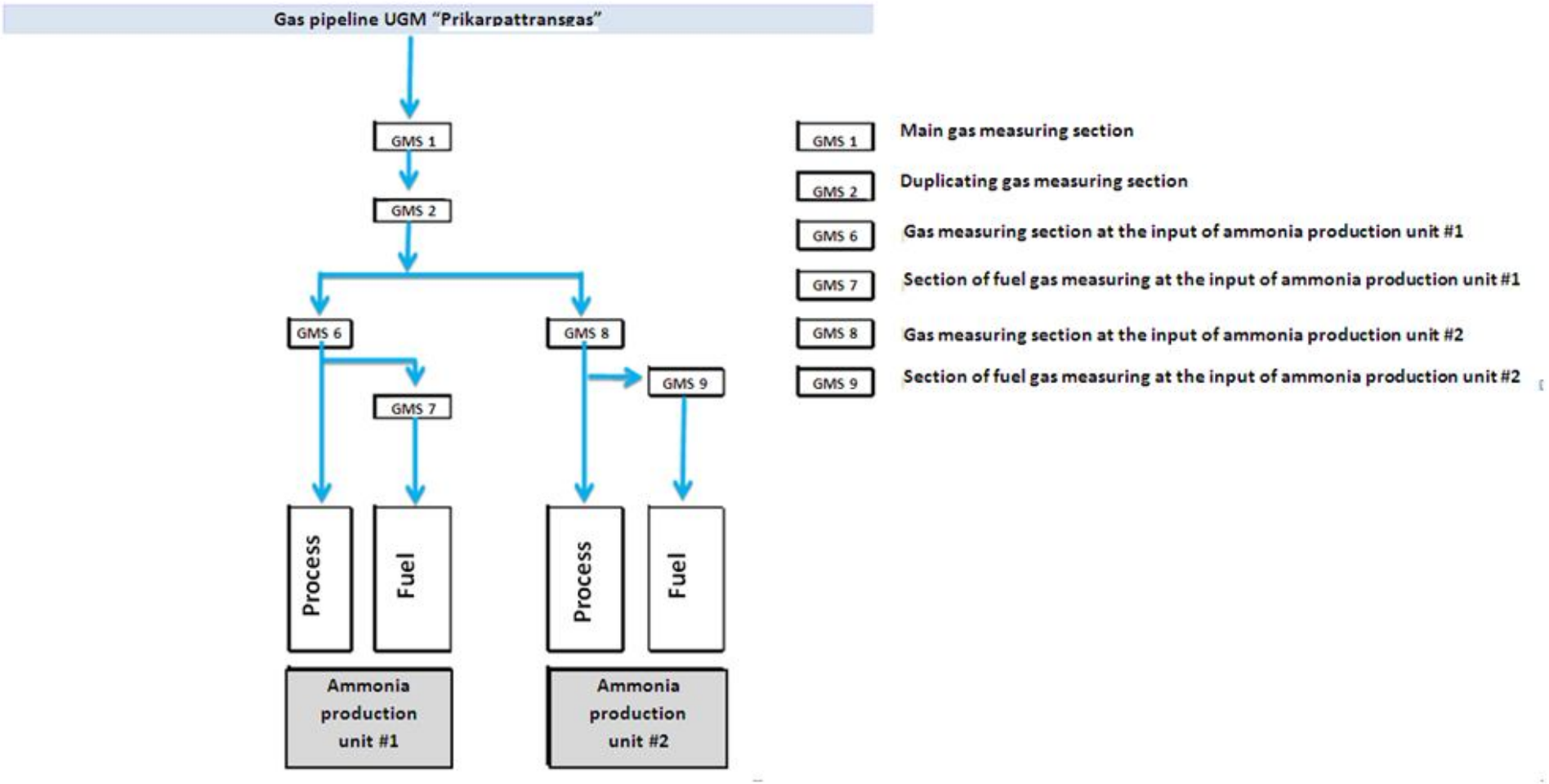


**Figure 10** – Location scheme of the gas measuring sections concerning the project.

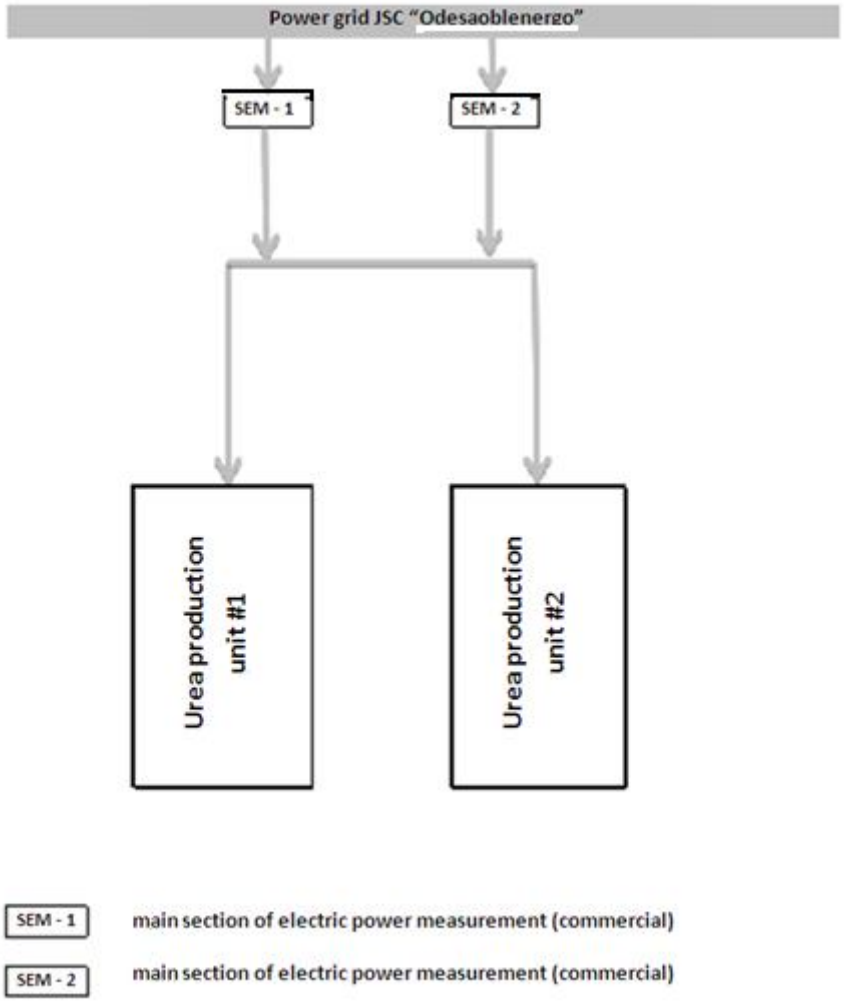


**Figure 11** – Location scheme of electric power measurement sections concerning the project.

The director of the JSC "OPP" appoints personnel for operation and maintenance of technical equipment needed for the project. Their functions also include registration of all data necessary for monitoring. The head of the monitoring group of fuel supply system operational data will be deputy chief engineer – head of technical and production department of the JSC "OPP". The monitoring will be conducted in close collaboration with technical personnel and will include the monitoring itself and also analysis and archiving of all data determined in the previous section. The functions of monitoring group will also include work coordination to estimate emissions reduction level. Under the order of the Head of the monitoring group, estimation of emission reduction shall be performed by the developer of Joint implementation project. Periodic data on energy sources consumption will be compared with relevant registered data taken from the technical personnel to approve data credibility. In case of inequality of these data the cause of its appearance must be found in collaboration with the technical personnel. If the discrepancy of monitoring data is found, monitoring system of relevant data must be corrected.

All information about monitoring and corrective measures must be archived for future verification of emissions reduction level. The head of the monitoring group is responsible for preparation and archiving of monitoring reports. The director analyses general monitoring data and relevant documentation from time to time. The developer of the joint implementation project will assist in organization of the monitoring if the need arises.

The monitoring management structure is shown in figure 12.

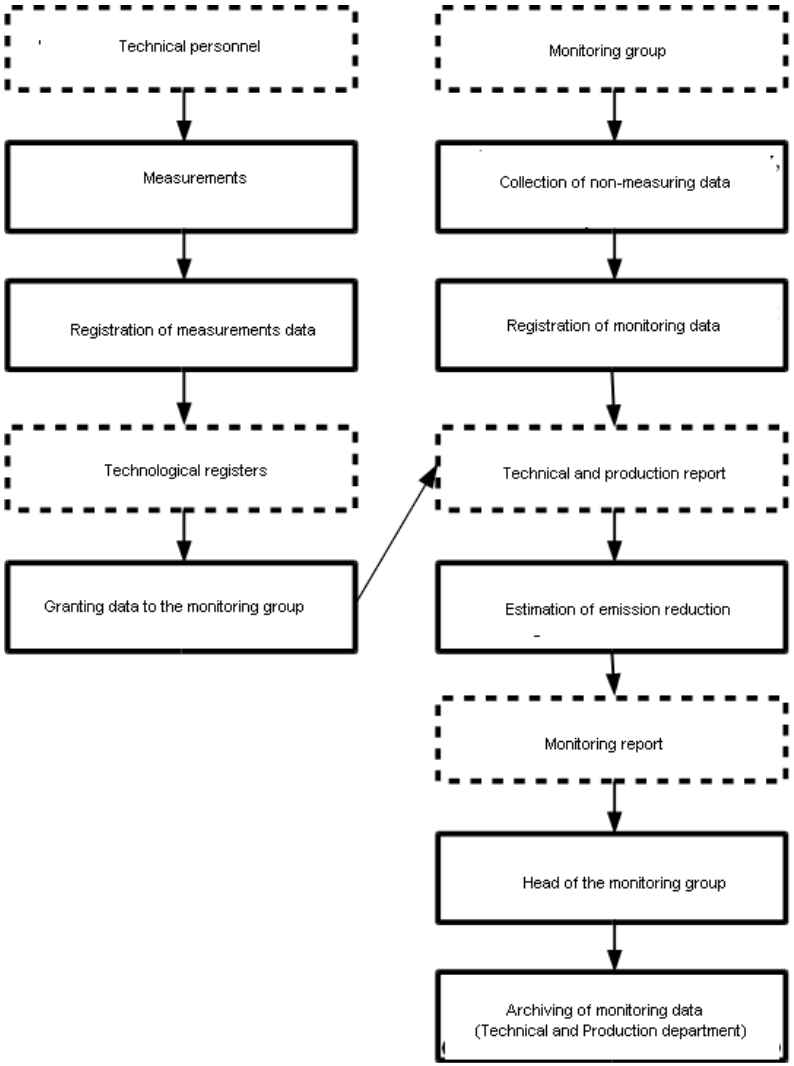


**Figure 12** – The monitoring management structure

Measuring and archiving the results are functions of the technical personnel. Technical personnel submit the results of measurements to the monitoring group for work coordination to estimate greenhouse gases emissions reduction. Under the order of the Head of the monitoring group, estimation of emission reduction shall be performed by the developer of Joint implementation project. The functions of the monitoring group also include collection of non-measured data which are also subject to the monitoring. The monitoring group must make back up copy of monitoring data which should be stored apart from the main data to avoid their loss in case of force majeure.

## D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Persons establishing the monitoring plan:

| | |
|---|---|
| Name of company: | "Center TEST Ltd." - project participant |
| Address: | Office 611, Marshall Tymoshenko street 13a, Kyiv, 04210, Ukraine |
| City: | Kyiv |
| Country: | Ukraine |
| Contact person: | Kolesnikov Victor Victorovitch |
| Position: | Director |
| Telephone: | +380 44 5692404 |
| Fax: | +380 68 1292233 |
| e-mail: | vicv@bigmir.net |

## SECTION E. Estimation of greenhouse gas emissions reduction

### E.1. Estimated project emissions:

Project emissions are estimated according to the formula described in D.1.1.2.

| Year | Estimated project emissions ($t CO_{2e}$) |
|---|---|
| 2004 | 1 406 617 |
| 2005 | 2 705 205 |
| 2006 | 2 685 006 |
| 2007 | 2 660 391 |
| 2008 | 2 586 108 |
| 2009 | 1 462 165 |
| 2010 | 2 323 021 |
| 2011 | 2 260 598 |
| 2012 | 2 256 899 |
| 2013 | 2 258 212 |
| 2014 | 2 252 901 |
| 2015 | 2 245 475 |
| 2016 | 2 237 974 |
| 2017 | 2 239 287 |
| 2018 | 2 237 974 |
| 2019 | 2 239 287 |
| 2020 | 2 237 974 |

### E.2. Estimated leakage:

Not applied to this project.

### E.3. The sum of E.1. and E.2.:

The sum of E.1. and E.2. is equal to E.1.

### E.4. Estimated baseline emissions:

Baseline emissions are estimated according to the formula described in D.1.1.4.

| Year | Estimated baseline emissions ($t CO_{2e}$) |
|---|---|
| 1 | 2 |
| 2004 | 1 479 638 |
| 2005 | 2 826 966 |
| 2006 | 2 821 276 |
| 2007 | 2 831 540 |
| 2008 | 2 733 331 |
| 2009 | 1 595 195 |
| 2010 | 2 584 482 |
| 2011 | 2 549 310 |
| 2012 | 2 547 622 |

| 1 | 2 |
|---|---|
| 2013 | 2 549 310 |
| 2014 | 2 547 622 |
| 2015 | 2 549 310 |
| 2016 | 2 547 622 |
| 2017 | 2 549 310 |
| 2018 | 2 547 622 |
| 2019 | 2 549 310 |
| 2020 | 2 547 622 |

**E.5. Difference between E.4. and E.3. representing the emission reductions of the project:**

| Year | Estimated emission reductions ($t CO_{2e}$) |
|---|---|
| 2004 | 73 021 |
| 2005 | 121 761 |
| 2006 | 136 270 |
| 2007 | 171 150 |
| 2008 | 147 223 |
| 2009 | 133 030 |
| 2010 | 261 461 |
| 2011 | 288 712 |
| 2012 | 290 723 |
| 2013 | 291 098 |
| 2014 | 294 721 |
| 2015 | 303 834 |
| 2016 | 309 648 |
| 2017 | 310 023 |
| 2018 | 309 648 |
| 2019 | 310 023 |
| 2020 | 309 648 |

**E.6. Table providing values obtained when applying formulae above:**

| Year | Estimated project emissions ($t CO_{2e}$) | Estimated leakage ($t CO_{2e}$) | Estimated baseline emissions ($t CO_{2e}$) | Estimated emission reductions ($t CO_{2e}$) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 2004 | 1 406 617 | 0 | 1 479 638 | 73 021 |
| 2005 | 2 705 205 | 0 | 2 826 966 | 121 761 |
| 2006 | 2 685 006 | 0 | 2 821 276 | 136 270 |
| 2007 | 2 660 391 | 0 | 2 831 540 | 171 150 |
| 2008 | 2 586 108 | 0 | 2 733 331 | 147 223 |
| 2009 | 1 462 165 | 0 | 1 595 195 | 133 030 |
| 2010 | 2 323 021 | 0 | 2 584 482 | 261 461 |
| 2011 | 2 260 598 | 0 | 2 549 310 | 288 712 |
| 2012 | 2 256 899 | 0 | 2 547 622 | 290 723 |
| 2013 | 2 258 212 | 0 | 2 549 310 | 291 098 |

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| 2014 | 2 252 901 | 0 | 2 549 310 | 294 721 |
| 2015 | 2 245 475 | 0 | 2 547 622 | 303 834 |
| 2016 | 2 237 974 | 0 | 2 549 310 | 309 648 |
| 2017 | 2 239 287 | 0 | 2 547 622 | 310 023 |
| 2018 | 2 237 974 | 0 | 2 549 310 | 309 648 |
| 2019 | 2 239 287 | 0 | 2 547 622 | 310 023 |
| 2020 | 2 237 974 | 0 | 2 549 310 | 309 648 |
| Total (t $CO_{2\,e}$) | 38 295 115 | 0 | 42 357 089 | 4 061 974 |

## SECTION F. Environmental impact

**F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:**

The suggested interferences in the existing production scheme will make positive environmental impact due to reduction of energy sources consumption for the production needs which will result in the decrease of greenhouse emissions into the atmosphere.

Emissions reduction will take place due to this project realization, namely:

- the subproject "Installation of waste heat boilers for the flue gases" will allow to reduce amount of natural gas burnt for heat energy generation in boiler shop of the plant, thus decreasing greenhouse emissions into the atmosphere;

- the subproject "Modernization of two urea production units" will allow to reduce specific electric and heat energy consumption for production of 1 ton of urea. The decrease of specific heat energy consumption will result in reduction of natural gas burnt in boiler shop for heat energy generation, thus decreasing greenhouse emissions into the atmosphere. The reduction of specific electric power consumption will result in decrease of electric power supplied from Electricity Transmission Grid of Ukraine, reducing the amount of fossil fuel for electric power generation at power plants of Ukraine;

- the subproject "Modernization of two ammonia production units" will allow to reduce natural gas consumption for ammonia production, thus decreasing greenhouse emissions into the atmosphere.

Emissions reduction achieved due to this project implementation will have an impact on the environment of Ukraine but does not influence greenhouse gases emissions abroad.

**F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

According to the requirements of relevant state services, the JSC "OPP" reports on ecological characteristics from time to time. Under the order of Ministry for environmental protection of Ukraine №108 dated 09.03.2006 the Administration of ecological resources in Odessa region issued to the JSC "OPP" the permit for emissions after the scope of pollutant emissions was justified according to the instructions approved by this order.

The realization of this project has facilitated the reduction of pollutant emissions from stationary sources. According to the issued permit of the Administration of ecological resources in Odessa region the environmental impact is not sufficient, but generally positive.

According to the requirements of the Ukrainian legislation in force, namely the law of Ukraine "On environmental protection" №1264-XII[1] dated 25.06.1991 and ДБН А.2.2-1[2], the implementation of this project does not demand ecological assessment and thereafter elaboration of "Structure and contents of the environmental impact assessment (EIA) materials during design and construction of enterprises, buildings and facilities"

[1] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?page=1&nreg=1264-12
[2] ДБН А.2.2-1-2003 "Склад і зміст матеріалів оцінки впливів на навколишнє середовище (ОВНС) при проектуванні і будівництві підприємств, будинків і споруд"

## SECTION G. Stakeholders' comments

### G.1. Information on stakeholders' comments on the project, as appropriate:

The host Party does not require consultations with stakeholders for joint implementation projects.

Stakeholders' comments will be collected during publishing of the project within the determination procedure.

Annex 1

## CONTACT INFORMATION ON THE PROJECT PARTICIPANTS

| | |
|---|---|
| Organisation: | JSC "OPP" (Joint Stock Company "Odessa Port Plant") |
| Street/P.O.Box: | Zavodskaya |
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| City: | Yuzhne |
| State/Region: | Odessa |
| Postal code: | 65481 |
| Country: | Ukraine |
| Phone: | +380 048 7586009 |
| Fax: | +380 048 7586008 |
| E-mail: | office@opz.odessa.ua |
| URL: | |
| Represented by: | |
| Title: | Head of Innovations Department |
| Salutation: | Mr |
| Last name: | Korsun |
| Middle name: | Borysovitch |
| First name: | Oleg |
| Department: | Innovations |
| Phone (direct): | +380 048 7586066 |
| Fax (direct): | +380 048 7586008 |
| Mobile: | |
| Personal e-mail: | Oleg.Korsun@opz.odessa.ua |

| | |
|---|---|
| Organisation: | "Center TEST Ltd." |
| Street/P.O.Box: | Marshall Tymoshenko |
| Building: | 13 a |
| City: | Kyiv |
| State/Region: | |
| Postal code: | 04210 |
| Country: | Ukraine |
| Phone: | +380 44 5692403 |
| Fax: | +380 44 5692404 |
| E-mail: | test.co2@gmail.com |
| URL: | |
| Represented by: | |
| Title: | Director |
| Salutation: | Mr |
| Last name: | Kolesnikov |
| Middle name: | Victorovitch |
| First name: | Victor |
| Department: | |
| Phone (direct): | +380 44 5692403 |
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| Mobile: | +380 68 1292233 |
| Personal e-mail: | vicv@bigmir.net |

| | |
|---|---|
| Organisation: | "RETON SOLUTION LLP" Company |
| Street/P.O.Box: | Suite 2, 23-24 Great James Street |
| Building: | |
| City: | London |
| State/Region: | |
| Postal code: | |
| Country: | UK |
| Phone: | +44 20 8144 1311 |
| Fax: | |
| E-mail: | |
| URL: | www.climate-pb.com |
| Represented by: | |
| Title: | Financial manager |
| Salutation: | Mr |
| Last name: | Khalabuzar |
| Middle name: | Valentinovitch |
| First name: | Viktor |
| Department: | |
| Phone (direct): | +380 67 4090881 |
| Fax (direct): | |
| Mobile: | +380 67 4090881 |
| Personal e-mail: | fin@climate-pb.com |

Annex 2

## BASELINE INFORMATION

The baseline for this project was chosen according to the "Guidance on criteria for baseline setting and monitoring" (version 02), the choice of the baseline was founded on the specific approach, applied only for this particular joint implementation project. The description and justification of the baseline scenario are given in the section B.1 of this document.

The current situation at JSC "OPP" was taken as the baseline without any modernization activity according to the project.

Main baseline emissions are $CO_2$ emissions, resulting from:

- natural gas combustion in the boiler shop of the plant for heat energy generation;
- electric power consumption from Electricity Transmission Grid of Ukraine for urea production;
- natural gas consumption for ammonia production.

Under the baseline chosen, emissions were calculated according to the formula, given in the section D.1.1.4 of this document.

Annex 3

## MONITORING PLAN

The monitoring plan for this project was chosen according to the "Guidance on criteria for baseline setting and monitoring" (version 02). The choice of the monitoring plan was based on the specific approach, applied only for this particular joint implementation project.

The monitoring plan is determined in the section D of this document.

Data (parameters) which is subject to monitoring is given in the following table.

| **Data/Parameter** | $EF_{co2,elec}$ |
|---|---|
| Data unit | t $CO_{2\,e}$/MW·hour |
| Description | Emission factor for Electricity Transmission Grid of Ukraine |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | Study "Standardized emission factors for the Ukrainian electricity grid" (Version 5) |
| Value of data applied (for ex ante calculations/determinations) | 0,807 – for joint implementation projects on electric power generation;<br>0,896 – for joint implementation projects on energy efficiency |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The research for determination of this factor for Electricity Transmission Grid of Ukraine was conducted by Global Carbon B.V. company and defined by TUEV SUED company |
| QA/QC procedures (to be) applied | This parameter is calculated according to "Tool to calculate the emission factor for an electricity system" (version 02) |
| Any comment | - |

| **Data/Parameter** | $W_{boilers}$ |
|---|---|
| Data unit | MW |
| Description | Electric power of the equipment maintaining operational modes of waste-heat boilers for flue gases |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | Equipment certificate |
| Value of data applied (for ex ante calculations/determinations) | 0,0888 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | Two electric pumps with power of 13,8 and 75 kW are used for maintaining operational modes of waste-heat boilers for flue gases |

<table>
<tr><td>Data/Parameter</td><td>$T_{boilers}$</td></tr>
<tr><td>Data unit</td><td>hour</td></tr>
<tr><td>Description</td><td>Operational time of waste heat boilers for flue gases</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>Measurement</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected annual operational hours of waste heat boilers for flue gases is calculated according to predictional data on JSC "OPP" production.<br><br>
<table>
<tr><td>Year</td><td>hours</td></tr>
<tr><td>2004</td><td>8 580</td></tr>
<tr><td>2005</td><td>8 217</td></tr>
<tr><td>2006</td><td>8 644</td></tr>
<tr><td>2007</td><td>8 712</td></tr>
<tr><td>2008</td><td>8 512</td></tr>
<tr><td>2009</td><td>5 478</td></tr>
<tr><td>2010</td><td>8 650</td></tr>
<tr><td>2011</td><td>8 650</td></tr>
<tr><td>2012</td><td>8 650</td></tr>
<tr><td>2013</td><td>8 650</td></tr>
<tr><td>2014</td><td>8 650</td></tr>
<tr><td>2015</td><td>8 650</td></tr>
<tr><td>2016</td><td>8 650</td></tr>
<tr><td>2017</td><td>8 650</td></tr>
<tr><td>2018</td><td>8 650</td></tr>
<tr><td>2019</td><td>8 650</td></tr>
<tr><td>2020</td><td>8 650</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Operational hours of waste heat boilers for flue gases is measured by relevant time</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>$EC_{urea}$</td></tr>
<tr><td>Data unit</td><td>MW·hour</td></tr>
<tr><td>Description</td><td>Amount of electric power consumed by urea production units</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>Measurement</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of electric power is calculated according to predictional data on JSC "OPP" production.<br><br>
<table>
<tr><td>Year</td><td>MW·hour</td></tr>
<tr><td>2004</td><td>160 850</td></tr>
<tr><td>2005</td><td>161 720</td></tr>
<tr><td>2006</td><td>170 087</td></tr>
<tr><td>2007</td><td>170 796</td></tr>
<tr><td>2008</td><td>170 935</td></tr>
<tr><td>2009</td><td>162 749</td></tr>
<tr><td>2010</td><td>169 743</td></tr>
<tr><td>2011</td><td>172 620</td></tr>
<tr><td>2012</td><td>172 620</td></tr>
<tr><td>2013</td><td>172 620</td></tr>
<tr><td>2014</td><td>172 620</td></tr>
<tr><td>2015</td><td>172 620</td></tr>
<tr><td>2016</td><td>172 620</td></tr>
<tr><td>2017</td><td>172 620</td></tr>
<tr><td>2018</td><td>172 620</td></tr>
<tr><td>2019</td><td>172 620</td></tr>
<tr><td>2020</td><td>172 620</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Amount of electric power is measured by relevant electricity meters</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>Measuring equipment used for measurements is subject to periodic state inspection</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/Parameter</td><td>$HC_{urea}$</td></tr>
<tr><td>Data unit</td><td>Tcal</td></tr>
<tr><td>Description</td><td>Amount of heat energy consumed by urea production units</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>Measurement</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of heat energy is calculated according to predictional data on JSC "OPP" production.
<table>
<tr><td rowspan="2">Year</td><td colspan="2">Tcal</td></tr>
<tr><td>Urea production unit #1</td><td>Urea production unit #2</td></tr>
<tr><td>2004</td><td>309,673</td><td>303,257</td></tr>
<tr><td>2005</td><td>346,186</td><td>325,811</td></tr>
<tr><td>2006</td><td>320,721</td><td>345,656</td></tr>
<tr><td>2007</td><td>319,246</td><td>333,595</td></tr>
<tr><td>2008</td><td>316,756</td><td>357,008</td></tr>
<tr><td>2009</td><td>282,669</td><td>279,472</td></tr>
<tr><td>2010</td><td>307,619</td><td>278,959</td></tr>
<tr><td>2011</td><td>299,976</td><td>296,155</td></tr>
<tr><td>2012</td><td>291,139</td><td>296,155</td></tr>
<tr><td>2013</td><td>291,139</td><td>296,155</td></tr>
<tr><td>2014</td><td>291,139</td><td>281,347</td></tr>
<tr><td>2015</td><td>277,526</td><td>281,347</td></tr>
<tr><td>2016</td><td>277,526</td><td>281,347</td></tr>
<tr><td>2017</td><td>277,526</td><td>281,347</td></tr>
<tr><td>2018</td><td>277,526</td><td>281,347</td></tr>
<tr><td>2019</td><td>277,526</td><td>281,347</td></tr>
<tr><td>2020</td><td>277,526</td><td>281,347</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Amount of heat energy is measured by relevant heat energy measuring section</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>Measuring equipment used for measurements is subject to periodic state inspection.</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| **Data/Parameter** | $\eta_{boiler}$ |
|---|---|
| Data unit | % |
| Description | Power efficiency (Efficiency Factor) of the boiler shop |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01) |
| Value of data applied (for ex ante calculations/determinations) | 87 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | This parameter is determined according to the requirements of "Tool to determine the baseline efficiency of thermal or electric energy generation systems" (version 01) |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| **Data/Parameter** | $OXID_{NG}$ |
|---|---|
| Data unit | % |
| Description | Natural gas oxidation factor |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "IPCC Guidelines for National Greenhouse Gas Inventories" |
| Value of data applied (for ex ante calculations/determinations) | 100 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "IPCC Guidelines for National Greenhouse Gas Inventories" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| **Data/Parameter** | $W_{NG}$ |
|---|---|
| Data unit | t C/TJ |
| Description | Carbon content of natural gas combustion |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of Ukraine" |
| Value of data applied (for ex ante calculations/determinations) | 15,3 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

<table>
<tr><td>Data/Parameter</td><td>$FC_{NG,ammonia}$</td></tr>
<tr><td>Data unit</td><td>million $m^3$</td></tr>
<tr><td>Description</td><td>Amount of natural gas consumed by ammonia production units</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>Measurement</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of natural gas is calculated according to predictional data on JSC "OPP" ammonia production
<table>
<tr><td rowspan="2">Year</td><td colspan="2">million $m^3$</td></tr>
<tr><td>Ammonia production unit №1</td><td>Ammonia production unit №2</td></tr>
<tr><td>2004</td><td>584,664</td><td>-</td></tr>
<tr><td>2005</td><td>674,608</td><td>593,635</td></tr>
<tr><td>2006</td><td>596,044</td><td>658,223</td></tr>
<tr><td>2007</td><td>608,936</td><td>633,812</td></tr>
<tr><td>2008</td><td>542,257</td><td>657,808</td></tr>
<tr><td>2009</td><td>502,702</td><td>118,107</td></tr>
<tr><td>2010</td><td>470,649</td><td>602,239</td></tr>
<tr><td>2011</td><td>572,000</td><td>464,850</td></tr>
<tr><td>2012</td><td>468,000</td><td>568,150</td></tr>
<tr><td>2013</td><td>572,000</td><td>464,850</td></tr>
<tr><td>2014</td><td>468,000</td><td>568,150</td></tr>
<tr><td>2015</td><td>572,000</td><td>462,150</td></tr>
<tr><td>2016</td><td>465,300</td><td>564,850</td></tr>
<tr><td>2017</td><td>568,700</td><td>462,150</td></tr>
<tr><td>2018</td><td>465,300</td><td>564,850</td></tr>
<tr><td>2019</td><td>568,700</td><td>462,150</td></tr>
<tr><td>2020</td><td>465,300</td><td>564,850</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>Amount of natural gas consumed is measured by gas measuring section</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>Measuring equipment used for measurements is subject to periodic state inspection</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| **Data/Parameter** | $\rho_{NG}$ |
|---|---|
| Data unit | t/million $m^3$ |
| Description | Natural gas density |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of Ukraine" |
| Value of data applied (for ex ante calculations/determinations) | 693 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| **Data/Parameter** | $m_c$ |
|---|---|
| Data unit | t C/t NG |
| Description | Natural gas carbon content |
| Time off determination/monitoring | Annually. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | "National Cadastre of Ukraine" |
| Value of data applied (for ex ante calculations/determinations) | 0,738 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | "National Cadastre of Ukraine" is subject to periodic revision and submission of relevant corrective data " |
| QA/QC procedures (to be) applied | This parameter is within the range of ambiguity by default IPCC values |
| Any comment | - |

| **Data/Parameter** | $HG_{boilers}$ |
|---|---|
| Data unit | Tcal |
| Description | Amount of heat energy generated by waste heat boiler for flue gases |
| Time off determination/monitoring | Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | Measurement |
| Value of data applied (for ex ante calculations/determinations) | Expected amount of heat energy is calculated according to predictional data on JSC "OPP" production |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Amount of heat energy is measured by heat energy measuring section |
| QA/QC procedures (to be) applied | Measuring equipment used for measurements is subject to periodic state inspection |
| Any comment | - |

| Year | Tcal |
|---|---|
| 2004 | 113,156 |
| 2005 | 113,637 |
| 2006 | 128,530 |
| 2007 | 118,375 |
| 2008 | 117,498 |
| 2009 | 71,892 |
| 2010 | 121,468 |
| 2011 | 121,468 |
| 2012 | 121,468 |
| 2013 | 121,468 |
| 2014 | 121,468 |
| 2015 | 121,468 |
| 2016 | 121,468 |
| 2017 | 121,468 |
| 2018 | 121,468 |
| 2019 | 121,468 |
| 2020 | 121,468 |

<table>
<tr><td>Data/Parameter</td><td>$P_{urea}$</td></tr>
<tr><td>Data unit</td><td>t</td></tr>
<tr><td>Description</td><td>Amount of produced urea</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>"Technical and production reports"</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of produced urea is calculated according to predictional data on JSC "OPP" production
<table>
<tr><td rowspan="2">Year</td><td colspan="2">t</td></tr>
<tr><td>Urea production unit #1</td><td>Urea production unit #2</td></tr>
<tr><td>2004</td><td>422 467</td><td>413 713</td></tr>
<tr><td>2005</td><td>447 595</td><td>421 250</td></tr>
<tr><td>2006</td><td>427 541</td><td>460 781</td></tr>
<tr><td>2007</td><td>452 110</td><td>472 431</td></tr>
<tr><td>2008</td><td>442 184</td><td>500 189</td></tr>
<tr><td>2009</td><td>423 849</td><td>424 705</td></tr>
<tr><td>2010</td><td>461 000</td><td>424 000</td></tr>
<tr><td>2011</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2012</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2013</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2014</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2015</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2016</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2017</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2018</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2019</td><td>450 000</td><td>450 000</td></tr>
<tr><td>2020</td><td>450 000</td><td>450 000</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>The amount of produced urea is calculated on the basis of technical and production data</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| **Data/Parameter** | $SEC_{urea,elec}$ |
|---|---|
| Data unit | MW·hour/t |
| Description | Specific electric power consumption for urea production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based on chronological data on urea production unit operation was accepted for this parameter within 3 years before the project implementation, namely from 1999 to 2001. |
| Value of data applied (for ex ante calculations/determinations) | 0,1935 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |

| **Data/Parameter** | $SEC_{urea,term}$ |
|---|---|
| Data unit | Tcal/t |
| Description | Specific heat energy consumption for urea production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based on chronological data on urea production unit operation was adopted for this parameter within 3 years before the project implementation, namely from 1999 to 2001. |
| Value of data applied (for ex ante calculations/determinations) | $0,8242 \cdot 10^{-3}$ |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |

<table>
<tr><td>Data/Parameter</td><td>$P_{ammonia}$</td></tr>
<tr><td>Data unit</td><td>t</td></tr>
<tr><td>Description</td><td>Amount of produced ammonia</td></tr>
<tr><td>Time off determination/monitoring</td><td>Monthly. Data must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit</td></tr>
<tr><td>Source of data (to be) used</td><td>"Technical and production reports"</td></tr>
<tr><td>Value of data applied<br>(for ex ante calculations/determinations)</td><td>Expected amount of produced ammonia is calculated according to predictional data on JSC "OPP" production
<table>
<tr><td rowspan="2">Year</td><td colspan="2">t</td></tr>
<tr><td>Ammonia production unit #1</td><td>Ammonia production unit #2</td></tr>
<tr><td>2004</td><td>515 750</td><td>-</td></tr>
<tr><td>2005</td><td>613 159</td><td>522 150</td></tr>
<tr><td>2006</td><td>533 678</td><td>594 155</td></tr>
<tr><td>2007</td><td>554 482</td><td>572 568</td></tr>
<tr><td>2008</td><td>487 525</td><td>591 219</td></tr>
<tr><td>2009</td><td>466 635</td><td>106 127</td></tr>
<tr><td>2010</td><td>437 000</td><td>583 000</td></tr>
<tr><td>2011</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2012</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2013</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2014</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2015</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2016</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2017</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2018</td><td>450 000</td><td>550 000</td></tr>
<tr><td>2019</td><td>550 000</td><td>450 000</td></tr>
<tr><td>2020</td><td>450 000</td><td>550 000</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures (to be) applied</td><td>The amount of produced ammonia is calculated on the basis of technical and production data</td></tr>
<tr><td>QA/QC procedures (to be) applied</td><td>-</td></tr>
<tr><td>Any comment</td><td>-</td></tr>
</table>

| **Data/Parameter** | $SEC_{ammonia}$ |
|---|---|
| Data unit | $m^3/t$ |
| Description | Specific natural gas consumption for ammonia production |
| Time off determination/monitoring | Fixed data. It must be stored during the whole crediting period and 2 years after the last charge of emission reduction unit |
| Source of data (to be) used | A fixed value based of chronological data on ammonia production unit operation was adopted for this parameter within 3 years before the project implementation: from 2001 to 2003 for ammonia production unit №1; from 2002 to 2004 for ammonia production unit №2 |
| Value of data applied (for ex ante calculations/determinations) | 1 156 – for ammonia production unit №1;<br>1 147 – for ammonia production unit №2 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Fixed data |
| QA/QC procedures (to be) applied | - |
| Any comment | - |