JOINT IMPLEMENTATION PROJECT

"IMPLEMENTATION OF ENERGY SAVING MEASURES at PRJSC LINIK, Ukraine"

(project name)

Position of the head of organization, institution, facility – document developer

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Position of the manager of the business – emission source owner where the joint implementation project is planned to be realized

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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:

Implementation of energy saving measures at PRJSC LINIK, Ukraine

Sectoral scope: 5. Chemical industry

Version of the document: 2.2

Date of the document: 15 October 2012

A.2. Description of the project:

Hydrogen is one of the main intermediate products largely utilized in oil and petrochemical industries. Its usage has been constantly growing in modern refineries, chemical and petrochemical complexes in order to treat heavier oil feedstock[1]. In some refining processes, hydrogen is both used as a raw material and obtained in some processes as a by-product. Generally, in refineries or petrochemical complexes, the off-gas streams contain considerable amount of hydrogen, which are mostly incinerated in refinery flares as a waste gas[2]. At the same time hydrocarbons are converted into hydrogen in reformers in order to produce the hydrogen needed for hydrogen consuming processes.

Nitrogen has long been used in the refineries for a number of uses including: workover overpressure, purging of lines, compressors, and seals, tank blanketing. The purpose of using nitrogen for inerting, blanketing, and purging with refineries is to suppress flammability by reducing oxygen levels to a point below which combustion is possible.

Before the project implementation at PRJSC "LINIK":

- hydrogen was produced by Steam Methane Reforming process with emitting greenhouse gases (GHG) into the atmosphere due to using of natural gas as feedstock and fuel;
- nitrogen was produced by A-8-1 Unit in Nitrogen-Oxygen Plant with emitting GHG into the atmosphere due to electricity consumption.

The project is aimed at achieving GHG emission reductions by decreasing energy resources consumption. The project include following sub-projects.

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

In the baseline scenario it is assumed that hydrogen continue produced by Steam Methane Reforming process with emitting GHG into the atmosphere.

The sub-project includes the installation of Pressure Swing Adsorption Unit for hydrogen production as part of Steam Methane Reforming Plant. Therefore, in the project scenario the hydrogen extracted from the off-gases will partly substitute the hydrogen from Steam Methane Reforming process, and reduce GHG emissions.

[1] Corneil, H.G. and F.J. Heinzelmann, 1980. Hydrogen for future refining. Hydrocarbon Process., 59: 85-94
[2] Ratan, S. and P. Wentink, 2001. Cost effective hydrogen from refinery off-gases. Proceedings of 4th National Rubber Conference, Feb. 20-21, Iran, pp: 131-137

Sub-project 2. Reconstruction of AK-1.5 units at Nitrogen-Oxygen Plant

In the baseline scenario it is assumed that nitrogen continue produced by A-8-1 Unit in Nitrogen-Oxygen Plant with emitting GHG into the atmosphere due to electricity consumption.

The sub-project includes the reconstruction of two AK-1.5 units for nitrogen production as part of Nitrogen-Oxygen Plant. Therefore, in the project scenario nitrogen will produce by two AK-1.5 units. A-8-1 unit is being operated periodically to cover addition needs of the enterprise in nitrogen during repair of facilities, completion of repair to perform a pressure test of equipment. As a result, the sub-project has reduced electricity consumption at Nitrogen-Oxygen Plant and significantly reduced emissions of GHG into the atmosphere. Extracted nitrogen is then used for processes at enterprise.

The design paperwork was initiated for Sub-project 1 in 2006 and for Sub-project 2 in 2005 in the framework of this project. Commissioning date of PSA Unit is November 2008. Commissioning date of AK-1.5 units is December 2008. The project is implemented at the site which is legally used by the enterprise.

A.3. Project participants:

Table 1 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 (Host party)	• PRIVATE JOINT STOCK COMPANY "LISICHANSK OIL INVESTMENTS COMPANY" (PRJSC "LINIK")	No
Netherlands	• Global Carbon B.V.	No

PRJSC "LINIK" is the project host. Global Carbon B.V. is the developer of this JI project.

A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

Ukraine

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

Luhansk region

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

The physical location of the project is the site near the town of Lisichansk, Luhansk region.

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

Figure 1 Map of Ukraine and location of the project site

This project is implemented within Luhansk region of Ukraine near town Lisichansk, Luhansk region Ukraine, where industrial site of PRJSC "LINIK" is located. The global position of the industrial site is 48°50'46.12"N 38°18'1.95"E. The town of Lisichansk was established in 1710[3]. The population is about 149 500 inhabitants[4].

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[3] URL: http://citylisichansk.com/viewpage.php?page_id=39 (last reference – 20/05/2012)

[4] URL: http://lisichansk.com.ua/2009/09/17 (last reference – 20/05/2012)

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

The activities implemented within the project reflect current best practices: the installed equipment and implemented technologies bring considerable reduction in energy consumption; they bring greater effect compared to any commonly used equipment in Ukraine. It is unlikely that the implemented equipment will be replaced by another technology in the near future, because it is state-of-the-art and is among the best of its kind in the world. However, the project implementation has faced financial and technological barriers, and has been made possible owing to the incentives from the JI mechanism.

The JI project envisages implementation of the following sub-projects:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Compressed hydrogen is widely used within the manufacturing cycle of LINIK. Hydrogen is used in the hydrotreatment of diesel fuel in order to increase the depth of LCH-24/2000 desulfurization of raw materials.

Before the project implementation hydrogen was produced in Steam Methane Reforming Plant (SMR Plant). Steam Methane Reforming (SMR) refers to the entire production process presented in the Figure in Annex 4. This name is commonly retained even when other feedstocks (e.g. naphtha) are used. Meanwhile, the steam methane reformer refers only to the fuel powered chemical reactor in which the chemical reaction presented below takes place.

In its simplest form, the steam methane reforming process for pure hydrogen production consists of several stages as shown in the Figure in the Annex 4:

1. desulphurization unit
2. steam methane reactor
3. shift reactors
4. heat exchangers
5. condensate stripper
6. absorber
7. CO_2 regenerators

The process uses a light hydrocarbon feedstock such as natural gas. As a first step, this feedstock is desulphurized because the catalysts used in the steam methane reformer and the shift reactor are extremely vulnerable to sulphur contamination. Next, in the second step the steam methane reformer executes the main step of the process:

Steam-Reforming Reactions[5]

Methane:
$CH_4 + H_2O \text{ (+heat)} \rightarrow CO + 3H_2$

Propane:
$C_3H_8 + 3H_2O \text{ (+heat)} \rightarrow 3CO + 7H_2$

Ethanol:
$C_2H_5OH + H_2O \text{ (+heat)} \rightarrow 2CO + 4H_2$

These reactions are achieved by passing the steam-feedstock mixture through the reformer tubes filled with a nickel-based catalyst at 800-900 °C. The heat necessary to compensate for the overall endothermic reaction is radiated to the reformer by the burners that use natural gas as a fuel and refinery gas from Catalytic Cracking Plant (CCP).

In the third step which is known as gas water-gas shift reaction, the carbon monoxide (CO) produced in the first reaction reacts with the steam over a catalyst to form hydrogen and carbon dioxide (CO_2).

[5] URL: http://www1.eere.energy.gov/hydrogenandfuelcells/production/natural_gas.html (last reference – 20/05/2012)

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This time, the water-gas shift reaction occurs at a lower temperature in the range of 200-450 °C in the presence of a catalyst (e.g. iron-chromium, copper alloys)[6].

Water-gas Shift Reaction
$CO + H_2O \rightarrow CO_2 + H_2$ (+small amount of heat)

Overall reaction of the steam methane reforming process:

$CH_4 + 2H_2O$ (+heat) $\rightarrow CO_2 + 4H_2$ (+heat)

In the next step converted gas is cooled in the heat exchangers and after that the hydrogen is purified: carbon dioxide is absorbed by absorbing solution.

The primary release of CO_2 at plants using the natural gas catalytic steam reforming process occurs during regeneration of the CO_2 scrubbing solution with lesser emissions resulting from condensate stripping.[7].

After absorption of CO_2 from the process gas, the saturated absorbing solutions (potassium carbonate, monoethanolamine (MEA)) are regenerated for re-use with steam stripping and/or boiling to release CO_2 from the bicarbonates according to the following reactions:

$2KHCO_3$ (+heat) $\rightarrow K_2CO_3 + H_2O + CO_2$

$(C_2H_5ONH_2)_2 + H_2CO_3$ (+heat) $\rightarrow 2C_2H_5ONH_2 + H_2O + CO_2$

The stripping gas, containing CO_2 and other impurities is directed to the atmosphere.

Cooling the synthesis gas after low temperature shift conversion forms a condensate containing small quantities of CO_2 and other process impurities. The condensate is stripped by steam, whereby the components may be vented to the atmosphere[8].

All carbon in natural gas which is used by SMR Plant is converted to the CO_2 will be vented into atmosphere and is included in the project.

Electricity is purchased from the grid to operate the pumps and compressors.

Table below gives the major performance for SMR Plant at 100% operating capacity.

Table 2 Steam Methane Reforming Plant Data

Parameter	Unit	Value
Hydrogen production	t/year	26200
Hydrogen purity	%	96.0

The project provides for the implementation of the Pressure Swing Adsorption Unit (PSA Unit) for hydrogen production as part of SMR Plant. This unit is designed to produce high-purity hydrogen from off-gases of Catalytic Reforming Plant (CRP) and Catalytic Cracking Plant (CCP).

The pressure swing adsorption process is based on physical adsorption phenomena, whereas highly volatile compounds with low polarity as represented by hydrogen are practically nonadsorbable compared to molecules such as CH_4, C, N_2 and hydrocarbons. Hence most impurities in a hydrogen-containing stream can be selectively adsorbed and high-purity hydrogen product is obtainable. The Annex 4 presents the scheme of a PSA Unit.

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[6] Nazim Z. Muradov, Production of Hydrogen from Hydrocarbons, in Hydrogen Fuel: Production, Transport and Storage, R.B. Gupta, Editor. 2009, CRC Press: Boca Raton, FL. p. 33-101.
[7] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 3: Industrial Processes and Product Use Chapter 3: Chemical Industry Emissions p. 3.11
URL: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_3_Ch3_Chemical_Industry.pdf (last reference – 20/05/2012)
[8] U.S. EPA (1985). Criteria Pollutant Emissions Factors. Volume 1, Stationary Point and Area Sources. AP-42 4th Edition (and Supplements A and B). U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, USA.

The liquid fraction of the feed gas is separated in coalescer in order to avoid that any liquid is fed to the PSA Unit. The saturated gas is routed to the adsorber vessels.

Gas passes through the stationary adsorber layers. All compounds besides hydrogen are captured. The increase of PSA Unit up-time, causes worsening hydrogen purity, due to lower efficiency of adsorbent. Process of adsorption should be cyclic and last at least 3-6 min. After this period gas ought to feed another adsorber, consisting of regenerated adsorbent. Meanwhile saturated adsorbent is regenerated. The process of regeneration is conducted under lower pressure (atmospheric pressure). Conditions prompt desorption of impurities. The adsorber is blown through by hydrogen and filled till it reaches operating pressure. From that point the next cycle starts.

The number of adsorber vessels in PSA Unit installations is 5. The PSA Unit control allows the PSA Unit operation within a capacity range between 20% and 100% of design feed gas capacity at approx. constant hydrogen recovery and constant product quality. The PSA Unit can be operated with 5 or 4 adsorber vessels.

The adsorbed impurities together with the purging gas are routed to the fuel gas network.

The degree of hydrogen recovery depends on compositions of raw material and product purity and can vary from 60% to 98%. The larger the installation is, the easier it is for it to achieve high purity and considerable hydrogen recovery degree.

Table below gives the major performance for PSA Unit at 100% operating capacity**.**

Table 3 Pressure Swing Adsorption Unit Data

Parameter	Unit	Value
Number of adsorber vessels		5
Hydrogen production (total)	m^3/h*	16 473**
Hydrogen purity	%	99.9
Hydrogen recovery	%	60-98

*at temperature 20 ˚C and pressure 101.325 kPa

**The maximum PSA Unit capacity is calculated by the PSA program and is expressed by the amount of feed gas that can be purified at given operating conditions. It is not a fixed value, but depends on present process mode (amount of adsorbers in service), process conditions (feed temperature, feed composition, adsorption and desorption pressure) and on the Operation Factor, which has to be adjusted in order to compensate for present process conditions (feed gas composition, H_2-purity) and adsorbent performance.

As a result, natural gas was used as a feedstock for production of hydrogen and as a fuel for heating the reaction mixture in SMR Plant. Both SMR Plant and PSA Unit use electricity for the production of hydrogen. Thus, there is a significant reduction of natural gas consumption in SMR Plant, as well as reduction of electricity consumption by improving the efficiency of hydrogen production and finally reduction emissions of greenhouse gases into the atmosphere.

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Nitrogen-Oxygen Plant consists of 3 units: one A-8-1 and two AK-1.5. Nitrogen-Oxygen Plant produces gaseous and liquid nitrogen and oxygen by liquefaction of air and following rectification for the needs of the company.

Table below gives the major performance for A-8-1 and AK-1.5 units at 100% operating capacity**.**

Table 4 Nitrogen-Oxygen Plant Units Data

Parameter	Unit	Value	
		A-8-1	2×AK-1.5
Nitrogen production	m3/h*	8000	3250
Oxygen production	m3/h*	3000	400
Nitrogen purity	%	99.999	99.999
Oxygen purity	%	99.7	99.7

*at temperature 20 ˚C and pressure 101.325 kPa

Productivity of operated A-8-1 is excessive for the company. Due to the lack of technological capability to control the productivity of the unit, excessive nitrogen was released in the atmosphere. As a result of 10 years downtime AK-1.5 units came out of order and needs for reconstruction.

The project involves replacement and modernization of the following equipment:

1. air purification units
2. air separation units
3. heat exchangers
4. liquefiers
5. turbo-expander units
6. pumps
7. dehumidifiers
8. refrigerators
9. compressors

The reconstruction of two AK-1.5 units allowed the enterprise to produce only required amount of nitrogen. A-8-1 unit is being operated periodically to cover addition needs of the enterprise in nitrogen during repair of facilities, completion of repair to perform a pressure test of equipment. As a result, the sub-project has reduced electricity consumption at Nitrogen-Oxygen Plant and significantly reduced emissions of greenhouse gases into the atmosphere.

The design paperwork was initiated for Sub-project 1 in 2006 and for Sub-project 2 in 2005 in the framework of this project. Commissioning date of PSA Unit is November 2008. Commissioning date of AK-1.5 units is December 2008.

The project does not require extensive initial training. The required workforce can get basic industrial profession training locally. Most of the required personnel such as machinery operators, electric and mechanical maintenance workers are locally available. Maintenance needs are covered by the local capacities: in-house maintenance workers and outsourced maintenance. The project makes provisions for training needs. All workers are required to have a valid professional education certificate and pass periodical safety trainings and exams. Professional education can be obtained locally in the Luhansk region in all of the professional areas covered by 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:

There are six refinery plants in Ukraine and all of them are facing significant barriers and obstacles due to state economic regulation. Growth of fuel import, reduction in feedstock processing, old inefficient equipment and low price for final products make it close to impossible to sustain operations for almost every Ukrainian refinery plant[9]. In such circumstances plants are unable to upgrade the core production processes without JI incentives.

The proposed JI project is aimed at reduction of greenhouse gas emissions by decreasing the consumption of energy resources through the implementation of energy efficiency measures.

Prior to the project implementation, the plant produced hydrogen and nitrogen consuming a lot of natural gas and electricity.

Within the project activity, the plant implemented measures aimed at reduction of greenhouse gas emissions:

- Installation of Pressure Swing Adsorption Unit for hydrogen extraction from the refinery off-gases with decreasing natural gas and electricity consumption – the emission reductions are generated by reducing the specific consumption of the natural gas required for the production of hydrogen;
- Reconstruction of two AK-1.5 units for nitrogen production with decreasing electricity consumption – emission reductions are generated through the decrease in specific electricity consumption required for nitrogen production.

The emission reductions would not occur in the absence of the proposed project, because modernization required significant investment and was financially unattractive for the project owner. Detailed description on the baseline setting and full additionality test can be found in section B of this PDD.

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

Table 5 Estimated amount of GHG emissions reductions during the part of the crediting period within the first commitment period of the Kyoto Protocol

Length of the part of the crediting period	Years 4 years and 2 month
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2008	7 040
Year 2009	59 782
Year 2010	80 579
Year 2011	72 321
Year 2012	70 895
Total estimated emission reductions over the part of the crediting period (tonnes of CO_2 equivalent)	290 617
Annual average of estimated emission reductions over the part of the crediting period (tonnes of CO_2 equivalent)	69 748

[9] URL: http://www.nefterynok.info/analytics.phtml?art_id=115 (last reference – 20/05/2012)

Table 6 Estimated amount of GHG emissions reductions for the part of the crediting period after the end of first commitment period of the Kyoto Protocol and for crediting period

Length of the part of the crediting period after 2012, for which emission reductions are estimated	Years
	16
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
Year 2013	70 895
Year 2014	70 895
Year 2015	70 895
Year 2016	70 895
Year 2017	70 895
Year 2018	70 895
Year 2019	70 895
Year 2020	70 895
Year 2021	70 895
Year 2022	70 895
Year 2023	70 895
Year 2024	70 895
Year 2025	70 895
Year 2026	70 895
Year 2027	70 895
Year 2028	70 895
Total estimated emission reductions in the part of the crediting period after 2012 (tonnes of CO_2 equivalent)	1 134 320
Annual average of estimated emission reductions in the part of the crediting period after 2012 (tonnes of CO_2 equivalent)	70 895
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	1 424 937
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	70 658

A.5. Project approval by the Parties involved:

The project obtained Letter of Endorsement (#2585/23/7 dated 14/09/2012) from State Environmental Investment Agency of Ukraine. Due to the Netherlands legislation, no LoE from the Netherlands is needed.

The project obtained Letter of Approval from Netherlands (#2012JI31 dated 02/07/2012). After receiving Determination Report from the Accredited Independent Entity the project documentation will be submitted to the Ukrainian Designated Focal Point (DFP) which is State Environmental Investment Agency of Ukraine, for receiving a Letter of Approval.

SECTION B. Baseline

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

A baseline for the JI project is set in accordance with Appendix B to decision 9/CMP.1 (JI guidelines)[10], and with further guidance on baseline setting and monitoring developed by the Joint Implementation Supervisory Committee (JISC). In accordance with the Guidance on Criteria for Baseline Setting and Monitoring (version 03)[11] (hereinafter referred to as Guidance), the baseline for a JI project is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of GHGs that would **occur in the absence of the proposed project**.

In accordance with the Paragraph 9 of the Guidance the project participants may select: an approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (JI specific approach); or a methodology for baseline setting and monitoring approved by the Executive Board of the clean development mechanism (CDM), including methodologies for small-scale project activities, as appropriate, in accordance with paragraph 4(a) of decision 10/CMP.1, as well as methodologies for afforestation/reforestation project activities. Paragraph 11 of the Guidance allows project participants that select a JI specific approach to use selected elements or combinations of approved CDM baseline and monitoring methodologies or approved CDM methodological tools, as appropriate.

Description and justification of the baseline chosen is provided below in accordance with the "Guidelines for users of the Joint Implementation Project Design Document Form" (version 04)[12], using the following step-wise approach:

Step 1. Indication and description of the approach chosen regarding baseline setting

Project participants have chosen the following approach regarding baseline setting, defined in the Guidance (Paragraph 9):

- An approach for baseline setting and monitoring developed in accordance with appendix B of the JI guidelines (**JI specific approach**).

The detailed theoretical description of the baseline in a complete and transparent manner, as well as a justification in accordance with Paragraph 23 through 29 of the Guidance is provided by the project participants below.

The baseline for this project shall be established in accordance with appendix B of the JI guidelines and Guidance on Criteria for Baseline Setting and Monitoring. Furthermore, the baseline shall be identified by listing and describing plausible future scenarios on the basis of conservative assumptions and selecting the most plausible one.

The most plausible future scenario will be identified by performing a barrier analysis. Should only two alternatives remain, of which one alternative should represent the project scenario with the JI incentive, the additionality will be demonstrated.

Step 2. Application of the approach chosen

Plausible future scenarios shall be identified in order to establish a baseline.

[10] URL: http://unfccc.int/resource/docs/2005/cmp1/eng/08a02.pdf#page=2 (last reference – 20/05/2012)
[11] URL: http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf (last reference – 20/05/2012)
[12] URL: http://ji.unfccc.int/Ref/Documents/Guidelines.pdf (last reference – 20/05/2012)

Sub step 2a. Identifying and listing plausible future scenarios.

Subproject 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Scenario 1. Continuation of existing situation

This scenario foresees continuation of activities under a business-as-usual scenario. In absence of the project activity, the plant continues to process hydrogen by Steam Methane Reforming. Off-gases are released in the atmosphere.

Scenario 2. Construction of Pressure Swing Adsorption Unit for hydrogen production (proposed project activity without JI incentives)

According to this scenario Pressure Swing Adsorption Unit will be construction and put into operation for hydrogen production from refinery off-gases. This measure will decrease amount of natural gas and electricity consumption. The high level of purity of hydrogen from the PSA in fact allows the maintenance of a high purity level in the gas recycled to the desulphurization section[13].

Scenario 3. Hydrogen recovery from refinery off-gases by membrane

Membrane technology is based on the selective separation properties of a polymeric membrane. The small molecules are separated from larger molecules in the membrane systems due to their higher permeation ability. Hydrogen is one of the high permeability gases, which can be separated from the other components of the off-gas through the polymeric membrane. The driving force needed for the separation in this technique is partial differential pressure across the membrane module[14].

Scenario 4. Hydrogen recovery from refinery off-gases by cryogenic separation

Cryogenic technology is based on the difference in the relative component freezing points at low temperatures. Since hydrogen has a higher volatility and a lower freezing point than the other components present in the off-gas stream, it sustains a gaseous state, while the other components are crystallized when the temperature is lowered significantly. This would also result in capturing the impurities of the off-gas in crystallized components, which in turn, leads to separation of the gaseous hydrogen from these impurities.

Subproject 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Scenario 1. Continuation of existing situation

In this scenario A-8-1 unit continues operation. The unit is in a workable condition and completely satisfies plant’s demand in nitrogen. Only periodic maintenance without any modernization activities is being carried out on them. The unit work in a full capacity mode without regulation ability causing overproduction of nitrogen that is released in the atmosphere. AK 1.5 units don’t undergo any modernization activities.

Scenario 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant (proposed project activity without JI incentives)

According to this scenario two АК-1.5 units will be reconstructed and put into operation for nitrogen production. This measure will decrease amount of electricity consumption at Nitrogen-Oxygen Plant.

[13] URL: http://www.treccani.it/export/sites/default/Portale/sito/altre_aree/Tecnologia_e_Scienze_applicate/enciclopedia/inglese/inglese_vol_2/059-70_ING3.pdf (last reference – 20/05/2012)

[14] Maciula, E.A., 1980. Membrane processing favors hydrogen recovery. Hydrocarbon Process., 59: 115-118.

Scenario 3. Construction new units for nitrogen production at Nitrogen-Oxygen Plant

New units will be constructed and put into operation for nitrogen production. This measure will decrease amount of electricity consumption. ***Sub step 2b. Barrier analysis***

Subproject 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Scenario 1. Continuation of existing situation

This scenario does not anticipate any activities and therefore does not face any barriers.

Scenario 2. Construction Pressure Swing Adsorption Unit for hydrogen production (proposed project activity without JI incentives)

Investment barrier: Implementation cost of the new equipment is rather high. In terms of difficult economic situation in Ukraine, the considered scenario appears to be unattractive for the possible investments because of many uncertainties and low yield. Please refer to Section B.2 for details.

Scenario 3. Hydrogen recovery from refinery off-gases by membrane

Technological barrier: This scenario is based on known technology, however, this technology is not currently available in Ukraine and there is no evidence that such projects will be implemented in the near future. Implementation of this scenario requires research on compatibility of old equipment with new one. Complex project works and long commissioning period shall take place in order to adjust new equipment with operation processes. The considered activity carries risks concerning reliable and long-term operation of the new equipment.

In order to choose the feasible technique among the separation techniques for the hydrogen recovery from the off-gas stream, several factors have to be considered[15]:

- off-gas stream properties (composition, pressure, flow rate)
- recovery percentage
- recovering gas properties (purity, pressure)
- capital costs
- compression costs
- degree of flexibility in the system

This scenario has some technological limitation:

- High feed pressure with low product pressure and pre-treatment requirements. Off-gases are available at low pressure and contain other substances; therefore, additional expensive equipment is needed.
- Low product capacity and low operating flexibility.
- High technological risks.

Investment barrier: Implementation cost of the new equipment is rather high. In terms of difficult economic situation in Ukraine, the considered scenario appears to be unattractive for the possible investments because of many uncertainties and low yield.

Scenario 4. Hydrogen recovery from refinery off-gases by cryogenic separation

Technological barrier: This scenario is based on known technology, however, this technology is not currently available in Ukraine and there is no evidence that such projects will be implemented in the near future. Implementation of this scenario requires research on compatibility of old equipment with new one. Complex project works and long commissioning period shall take place in order to adjust new equipment with operation processes. The considered activity carries risks concerning reliable and long-term operation of the new equipment.

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[15] Ratan, S. and P. Wentink, 2001. Cost effective hydrogen from refinery off-gases. Proceedings of 4th National Rubber Conference, Feb. 20-21, Iran, pp: 131-137.

This scenario has some technological limitation:

- High pre-treatment requirements. Off-gases contain other substances; therefore, additional expensive equipment is needed which result in higher capital cost.
- Low product capacity and low operating flexibility.
- High technological risks.

Investment barrier: Investment into unproven technology carries a high risk. In case of Ukraine, which carries a high country risk[16], investment into such unproven projects are less likely to attract investors than some other opportunities in the hydrogen production sector with higher returns. Cost of the produced hydrogen is likely to be much higher than alternatives.

Subproject 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Scenario 1. Continuation of existing situation

Although the A-8-1 unit consumes considerable amount of electric energy, it provides reliable support for the operation processes. No additional investment is needed for supporting this scenario. This scenario comprises risk-free practice and does not face any barriers.

Scenario 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant (proposed project activity without JI incentives)

Investment barrier: This scenario is financially unattractive and faces barriers. Please refer to section B.2 for details.

Scenario 3. Construction of the new units at Nitrogen-Oxygen Plant for nitrogen production

Investment barrier: Installation of units at Nitrogen-Oxygen Plant requires significant capital investment into equipment purchase, and building, projecting, mounting and commissioning works. Additionally several new communications and pipelines shall be installed. Comparing to the others scenarios, this one requires the most investments and moreover causes higher GHG emissions, thereby, it is unfavourable for implementation

Sub step 2c. Baseline identification

For both subprojects all scenarios, except Scenario 1 - Continuation of existing situation, face prohibitive barriers. Therefore, the following scenarios are the most plausible future scenarios and are identified as baseline scenarios:

Subproject 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Baseline scenario: Continuation of existing situation

This scenario foresees continuation of activities under a business-as-usual scenario. In absence of the project activity, the plant continues to process hydrogen by Steam Methane Reforming. Off-gases are released in the atmosphere.

[16] AMB Country Risk Report: Ukraine September 28, 2011 URL: http://www3.ambest.com/ratings/cr/reports/Ukraine.pdf (last reference – 20/05/2012)

Subproject 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

<u>Baseline scenario: Continuation of existing situation</u>

In this scenario A-8-1 unit continues operation. The unit is in a workable condition and completely satisfies plant's demand in nitrogen. Only periodic maintenance without any modernization activities is being carried out on them. The unit work in a full capacity mode without regulation ability causing overproduction of nitrogen that is released in the atmosphere. АК 1.5 units don't undergo any modernization activities.

This baseline scenario has been established according to the criteria outlined in the Guidance:

1) The baseline covers **emissions from all gases, sectors and source categories** listed in Annex A of the Kyoto Protocol, and/or anthropogenic removals by sinks, within the project and anthropogenic removals by sinks, within the project boundary and is established in accordance with the Appendix B of the JI guidelines. Section B.3 of this PDD provides information on the coverage of emissions within the project boundary by the baseline of this project.

2) **On a project specific basis**. This baseline is established on a project specific basis using the JI-specific approach;

3) **In a transparent manner with regard to the choice of approaches, assumptions, methodologies, parameters, data sources and key factors**. All parameters and data are either monitored by the project participants or are taken from sources that provide a verifiable reference for each parameter. Project participants use approaches suggested by the Guidance;

4) **Taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector.** Key factors have been assessed and their impact is summarized below:

   a) **Sectoral reform policies and legislation.** State program of industry development until 2017[17] foresees three stages of development:

   - During the first stage (2009-2012) maximal employment of existing capacities and their modernization is to be performed. Manufacturing of new competitive production is to be mastered; innovative activities have to be developed. Organization and management of the enterprises is to be improved;
   - The second stage (2013-2015) implies that the key factor of development will be implementation of state-of-the-art manufacturing capacities, namely scientific-intensive ones. Range of competitive products is to be enhanced;
   - Further development of the industrial field is anticipated during the third stage (2016-2017);

   However, it is supposed that enterprises finance those improvements from their own funds or bank loans, which practically means that Ukrainian government is not intervening in this process and execution of the Program fully depends on market conditions and availability of financial resources. In case of existence of any incitements in accordance with this program, they could alleviate the barriers, which prevent the proposed project realization. Nevertheless, no definite mechanisms for stimulation were developed. Therefore, plants in Ukraine have no obligations to implement any energy efficient measures. Taking into account the above mentioned it is reckoned that no policies and legislation can influence the baseline;

[17] http://industry.kmu.gov.ua/control/uk/publish/article?art_id=57967&cat_id=57966 (last reference – 20/05/2012)

b) **Economic situation/growth and socio-demographic factors in the relevant sector as well as resulting predicted demand.** The market of such refined oil products as fuel oil, lubricants and chemicals is a transparent market where standardized types of products exist. Amount of manufacturing goods depends on management and marketing activities of the plant. It is assumed that the level of production and demand of the plant is not influenced by the project. Thereby, suppressed and/or increased demand that will be met by the project can be considered in the baseline as appropriate (e.g. by assuming that the same level of service as in the project scenario would be offered in the baseline scenario).

c) **Availability of capital (including investment barriers).** Ukraine has been always considered a high-risk country for investments and doing business. Table below summarizes key indicators of business practices in Ukraine.

Table 7 International ratings of Ukraine

Indicators	2006	2007	2008	2009	Note
Corruption index of Transparency International	99 position from 163	118 position from 180	134 position from 180	-	Index of corruption
Rating of business practices of The World Bank (The Doing Business)	124 position from 155	118 position from 179	139 position from 178	145 position from 181	Rating of conduct of business (ease of company opening, licensing, staff employment, registration of ownership, receipt of credit, defence of interests of investors)
The IMD World Competitiveness Yearbook	46 position from 55	46 position from 55	54 position from 55	56 position from 57	Research of competitiveness (state of economy, efficiency of government, business efficiency and state of infrastructure)
Index of Economic Freedom of Heritage Foundation	99 position from 157	125 position from 161	133 position from 157	152 position from 179	Determination of degrees of freedom of economy (business, auction, financial, monetary, investment, financial, labor freedom, freedom from Government, from a corruption, protection of ownership rights)
Global Competitiveness Index of World Economic Forum	69 position from 125	73 position from 131	72 position from 134	-	Competitiveness (quality of institutes, infrastructure, macroeconomic stability, education, development of financial market, technological level, innovative potential)

Risks of doing business in Ukraine significantly impact the availability of capital in the country. Commercial loan rates in EURO in Ukraine for the period of over 5 years fluctuated in March – October 2010 between 8% and 10.4% according to the official statistics of the National Bank of Ukraine[18]. For the reference similar rates in Germany for this period fluctuated between 2.3% to 3.6% according to the European Central Bank[19]. Cost of debt financing in Ukraine is at least twice as high than in the Eurozone. The risks of investing into Ukraine are additionally confirmed by the

[18] Statistical Release. Archive, Interest Rates, 2010. URL: http://www.bank.gov.ua/files/4-Financial_markets(4.1).xls (last reference – 20/05/2012)

[19] Germany, Harmonised long-term interest rates for convergence assessment purposes URL: http://sdw.ecb.europa.eu/browse.do?node=bbn642 (last reference – 20/05/2012)

country ratings provided by the Moody's international rating agency and the associated country risk premium. The table below compares country risk premiums for Russia and Ukraine[20]:

Table 8 Country risk premiums for Russia and Ukraine

Total Risk Premium, %	2008	2009	2010
Russia	6.52	8	6.9
Ukraine	10.04	14.75	12.75

As it is demonstrated by this table, Russia, while offering a comparable set of investment opportunities, is a significantly less risky country for investing in than Ukraine. High interest rates and shortness of the resources of financial institutions make it hard to finance any big infrastructure projects. Such projects are looking upon direct public financing or partnerships between private investors, international financial organizations and government. Large scale privately financed infrastructure projects in Ukraine are hard to come by.

d) **Local availability of technologies/techniques, skills and know-how and availability of the best available technologies/techniques in the future.** Due to global market, up-to-date technologies from developed countries are available for purchase, however their cost is high and implementation requires existence of knowledgeable personnel able to introduce and operate the equipment. Currently, lack of investments and lack of modern technologies application experience in Ukraine impede possible modernization projects and further progress of the industry sector.
e) **Fuel prices and availability.** Electricity and natural gas are widely used in Ukrainian industry. Natural gas is mostly imported from the Russian Federation. Prices for gas consumers are regulated by National Electricity Regulatory Commission, which has a special department for cost and prices monitoring by size of demand and categories of consumers. Electric energy in Ukraine is produced mainly by fossil fuel fired thermal power stations and nuclear power stations. Wholesale Electricity Market of Ukraine managed by state enterprise "Energorynok" is responsible for marketing of electric energy. Price for electric energy ranges in a large extent for different types of consumers.

5) **In such a way that emission reduction units (ERUs) cannot be earned for decreases in activity levels outside the project activity or due to force majeure.** According to the proposed approach emission reductions will be earned only when project activity will generate refined oil products, so no emission reductions can be earned due to any changes outside the project activity.

6) **Taking account of uncertainties and using conservative assumptions.** A number of steps have been taken in order to account for uncertainties and safeguard conservativeness:

a) Lower range of parameters is used for calculation of baseline emissions and higher range of parameters is used for calculation of project activity emissions;

b) Default values were used to the extent possible in order to reduce uncertainty and provide conservative data for emission calculations.

c) The emissions of methane and nitrous oxide have not taken into consideration. This is conservative.

Baseline GHG emissions

In order to calculate baseline GHG emissions following assumptions were made:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

- The hydrogen produced within the project scenario displaces the same amount of hydrogen that would be produced in the baseline scenario;
- The proposed project will not influence the refined oil production level;

[20] Data from Aswath Damodaran, Ph.D., Stern School of Business NYU URL: http://pages.stern.nyu.edu/~adamodar/ (last reference – 20/05/2012)

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

- The electricity consumed within the baseline scenario is constant;
- The proposed project will not influence the refined oil production level;

Baseline GHG emissions come from following sources:

Sub-project 1.

1. Carbon dioxide emissions from use of natural gas as a fuel and feedstock in SMR Plant
2. Carbon dioxide emissions from electricity consumption in SMR Plant

Sub-project 2.

1. Carbon dioxide emissions of electricity consumption in Nitrogen-Oxygen Plant (only A-8-1 unit)

As stated in the Guidance on criteria for baseline setting and monitoring the indicators, constants, variables and/or models used shall be reliable (i.e. provide consistent and accurate values) and valid (i.e. be clearly connected with the effect to be measured), and shall provide a transparent picture of the GHG emissions reductions or to be monitored. Default values may be used, as appropriate. In the selection of default values, accuracy and reasonableness shall be carefully balanced. The default values chosen should originate from recognized sources, be supported by statistical analyses providing reasonable confidence levels and be presented in a transparent manner.

The value of ex-ante parameter has been calculated in a transparent manner using the corresponding historical data from technical reports of the company. The accuracy is ensured by analysing the values for the period of 35 months (almost 3 years) prior to the project implementation and extracting the weighted average value. The period is sufficient to reflect and equalize the operational fluctuations and deviations which occur in the manufacturing process, thus the default value has been estimated with a high level of confidence.

Key information and data used to establish the baseline (variables, parameters, data sources etc.) are provided below in tabular form.

Data/Parameter	$P_{H2,SP1,PJ,y}$
Data unit	t
Description	Hydrogen produced in period y
Time of determination/monitoring	Monthly
Source of data (to be) used	Project owner technical reports
Value of data applied (for ex ante calculations/determinations)	Set ex-post during monitoring
Justification of the choice of data or description of measurement methods	The value is measured by hydrogen meters and totalled in technical reports of project owner
QA/QC procedures (to be) applied	Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data and regular cross-checks between them and previous statistical data are performed.
Any comment	No

Data/Parameter	$SEC_{SP1,H2,BL}$
Data unit	MWh/t
Description	Specific electricity consumption per tonne of hydrogen in baseline scenario
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Project owner technical reports.

Value of data applied (for ex ante calculations/determinations)	1.746
Justification of the choice of data or description of measurement methods	This data based on average value for the period 2006-2008 before the project implementation
QA/QC procedures (to be) applied	Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data and regular cross-checks between them and previous statistical data are performed.
Any comment	Please see Annex 2 for details

Data/Parameter	$\mathbf{SFC_{SP1,H2,BL}}$
Data unit	1000 m3/t
Description	Specific natural gas consumption (as fuel) per tonne of hydrogen in baseline scenario
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Project owner technical reports
Value of data applied (for ex ante calculations/determinations)	1.489
Justification of the choice of data or description of measurement methods	This data based on average value for the period 2006-2008 before the project implementation
QA/QC procedures (to be) applied	Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data and regular cross-checks between them and previous statistical data are performed.
Any comment	Please see Annex 2 for details

Data/Parameter	$\mathbf{SMC_{SP1,H2,BL}}$
Data unit	1000 m3/t
Description	Specific natural gas consumption (as material) per tonne of hydrogen in baseline scenario
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Project owner technical reports
Value of data applied (for ex ante calculations/determinations)	2.755
Justification of the choice of data or description of measurement methods	This data based on average value for the period 2006-2008 before the project implementation
QA/QC procedures (to be) applied	Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data and regular cross-checks between them and previous statistical data are performed.
Any comment	Please see Annex 2 for details

Data/Parameter	$\mathbf{NCV_{NG}}$
Data unit	GJ/1000 m3
Description	Net calorific value of natural gas
Time of determination/monitoring	Default value

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

Source of data (to be) used	National Inventory Report of Ukraine 1990-2010, Table P2.27 p.456 (1.A.1.b Petroleum Refining)
Value of data applied (for ex ante calculations/determinations)	35.3
Justification of the choice of data or description of measurement methods	This data based on default value
QA/QC procedures (to be) applied	Standard procedures are used
Any comment	No

Data/Parameter	**$k_{C,NG}$**
Data unit	tC/GJ
Description	Carbon content of natural gas
Time of determination/monitoring	Default value
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010, Table P2.29 p.458 (1.A.1.b Petroleum Refining)
Value of data applied (for ex ante calculations/determinations)	0.01517
Justification of the choice of data or description of measurement methods	This data based on default value
QA/QC procedures (to be) applied	Standard procedures are used
Any comment	tC/GJ = 0,001×tC/TJ

Data/Parameter	**$OXID_{NG}$**
Data unit	ratio
Description	Oxidation factor for natural gas combustion
Time of determination/monitoring	Default value
Source of data (to be) used	National Inventory Report of Ukraine 1990-2010, Table P2.30 p.459 (1.A.1.b Petroleum Refining)
Value of data applied (for ex ante calculations/determinations)	0.995
Justification of the choice of data or description of measurement methods	This data based on default value
QA/QC procedures (to be) applied	Standard procedures are used
Any comment	No

CO_2 emission factor for electricity consumption in period y is accepted by the DFP and is based on actual power plants data according with Calculation methodology for specific carbon dioxide emissions from electric energy production at thermal power plants and its consumption, National Environmental Investment Agency of Ukraine (NEIA), 2011. This methodology and the resulting specific carbon dioxide emissions have been developed by the DFP of Ukraine for the application in JI projects. Estimated specific carbon dioxide emissions for the years 2008, 2009, 2010 and 2011 are available . It is approved that actual ex-post emission factors will be calculated and published every year for the previous year before the 1st of March. For ex-ante estimations in this project design document the most recent available value of specific carbon dioxide emissions is used for the whole estimation period. Ex-post value of specific carbon dioxide emissions will be used if available for the calculation of emission reductions. In case this value is not available the most recent available value will be used instead.

Data/Parameter	**$EF_{CO2,EL}$**
Data unit	tCO_2/MWh
Description	CO_2 emission factor for electricity consumption in period y equal to the indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine dated August 13, 1998 #1052
Time of determination/monitoring	Ex-post as provided by the DFP on the annual basis
Source of data (to be) used	Order of the National Environmental Investment Agency of Ukraine #75 dated 12.05.2011 (for 2011) http://www.neia.gov.ua/nature/doccatalog/document?id=127498
Value of data applied (for ex ante calculations/determinations)	1.09
Justification of the choice of data or description of measurement methods	This value is the latest specific carbon dioxide emissions for Ukrainian electricity grid approved by the DFP of Ukraine
QA/QC procedures (to be) applied	Check on the updates of the emission factor.
Any comment	$kgCO_2/kWh = tCO_2/MWh$

Data/Parameter	**$EC_{SP2, BL}$**
Data unit	MWh
Description	Electricity consumption for nitrogen production in baseline scenario
Time of determination/monitoring	Fixed ex-ante
Source of data (to be) used	Project owner technical reports
Value of data applied (for ex ante calculations/determinations)	22 155
Justification of the choice of data or description of measurement methods	This data based on average value for the period 2006-2008 before the project implementation
QA/QC procedures (to be) applied	Regular cross-checks for rated characteristics of Nitrogen-Oxygen Plant are performed. The monthly and annual reports are based on the monthly technical reports data and regular cross-checks between them and previous statistical data are performed.
Any comment	Please see Annex 2 for details

Formulae used to estimate baseline GHG emissions are described in section D.1.1.4 and Annex 2.

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:

The following step-wise approach is used to demonstrate that the project provides reductions in GHG emissions by sources that are additional to any that would otherwise occur:

Step 1. Indication and description of the approach applied

Project participants have chosen **JI specific approach** regarding baseline setting, defined in the Guidance (Paragraph 9).

As suggested by Paragraph 44 (c) of the Annex 1 of the Guidance additionality can be demonstrated, inter alia, by using the following approach: the most recent version of the "Tool for the demonstration and assessment of additionality" approved by the CDM Executive Board or any other method for proving additionality approved by the CDM Executive Board.

At the time of this document completion the most recent version of the **"Tool for the demonstration and assessment of additionality" (version 06.0.0)**[21] (hereinafter referred to as Tool) approved by the CDM Executive Board is and it is used to demonstrate additionality of the project activity.

Step 2. Application of the approach chosen

The following steps are taken as per "Tool for the demonstration and assessment of additionality":

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

We will define realistic and credible alternatives to the project activity through the following Sub-steps:

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

Identify realistic and credible alternative(s) available to the project participants that deliver outputs with comparable quality, properties and application areas to the proposed project activity and that have been implemented previously or are being introduced in the relevant country/region.

Subproject 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Alternative 1. Continuation of the current situation

This scenario foresees continuation of activities under a business-as-usual scenario. In absence of the project activity, the plant continues to process hydrogen by Steam Methane Reforming. Off-gases are released in the atmosphere.

Alternative 2. Construction of Pressure Swing Adsorption Unit for hydrogen production (proposed project activity without JI incentives)

According to this scenario Pressure Swing Adsorption Unit will be construction and put into operation for hydrogen production from refinery off-gases. This measure will decrease amount of natural gas and electricity consumption.

Subproject 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Alternative 1. Continuation of the current situation

In the current situation A-8-1 unit continue operation. The unit is in a workable condition and completely satisfy plant's demand in nitrogen. Only periodic maintenance without any modernization activities is being carried out on them. The unit work in a full capacity mode without regulation ability causing overproduction of nitrogen that is released in the atmosphere. AK 1.5 units don't undergo any modernization activities.

[21] URL: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf (last reference – 20/05/2012)

Alternative 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant (proposed project activity without JI incentives)

According to this scenario two АК-1.5 units will be reconstructed and put into operation for nitrogen production. This measure will decrease amount of electricity consumption at Nitrogen-Oxygen Plant.

Outcome of Sub-Step 1a: We have identified realistic and credible alternative scenarios to the project activity.

Sub-step 1b: Consistency with mandatory laws and regulations

All of the alternatives identified above are consistent with mandatory laws and regulations of Ukraine. The refinery plants are operating within the legal framework of Ukraine.

Outcome of Sub-step 1b: We have identified realistic and credible alternative scenarios to the project activities that are in compliance with mandatory legislation and regulations taking into account the enforcement in the Ukraine.

Step 2. Investment Analysis

The purpose of the investment analysis in the context of additionality is to determine whether the proposed project activity is not:

a) The most economically or financially attractive; or
b) Economically or financially feasible, without the revenue from the sale of GHG emissions reductions.

Sub-step 2a: Determine appropriate analysis method

For both sub-projects the proposed alternatives will, apart from the JI benefits, generate economic benefits through the production of hydrogen (Scenario 3 and 4 for Sub-project 1) or will avoid investment costs (Scenario 1 for Sub-project 1 and Scenario 1 for Sub-project 2); therefore the simple cost analysis is not applicable. Either investment comparison analysis or benchmark analysis has to be applied in case of proposed activities.

Option III – benchmark analysis – has been chosen to conduct the investment analysis. The data necessary to make a careful and comparable estimation of the indicators for the Scenario 3 and 4 for Sub-project 1 and Scenario 3 are not available to the project participants. Therefore, it is not feasible to conduct investment comparison analysis as per Option II. Only plausible alternative represents the continuation of existing situation, a benchmark analysis (Option III) is applied.

Sub-step 2b: Option III. Apply benchmark analysis

For the benchmark analysis of the project the indicator of Net Present Value (NPV) was used. The goal of analysis will be to show that the project activity not undertaken as a joint implementation project (Alternative 2 for both sub-projects) will not be financially attractive and will lead to negative value of NPV. This benchmark has been selected for a number of reasons:

1. The project owner does not have formalized internal benchmark that is systematically applied during project evaluation;
2. No governmental approved benchmark is available for projects of this kind in Ukraine;
3. Positive/negative NPV is a generally accepted project evaluation benchmark. Its use is encouraged by many project finance professionals, while Internal Rate of Return (IRR) is considered to be controversial and is not recommended as the single benchmark for project evaluation[22].

The analysis took in consideration the following assumptions:

1. Time of investment decision taking is May 2005 for Sub-project 1 and Sub-project 2.

[22] *Principles of Corporate Finance* 7th edition, Richard A. Brealey, Stewart C. Myers, McGraw-Hill Higher Education, 2003 – p. 105

2. The period of assessment equal to period of expected operation of the project activity (technical lifetime). The period is 20 years for both sub-projects.
3. Calculations have been done in EUR.
4. Depreciation and any taxes (except for mandatory overhead payments) have not been taken into account.
5. All financing for the project is provided by equity and is considered as cash outflow.
6. The fair value of sub-projects activity assets at the end of the assessment period is included as a cash inflow in the final year. The fair value equal to depreciated value of project equipment in the end of analysed operation period.

The project investment costs include, inter alia:

- Purchase price for new equipment and machinery;
- Reconstruction of being networks on site and upgrade of old equipment for compatibility to new one;
- Construction and installation;
- Design, planning and development expenses.

The project operating costs include, inter alia:

- Employee salaries;
- Mandatory overhead costs;
- General operational expenses;
- Maintenance expenses.

As an appropriate discount rate for the NPV calculation in this case the cost of equity was used. The discount rate is set at a level of 15 % for the NPV calculation and represents the weighted average cost of capital for the project[23]. As the benchmark is based on parameters that are standard in the market, and the information on typical debt/equity finance structure observed in the sector of the country is not readily available, 50% debt and 50% equity financing is assumed as a default. The project cash-flow modelling has been performed in order to calculate project's indicator and compare it with the benchmark.

The project cash-flow modelling has been performed in order to calculate project's indicator and compare it with the benchmark.

Sub-step 2c: Calculation and comparison of financial indicators
The NPV for the operational period of 20 years of the proposed project activity has been calculated and produced results as follows:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Table 9 Financial indicators for Sub-project 1

Base case financing structure	EUR thousands
NPV	-58 542
Benchmark NPV	>0

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Table 10 Financial indicators for Sub-project 2

Base case financing structure	EUR thousands
NPV	-4 574
Benchmark NPV	>0

As it can be seen from the tables the possible sub-projects activity results in negative NPV under current discount rate. This means that any investor wishing to invest into such project will lose value of his investment instead of increasing it. Hence, the project cannot be considered as a financially attractive.

[23] See Annex 5

Sub-step 2d: Sensitivity analysis

The NPV values for the change in total investment cost and electricity production estimates which are the most important variables that influence the final results are shown in the table below. Changes in the electricity tariff are not included into the analysis as it is fixed by the law and as such it cannot vary. Changes in electricity production influence the same cash flow and this influence is analysed instead.

A sensitivity analysis should be made to show whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions, as it can be seen by application of "Tool for the demonstration and assessment of additionality". As suggested in this Tool, variations of the key factors in the sensitivity analysis should at least cover a range of +10% and –10%.

The following three key indicators were considered in the sensitivity analysis: investment cost, natural gas price, operational expenses. The other cost components and factors account for less than 20 % of total project costs or total project revenues and therefore are not considered in the sensitivity analysis.

The following scenarios were proposed in order to explore the sensitivity of the analysis results.

Results of the analysis are provided in the tables below.

Table 11 Sensitivity analysis for Subproject 1

Scenario	NPV, EUR thousand	Comment
Base Case	-58 542	
Scenario 1	-59 092	Investment cost +10%
Scenario 2	-58 984	Operational expenses +10%
Scenario 3	-57 892	Natural gas price +10%
Scenario 4	-57 991	Investment cost -10%
Scenario 5	-58 100	Operational expenses -10%
Scenario 6	-59 192	Natural gas price -10%

Table 12 *Sensitivity analysis for Subproject 2*

Scenario	NPV, EUR thousand	Comment
Base Case	-4 574	
Scenario 1	-4 833	Investment cost +10%
Scenario 2	-4 896	Operational expenses +10%
Scenario 3	-4 450	Natural gas price +10%
Scenario 4	-4 314	Investment cost -10%
Scenario 5	-4 252	Operational expenses -10%
Scenario 6	-4 698	Natural gas price -10%

According to the tables, the sub-projects don't reach positive NPV under any of the varying assumptions. Thus, the sensitivity analysis results presented above demonstrate the robustness of conclusions made in sub-step 2c. It can be concluded that project activity is unlikely to be financially/economically attractive.

Outcome of Step 2: After the sensitivity analysis it is concluded that the proposed JI project activities are unlikely to be financially/economically attractive.

Step 3: Barrier analysis
In line with the Tool for the demonstration and assessment of additionality no barrier analysis is needed when investment analysis is applied.

Step 4: Common practice analysis

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

No activities similar to the proposed project activity are observed in Ukraine. Oil refineries in Ukraine using outdated processing technology and have very limited funds for the modernization of production facilities.

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

It is required to follow Sub-step 4b according to of the Tool when this project is widely observed and commonly carried out. The proposed JI project does not represent a widely observed practice in the area considered (see Sub-step 4a). So, this sub-step is not applied. The facts mentioned above allow concluding that the proposed JI project is not common practice in Ukraine.

Sub-steps 4a and 4b are satisfied, i.e. similar activities cannot be widely observed. Thus proposed project activity is not a common practice.

Outcome of the analysis: Thus the additionality analysis demonstrates that project GHG emissions reductions are additional**.**

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

The project activities are physically limited to the plant site that is legally operated by the LINIK. At the same time, some sources of GHG emissions are indirect – carbon dioxide emissions due to the consumption of power from the Ukrainian electricity grid, as a result of electricity generation using fossil fuels.

The table below shows an overview of all emission sources in the baseline and project scenarios. Project boundary has been delineated in accordance with provisions of Paragraphs 13, 14 of the Guidance.

Table 13 Sources of GHG emissions in the baseline and project scenarios for Subproject 1

	Source	Gas	Included/Excluded	Justification / Explanation
Baseline	Natural gas consumption	CO_2	Included	Main emission source
	Electricity consumption	CO_2	Included	Main emission source
Project scenario	Natural gas consumption	CO_2	Included	Main emission source
	Electricity consumption	CO_2	Included	Main emission source

Baseline scenario for Subproject 1

The baseline scenario is the continuation of the existing situation. In absence of the project activity, the plant continues to process hydrogen by Steam Methane Reforming. Natural gas is used as a fuel and feedstock in SMR Plant which causing carbon dioxide emissions into the atmosphere. Also electricity used for processes of SMR Plant. GHG emissions sources in the baseline that are included into the project boundary are:

1) Carbon dioxide emissions from use of natural gas as a fuel and feedstock in SMR Plant
2) Carbon dioxide emissions from electricity consumption in SMR Plant

Project scenario for Subproject 1

In the project scenario Pressure Swing Adsorption Unit will be construction and put into operation for hydrogen production from refinery off-gases. This measure will decrease amount of natural gas and electricity consumption in SMR Plant. But electricity is used to run the project equipment. GHG emissions sources in the project scenario:

1) Carbon dioxide emissions from use of natural gas as a fuel and feedstock in SMR Plant
2) Carbon dioxide emissions from electricity consumption in SMR Plant including PSA Unit

Table 14 Sources of GHG emissions in the baseline and project scenarios for Subproject 2

	Source	Gas	Included/Excluded	Justification / Explanation
Baseline	Electricity consumption	CO_2	Included	Main emission source
Project scenario	Electricity consumption	CO_2	Included	Main emission source

Baseline scenario for Subproject 2

The baseline scenario is the continuation of the existing situation. In absence of the project activity A-8-1 unit continue operation. The unit is in a workable condition and completely satisfy plant's demand in nitrogen. Only periodic maintenance without any modernization activities is being carried out on them. The unit work in a full capacity mode without regulation ability causing overproduction of nitrogen that is released in the atmosphere. AK 1.5 units don't undergo any modernization activities.

GHG emissions sources in the baseline that are included into the project boundary are:

1) Carbon dioxide emissions of electricity consumption in Nitrogen-Oxygen Plant (only A-8-1 unit)

Project scenario for Subproject 2

In the project scenario two AK-1.5 units will be reconstructed and put into operation for nitrogen production. A-8-1 unit is being operated periodically to cover needs of the enterprise in nitrogen during repair of facilities, completion of repair to perform a pressure test of equipment, etc. This measure will decrease amount of electricity consumption in Nitrogen-Oxygen Plant. GHG emissions sources in the project scenario:

1) Carbon dioxide emissions of electricity consumption in Nitrogen-Oxygen Plant (A-8-1 and AK-1.5 units)

The following figures show the project boundaries and sources of GHG emissions in the baseline scenario and in the project scenario.

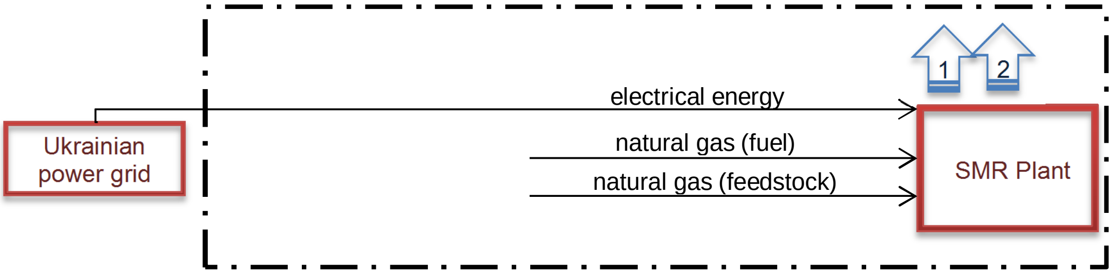

Fig. 2 Project boundaries under baseline scenario for Sub-project 1

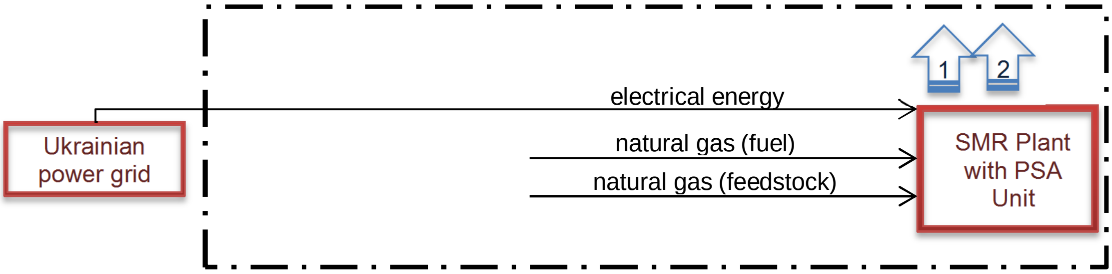

Fig.3 Project boundaries under project scenario for Sub-project 1

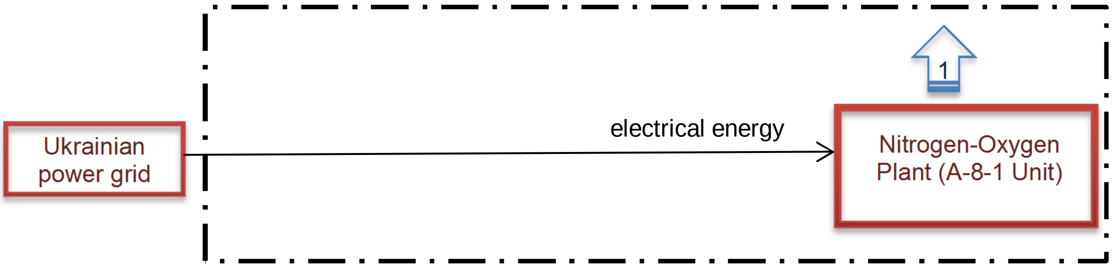

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Fig. 4 Project boundaries under baseline scenario for Sub-project 2

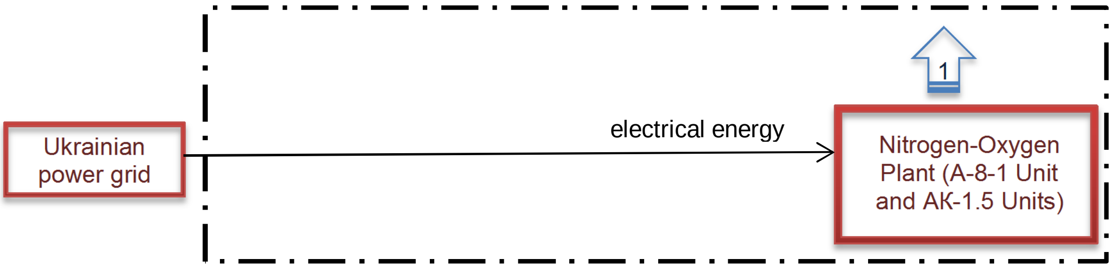

Fig.5 Project boundaries under project scenario for Sub-project 2

 Sources of greenhouse gas emissions:

 Project boundaries

Fig. 6 Symbols in the schematic diagram of the boundary

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: 06/04/2012

Name of person/entity setting the baseline: Natallia Belskaya JI Consultant Global Carbon B.V.
Phone: +38 050 410 26 79
Fax: +38 044 272 08 87
E-mail: belskaya@global-carbon.com

Global Carbon B.V. is the project participant and contact details are available in Annex 1.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project is 11/12/2006. It is date of positive expert's conclusion to design paperwork of Sub-project 2.

The design paperwork was initiated for Sub-project 1 in 2006 and for Sub-project 2 in 2005 in the framework of this project. Commissioning date of PSA Unit is November 2008. Commissioning date of AK-1.5 units is December 2008.

C.2. Expected operational lifetime of the project:

The expected lifetime of the project is estimated to last until the December 2028. Thus the operational lifetime of the project will be 20 years and 2 months (which equals to 242 months).

C.3. Length of the crediting period:

Start of the crediting period: 01/11/2008.

End of the crediting period: 31/12/2028.

Length of crediting period: 20 years and 2 months (which equals to 242 months).

Length of the part of crediting period within the first commitment period of the Kyoto Protocol: 4 years and 2 months (which equals to 50 months)

Length of the part of crediting period after the first commitment period of the Kyoto Protocol: 16 years (which equals to 192 months).

The status of GHG emissions reductions or enhancements of net removals generated by JI projects after the end of the first commitment period of the Kyoto Protocol may be determined by any relevant agreement under the UNFCCC.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

This monitoring plan is established in accordance with appendix B of the JI guidelines and the "Guidance on criteria for baseline setting and monitoring" version 03 developed by the JISC. The description of the monitoring plan chosen is provided using the following step-wise approach:

Step 1. Indication and description of the approach chosen regarding monitoring

Option *a* provided by the Guidance (Paragraph 9) is applied. **JI specific approach** is used for this project and therefore will be used for establishment of a monitoring plan. The monitoring plan will provide for:

1. *Collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of GHGs occurring within the project boundary during the crediting period:*

A clear management structure will be identified to establish the division of responsibilities for gathering monitoring data. Respective services of the plant will collect relevant data in the form of technical reports and other statistical documents. All monitored data will be stored both electronically and in hard copy. The data will be archived and be kept at least two years after last transaction Emission Reduction Units (ERUs) by the project.

2. *Collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary during the crediting period:*

The baseline data fixed ex-ante will be determined using statistical data collected for almost 3 years prior the project implementation. Data from technical reports, control measurements and calculations and other statistical documents will be applied. All monitored data will be stored both electronically and in hard copy. The data will be archived and be kept at least two years after last transaction ERUs by the project.

3. *Identification of all potential sources of, and the collection and archiving of data on increased anthropogenic emissions by sources of GHGs outside the project boundary that are significant and reasonably attributable to the project during the crediting period:*

No leakages take place during the project activities. The only source of greenhouse gas emissions outside the project boundaries and attributable to the project are emissions from electric energy generation at power plants operating on combustive fuel. This source is considered in the monitoring of greenhouse gas emissions by use of applying *Indirect specific carbon dioxide emissions from electricity consumption from the Ukrainian electricity grid*, calculated for each year by the Ukrainian DFP.

4. *Quality assurance and control procedures for the monitoring process:*

The quality of collected data will be secured by conducting regular calibrations of applied measurement equipment according to relevant industry standards. Calibration will be performed by the authorized representatives of the State Metrological System of Ukraine and instrumental department of the company. All measurement devices will be kept in optimal conditions; if any malfunction occurs, the meter will be displaced with similar one and the monitored data will be cross-checked and calculated by use of statistical information. The troubleshooting will be made by maintenance mechanics or on-duty electrician/operator.

5. *Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed JI project, and for leakage effects, if any;*

Calculation of anthropogenic emissions by sources will take place on a periodic basis. Data for the respecting period will be collected by the company and transferred to Global Carbon B.V. Obtained data will be processed and greenhouse gas emissions will be calculated according to the latest carbon emission factors and regulations in power.

Documentation of all steps involved in the calculations referred to in paragraphs 4 (b) and (f) of appendix B of the JI guidelines;

Step 2. Application of the approach chosen

JI specific approach is used for this project and therefore will be used for establishment of a monitoring plan.

For the greenhouse gas emissions only the CO_2 emissions are taken into account. The CH_4 and N_2O emission reductions will not be claimed. This is conservative.

See sub-sections below for the further information on monitoring approach application.

For any monitoring period the following parameters have to be collected and registered:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

1. **Hydrogen produced at the relevant period as a result of the implementation of the project activity**

   For the metering of this parameter the technical reports of the company are used. This parameter is registered with a specialized meters. The meters are situated on the project site. These meters register all hydrogen produced by the project activity. Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data.

2. **Electricity consumption for hydrogen production at the relevant period as a result of the implementation of the project activity**

   For the metering of this parameter the technical reports of the company are used. This parameter is registered with a specialized meters. The meters are situated on the project site. These meters register all electricity consumed by the project activity. Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data.

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3. **Natural gas consumption (as fuel) for hydrogen production at the relevant period as a result of the implementation of the project activity**

   For the metering of this parameter the technical reports of the company are used. This parameter is registered with a specialized meters. The meters are situated on the project site. These meters register all natural gas consumption (as fuel) by the project activity. Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data.

4. **Natural gas consumption (as material) for hydrogen production at the relevant period as a result of the implementation of the project activity**

   For the metering of this parameter the technical reports of the company are used. This parameter is registered with a specialized meters. The meters are situated on the project site. These meters register all natural gas consumption (as material) by the project activity. Regular cross-checks for rated characteristics of SMR Plant are performed. The monthly and annual reports are based on the monthly technical reports data.

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

1. **Electricity consumption for nitrogen production at the relevant period as a result of the implementation of the project activity**

   For the metering of this parameter the technical reports of the company are used. This parameter is registered with a specialized meters. The meters are situated on the project site. These meters register all electricity consumed by the project activity. Regular cross-checks for rated characteristics of Nitrogen-Oxygen Plant are performed. The monthly and annual reports are based on the monthly technical reports data.

There is no data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), but that are not already available at the stage of determination regarding the PDD.

Data and parameters that are not monitored throughout the crediting period, but are determined only once (and thus remain fixed throughout the crediting period), and that are available already at the stage of determination regarding the PDD are provided in the table below:

Table 15 List of fixed ex-ante parameters and default values used in the calculations of GHG emissions

Data / Parameter	Data unit	Description	Source of data (to be) used	Value	Any comment
$SEC_{SP1,H2,BL}$	MWh/t	Specific electricity consumption per tonne of hydrogen in baseline scenario	Please see Annex 2 for details	1.746	–
$SFC_{SP1,H2,BL}$	1000 m^3/t	Specific natural gas consumption (as fuel) per tonne of hydrogen in baseline scenario	Please see Annex 2 for details	1.489	–
$SMC_{SP1,H2,BL}$	1000 m^3/t	Specific natural gas consumption (as material) per tonne of hydrogen in baseline scenario	Please see Annex 2 for details	2.755	–
$EC_{SP2, BL}$	MWh	Electricity consumption for nitrogen production in baseline scenario	Please see Annex 2 for details	22155	–
NCV_{NG}	GJ/1000 m^3	Net calorific value of natural gas	National Inventory Report of Ukraine 1990-2010, Table P2.27 p.456 (1.A.1.b Petroleum Refining)	35.3	–
$k_{C,NG}$	tC/GJ	Carbon content of natural gas	National Inventory Report of Ukraine 1990-2010, Table P2.29 p.458 (1.A.1.b Petroleum Refining)	0.01517	tC/GJ = 0,001×tC/TJ
$OXID_{NG}$	ratio	Oxidation factor for natural gas combustion	National Inventory Report of Ukraine 1990-2010, Table P2.30 p.459 (1.A.1.b Petroleum Refining)	0.995	–

Archiving, data storage and record handling procedure
Documents and reports on the data that are monitored will be archived and stored by the project participants. The following documents will be stored: primary documents for the accounting of monitored parameters in paper form; intermediate reports, orders and other monitoring documents in paper and electronic form; documents on measurement devices in paper and electronic form. These documents and other data monitored and required for determination and verification, as well as any other data that are relevant to the operation of the project will be kept for at least two years after the last transfer of ERUs.

Training of monitoring personnel
The project will utilize technology that requires skills and knowledge in machinery operation, oil refining operation, electric equipment operation etc. This kind of skills and knowledge is available locally through the system of vocational training and education. This system is state-supervised in Ukraine. Professionals who graduate from vocational schools receive a standard certificate in the field of their professional study. Only workers with proper training can be allowed to operate this industrial equipment. Management of the project host will ensure that personnel of the project have received proper training and are eligible to work with the prescribed equipment.
Training on safety issues is mandatory and must be provided to all personnel of the project as required by local regulations. Procedure for safety trainings includes the scope of the trainings, training intervals, forms of training, knowledge checks etc. The project host management will maintain records for such trainings and periodic knowledge check-ups.
Activities that are directly related to the monitoring do not require specific training other than provided by the professional education. However, monitoring personnel will receive training on monitoring procedures and requirements. Personnel of the project host management will receive necessary training and consultations on Kyoto Protocol, JI projects and monitoring from the project participant – Global Carbon B.V.

Procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting
In cases any errors, fraud or inconsistencies are identified during the monitoring process, a special commission will be appointed by the project host management that will conduct a review of such case and issue an order that must also include provisions for necessary corrective actions to be implemented that will ensure such situations are avoided in future.
The project host management will also establish a communication channel that will make it possible to submit suggestions, improvement proposals and project ideas for more accurate future monitoring for every person involved in the monitoring activities. Such communications will be delivered to the project host management who is required to review these communications and in case it is found implement necessary corrective actions and improvements. The project participant – Global Carbon B.V. – will conduct periodic review of the monitoring plan and procedures and if necessary propose improvements to the project participants.

Emergency preparedness for cases where emergencies can cause unintended emissions
The project operation does not foresee any factors or emergencies that can cause unintended GHG emissions. Safe operation of equipment and personnel is ensured by systematic safety training. Procedures for dealing with general emergencies such as fire, major malfunction etc. are developed as part of the mandatory business regulations and are in accordance with local requirements.

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	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	$EC_{SP1,PJ,y}$ Electricity consumption for hydrogen production due to project activity in period y	Company records, electricity meters	MWh	m/c	continuously with monthly totals	100%	Electronic and paper	The value is measured by electricity meters and totalled in technical reports of project owner
2	$FC_{SP1,PJ,y}$ Natural gas consumption (as fuel) for hydrogen production due to project activity in period y	Company records, natural gas meters	1000 m^3	m/c	continuously with monthly totals	100%	Electronic and paper	The value is measured by natural gas meters and totalled in technical reports of project owner
3	$MC_{SP1,PJ,y}$ Natural gas consumption (as material) for hydrogen production due to project activity in period y	Company records, natural gas meters	1000 m^3	m/c	continuously with monthly totals	100%	Electronic and paper	The value is measured by natural gas meters and totalled in technical reports of project owner
4	$EC_{SP2,PJ,y}$ Electricity consumption for nitrogen production due to project activity in period y	Company records, electricity meters	MWh	m/c	continuously with monthly totals	100%	Electronic and paper	The value is measured by electricity meters and totalled in technical reports of project owner

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5	$EF_{CO2,EL}$ CO_2 emission factor for electricity consumption in period y equal to the indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine dated August 13, 1998 #1052	Orders of the DFP of Ukraine	tCO_2/MWh	e	ex-post as provided by the DFP of Ukraine on the annual basis	100%	Paper	The value is provided by the DFP of Ukraine.

CO_2 emission factor for electricity consumption is accepted by the Designated Focal Point (DFP) of Ukraine and is based on actual power plants data according to the *Calculation methodology for specific carbon dioxide emissions from electric energy production at thermal power plants and its consumption, National Environmental Investment Agency of Ukraine (NEIA), 2011*[24]. This methodology and the resulting specific carbon dioxide emissions have been developed by the DFP of Ukraine for the application in JI projects. Estimated specific carbon dioxide emissions for the years 2008, 2009, 2010 and 2011 are available[25]. It is approved that actual ex-post emission factors will be calculated and published every year for the previous year before the 1st of March. For ex-ante estimations in this project design document the most recent available value of specific carbon dioxide emissions is used for the whole estimation period. Ex-post value of specific carbon dioxide emissions will be used if available for the calculation of emission reductions. In case this value is not available the most recent available value will be used instead.

[24] http://www.neia.gov.ua/nature/doccatalog/document?id=125381
[25] http://neia.gov.ua/nature/control/uk/publish/category;jsessionid=FE36697EAC52DD187E792363BB3FDE46?cat_id=111922

Data/Parameter	$EF_{CO2,EL,y}$
Data unit	$kgCO_2/kWh = tCO_2/MWh$
Description	CO_2 emission factor for electricity consumption in period y equal to the indirect specific carbon dioxide emissions from electricity consumption by the 1st class electricity consumers according to the Procedure for determining the class of consumers, approved by the National Electricity Regulatory Commission of Ukraine from August 13, 1998 # 1052
Time of determination/monitoring	Ex-post as provided by the DFP of Ukrain on the annual basis
Source of data (to be) used	NEIA estimate for 2011: http://www.neia.gov.ua/nature/doccatalog/document?id=127498
Value of data applied (for ex ante calculations/determinations)	1.09
Justification of the choice of data or description of measurement methods	This value is the latest indirect specific carbon dioxide emissions from electricity consumption approved by the DFP of Ukraine.
QA/QC procedures (to be) applied	Check on the updates of the emission factor.
Any comment	No

The tables above include data and parameters that are monitored throughout the crediting period.

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

GHG emissions from the project activity are calculated as follows:

$$PE_y = PE_{SP1,y} + PE_{SP2,y} \quad \text{(Equation 1)}$$

where:

PE_y Project GHG emissions in period y, tCO_2e;
$PE_{SP1,y}$ Project GHG emissions of Sub-project 1 in period y, tCO_2e;
$PE_{SP2,y}$ Project GHG emissions of Sub-project 2 in period y, tCO_2e.

Results of the GHG emissions calculations are presented in metric tonnes of carbon dioxide equivalent (tCO_2e), 1 metric tonne of carbon dioxide equivalent is equal to 1 metric tonne of carbon dioxide (tCO_2), i.e. 1 tCO_2e = 1 tCO_2.

These, in turn, are calculated as:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Project GHG emissions of Sub-project 1 in period:

$$PE_{SP1,y} = PE_{SP1,EL,y} + PE_{SP1,NG,y} \quad \text{(Equation 2)}$$

where:

$PE_{SP1,EL,y}$ Project GHG emissions in period y from electricity consumption for hydrogen production, tCO_2e;
$PE_{SP1,NG,y}$ Project GHG emissions in period y from natural gas consumption (as fuel and material) for hydrogen production, tCO_2e.

Project GHG emissions in period from electricity consumption for hydrogen production:

$$PE_{SP1,EL,y} = EC_{SP1,PJ,y} \times EF_{CO2,EL,y} \quad \text{(Equation 3)}$$

where:

$EC_{SP1,PJ,y}$ Electricity consumption for hydrogen production due to project activity in period y, MWh;
$EF_{CO2,EL,y}$ CO_2 emission factor for electricity consumption in period y, tCO_2/MWh.

Project GHG emissions in period from fuel and material consumption for hydrogen production:

$$PE_{SP1,NG,y} = (FC_{SP1,PJ,y} + MC_{SP1,PJ,y}) \times NCV_{NG} \times EF_{CO2,NG} \qquad \text{(Equation 4)}$$

where:

$FC_{SP1,PJ,y}$ Natural gas consumption (as fuel) for hydrogen production due to project activity in period y, 1000 m^3;

$MC_{SP1,PJ,y}$ Natural gas consumption (as material) for hydrogen production due to project activity in period y, 1000 m^3;

NCV_{NG} Net calorific value of natural gas, GJ/1000 m^3;

$EF_{CO2,NG}$ CO_2 emission factor for combustion of natural gas, tCO_2/GJ.

Carbon dioxide emission factor for combustion of natural gas:

$$EF_{CO2,NG} = k_{C,NG} \times OXID_{NG} \times \frac{44}{12} \qquad \text{(Equation 5)}$$

$k_{C,NG}$ Carbon content of natural gas, tC/GJ;

$OXID_{NG}$ Oxidation factor for natural gas combustion, ratio;

$\frac{44}{12}$ Ratio of the molecular mass of a carbon dioxide to the molecular mass of a carbon.

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Project GHG emissions of Sub-project 2 in period:

$$PE_{SP2,y} = EC_{SP2,PJ,y} \times EF_{CO2,EL,y} \qquad \text{(Equation 6)}$$

where:

$EC_{SP2,PJ,y}$ Electricity consumption for nitrogen production due to project activity in period y, MWh;

$EF_{CO2,EL,y}$ CO_2 emission factor for electricity consumption in period y, tCO_2/MWh.

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	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
6	$P_{H2,SP1,PJ,y}$ Hydrogen produced in period y	Company records, hydrogen meters	t	m/c	continuously with monthly totals	100%	Electronic and paper	The value is measured by hydrogen meters and totalled in technical reports of project owner

The table above includes data and parameters that are monitored throughout the crediting period.

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

GHG emissions in the baseline scenario are calculated as follows:

$$BE_y = BE_{SP1,y} + BE_{SP2,y} \quad \text{(Equation 7)}$$

where:

BE_y Baseline GHG emissions in period *y*, tCO_2e;

$BE_{SP1,y}$ Baseline GHG emissions of Sub-project 1 in period *y*, tCO_2e;

$BE_{SP2,y}$ Baseline GHG emissions of Sub-project 2 in period *y*, tCO_2e.

These, in turn, are calculated as:

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Baseline GHG emissions of Sub-project 1 in period:

$$BE_{SP1,y} = BE_{SP1,EL,y} + BE_{SP1,NG,y}$$ (Equation 8)

where:

$BE_{SP1,EL,y}$ Baseline GHG emissions in period *y* from electricity consumption for hydrogen production, tCO_2e;

$BE_{SP1,NG,y}$ Baseline GHG emissions in period *y* from natural gas consumption (as fuel and material) for hydrogen production, tCO_2e.

Baseline GHG emissions in period from electricity consumption for hydrogen production:

$$BE_{SP1,EL,y} = P_{H2,SP1,PJ,y} \times SEC_{SP1,H2,BL} \times EF_{CO2,EL,y}$$ (Equation 9)

where:

$P_{H2,SP1,PJ,y}$ Hydrogen produced in period *y*, t;

$SEC_{SP1,H2,BL}$ Specific electricity consumption per tonne of hydrogen in baseline scenario, MWh/t;

$EF_{CO2,EL,y}$ CO_2 emission factor for electricity consumption in period *y*, tCO_2/MWh.

Baseline GHG emissions in period from fuel and material consumption for hydrogen production:

$$BE_{SP1,NG,y} = P_{H2,SP1,PJ,y} \times (SFC_{SP1,H2,BL} + SMC_{SP1,H2,BL}) \times NCV_{NG} \times EF_{CO2,NG}$$ (Equation 10)

where:

$P_{H2,SP1,PJ,y}$ Hydrogen produced in period *y*, t;

$SFC_{SP1,H2,BL}$ Specific natural gas consumption (as fuel) per tonne of hydrogen in baseline scenario, 1000 m^3/t;

$SMC_{SP1,H2,BL}$ Specific natural gas consumption (as material) per tonne of hydrogen in baseline scenario, 1000 m^3/t;

NCV_{NG} Net calorific value of natural gas, GJ/1000 m^3;

$EF_{CO2,NG}$ CO_2 emission factor for combustion of natural gas, tCO_2/GJ.

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Baseline GHG emissions of Sub-project 2 in period:

$$BE_{SP2,y} = EC_{SP2,BL} \times EF_{CO2,EL,y}$$ (Equation 11)

where:

$EC_{SP2,BL}$ Electricity consumption for nitrogen production in baseline scenario, MWh;

$EF_{CO2,EL,y}$ CO_2 emission factor for electricity consumption in period y, tCO_2/MWh.

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

This section is left blank on purpose

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 unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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):

This section is left blank on purpose

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

No leakage GHG emissions are considered.

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 applicable.

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

Not applicable.

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):

The emission reductions in period are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{(Equation 12)}$$

where:

ER_y GHG emissions reductions of the JI project in period y, tCO_2e;

BE_y Baseline GHG emissions in period y, tCO_2e;

PE_y Project GHG emissions in period y, tCO_2e.

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:

Collection and archiving of the information on the environmental impacts of the project will be done based on the approved EIA in accordance with the Host Party legislation - *State Construction Standard DBN A.2.2.-1-2003: "Structure and Contents of the Environmental Impact Assessment Report (EIR) for Designing and Construction of Production Facilities, Buildings and Structures"* State Committee Of Ukraine On Construction And Architecture, 2004 (see Section F.1).

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.1.1.1. – ID 1	Low	These data is used in technical and commercial accounting of the company. The electricity meters are calibrated according to the procedures of the Host Party.
D.1.1.1. – ID 2	Low	These data is used in technical and commercial accounting of the company. The natural gas meters are calibrated according to the procedures of the Host Party.
D.1.1.1. – ID 3	Low	These data is used in technical and commercial accounting of the company. The natural gas meters are calibrated according to the procedures of the Host Party.
D.1.1.1. – ID 4	Low	These data is used in technical and commercial accounting of the company. The electricity meters are calibrated according to the procedures of the Host Party.
D.1.1.1. – ID 5	Low	These data is used ex-post as provided by the DFP of Ukraine on the annual basis. Check on the updates of the emission factor.
D.1.1.3.– ID 6	Low	These data is used in technical and commercial accounting of the company. The hydrogen meters are calibrated according to the procedures of the Host Party.

Calibration of equipment will be done in accordance with the Host Party legislation - State Standard of Ukraine DSTU 2708:2006 “Metrology. Calibration of measuring instruments. The organization and procedure”

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

The project owner – PRJSC "LINIK" will implement provisions of this monitoring plan into its organizational and quality management structure. For monitoring, collection, registration, visualization, archiving, reporting of the monitored data and periodical checking of the measurement devices the management team headed by the Director of the company is responsible. The monitoring plan will be carried out by use of clear structure of responsibilities. Operational personnel will take data from the meters and transfer it to the corresponding departments from where the data will be gathered and structured for calculations of greenhouse gas emissions.

The departments involved in collecting and transferring the data for monitoring purposes are:

Optimization department
The department will be responsible for supplying all the gathered data to Global Carbon B.V. The department collects stores and processes all the monitoring data. It will hold the overall responsibility for implementation of the monitoring plan for the proposed JI project, like organizing and storing the data and calculation the GHG emissions reductions.

Energy department
The energy department is responsible for control of energy resources flow at the plant. It will monitor fuel, electricity and other energy resources consumption at company. The department will be responsible for collection of the data from the electricity and flow meters and crosschecking of it. For the purposes of monitoring, the energy department will report fuel, electricity and other energy resources consumption.

Environmental department
Environmental department is responsible for management of environmental aspects of company's operation and reporting with state environmental bodies. The department obtains allowances for the plant operation and monitors level of environmental impact caused by the company. The department will be responsible for supplying environmental documents for monitoring.

Instrumental department
Instrumental department will be responsible for data on all meters engaged in monitoring process. The department will carry out internal calibration procedures and support calibration of meters by the authorized representatives of the State Metrological System of Ukraine.

Labour protection department
Labour protection department will be responsible for periodic trainings and inspections of the personnel. It will monitor compliance of the work to all safety and policy standards.

Other departments of the plant will submit relevant data to the optimization department for the monitoring purposes.

The overall structure that the project operator will apply in implementing the monitoring plan is provided in a figure below:

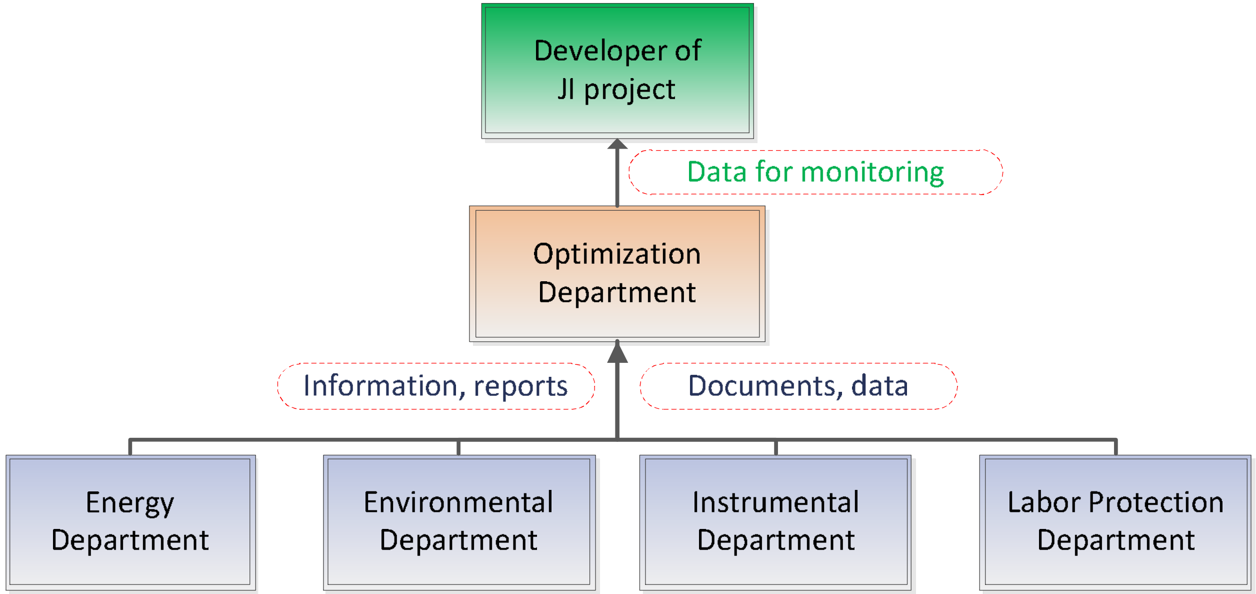

Figure 7 Monitoring flowchart

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

Name of person/entity setting the monitoring plan: Natallia Belskaya JI Consultant Global Carbon B.V.
Phone: +38 050 410 26 79
Fax: +38 044 272 08 87
E-mail: belskaya@global-carbon.com

Global Carbon B.V. is the project participant and contact details are available in Annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Table 16 Estimated project GHG emissions for the part of crediting period within the first commitment period of the Kyoto Protocol

		2008	2009	2010	2011	2012	Total
Project GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	174 030	147 617	131 760	160 070	146 482	**759 959**
Project GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	859	11 276	15 719	9 696	12 230	**49 780**
Total Project GHG emissions during the part of the crediting period	tonnes of CO_2 equivalent	174 889	158 893	147 479	169 766	158 712	**809 739**

Table 17 Estimated project GHG emissions for the part of the crediting period after the end of first commitment period of the Kyoto Protocol and for crediting period

		2013-2028	Total
Project GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	2 343 712	**2 343 712**
Project GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	195 680	**195 680**
Total Project GHG emissions during the part of the crediting period	tonnes of CO_2 equivalent	2 539 392	**2 539 392**
Total Project GHG emissions for the crediting period	tonnes of CO_2 equivalent	**3 349 131**	

E.2. Estimated leakage:

No leakage GHG emissions are considered.

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

Table 18 Estimated summary GHG emissions for the part of crediting period within the first commitment period of the Kyoto Protocol

		2008	2009	2010	2011	2012	Total
Summary GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	174 030	147 617	131 760	160 070	146 482	**759 959**
Summary GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	859	11 276	15 719	9 696	12 230	**49 780**
Total summary GHG emissions during the part of the crediting period	tonnes of CO_2 equivalent	174 889	158 893	147 479	169 766	158 712	**809 739**

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Table 19 Estimated summary GHG emissions for the part of the crediting period after the end of first commitment period of the Kyoto Protocol and for crediting period

		2013-2028	Total
Summary GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	2 343 712	**2 343 712**
Summary GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	195 680	**195 680**
Total summary GHG emissions during the part of the crediting period	tonnes of CO_2 equivalent	2 539 392	**2 539 392**
Total summary GHG emissions for the crediting period	tonnes of CO_2 equivalent	**3 349 131**	

E.4. Estimated baseline emissions:

Table 20 Estimated baseline GHG emissions for the part of crediting period within the first commitment period of the Kyoto Protocol

		2008	2009	2010	2011	2012	Total
Baseline GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	179 917	194 526	203 909	217 938	205 458	**1 001 748**
Baseline GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	2 012	24 149	24 149	24 149	24 149	**98 608**
Total Baseline GHG emissions during the part of the crediting period	tonnes of CO_2 equivalent	181 929	218 675	228 058	242 087	229 607	**1 100 356**

Table 21 Estimated baseline GHG emissions for the part of the crediting period after the end of first commitment period of the Kyoto Protocol and for crediting period

		2013-2028	Total
Baseline GHG emissions of Sub-project 1	tonnes of CO_2 equivalent	3 287 328	**3 287 328**
Baseline GHG emissions of Sub-project 2	tonnes of CO_2 equivalent	386 384	**386 384**
Total Baseline GHG during the part of the crediting period	tonnes of CO_2 equivalent	3 673 712	**3 673 712**
Total Baseline GHG emissions for the crediting period	tonnes of CO_2 equivalent	**4 774 068**	

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

Table 22 Estimated GHG emissions reductions for the part of crediting period within the first commitment period of the Kyoto Protocol

		2008	2009	2010	2011	2012	Total
GHG emissions reductions of Sub-project 1	tonnes of CO_2 equivalent	5 887	46 909	72 149	57 868	58 976	**241 789**
GHG emissions reductions of Sub-project 2	tonnes of CO_2 equivalent	1 153	12 873	8 430	14 453	11 919	**48 828**
Total GHG emissions reductions during the part of the crediting period	tonnes of CO_2 equivalent	7 040	59 782	80 579	72 321	70 895	**290 617**

Table 23 Estimated GHG emissions reductions for the part of the crediting period after the end of first commitment period of the Kyoto Protocol and for crediting period

		2013-2028	Total
GHG emissions reductions of Sub-project 1	tonnes of CO_2 equivalent	943 616	**943 616**
GHG emissions reductions of Sub-project 2	tonnes of CO_2 equivalent	190 704	**190 704**
Total GHG emissions reductions during the part of the crediting period	tonnes of CO_2 equivalent	1 134 320	**1 134 320**
Total GHG emissions reductions for the crediting period	tonnes of CO_2 equivalent	**1 424 937**	

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

Table 24 Estimated balance of GHG emissions under the proposed project over the part of crediting period within the first commitment period of the Kyoto Protocol

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emissions reductions (tonnes of CO_2 equivalent)
2008	174 889	0	181 929	7 040
2009	158 893	0	218 675	59 782
2010	147 479	0	228 058	80 579
2011	169 766	0	242 087	72 321
2012	158 712	0	229 607	70 895
Total (tonnes CO_2 equivalent)	**809 739**	**0**	**1 100 356**	**290 617**

Table 25 Estimated balance of GHG emissions under the proposed project for the part of the crediting period after the end of the first commitment period of the Kyoto Protocol

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emissions reductions (tonnes of CO_2 equivalent)
2013	158 712	0	229 607	70 895
2014	158 712	0	229 607	70 895
2015	158 712	0	229 607	70 895
2016	158 712	0	229 607	70 895
2017	158 712	0	229 607	70 895
2018	158 712	0	229 607	70 895
2019	158 712	0	229 607	70 895
2020	158 712	0	229 607	70 895
2021	158 712	0	229 607	70 895
2022	158 712	0	229 607	70 895
2023	158 712	0	229 607	70 895
2024	158 712	0	229 607	70 895
2025	158 712	0	229 607	70 895
2026	158 712	0	229 607	70 895
2027	158 712	0	229 607	70 895
2028	158 712	0	229 607	70 895
Total (tonnes CO_2 equivalent)	**2 539 392**	**0**	**3 673 712**	**1 134 320**

Table 26 Estimated balance of GHG emissions under the proposed project for the crediting period

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emissions reductions (tonnes of CO_2 equivalent)
Total for the crediting period (tonnes CO_2 equivalent)	**3 349 131**	**0**	**4 774 068**	**1 424 937**

SECTION F. Environmental impacts

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 Host Party for this project is Ukraine. Environmental Impact Assessment (EIA) is the part of the Ukrainian project planning and permitting procedures. Implementation regulations for EIA are included in the Ukrainian State Construction Standard DBN A.2.2.-1-2003[26] (Title: "Structure and Contents of the Environmental Impact Assessment Report (EIR) for Designing and Construction of Production Facilities, Buildings and Structures").

Annex E of this standard contains a list of types of projects or activities which constitute higher environmental risk for which full EIA is mandatory, and the Ministry of Ecology and Natural Resources of Ukraine being the competent authority.

The full scope EIA in accordance with the Ukrainian legislation has been conducted for the Sub-project 1 in 2007 by the local developer Ltd. “Ukrinterenergoinzhiniring” and for the Sub-project 2 in 2006 by the local developer JSC “Severodonetskiy ORGHIM”.

Key findings of EIA for the Sub-project 1 are summarized below:

- Impact on air is the main environmental impact of the project activity. Hydrogen sulfide and hydrocarbons C_1-C_{10} emissions due to the leakage of joint will be limited. The impact will not exceed maximum allowable concentration at the edge of the protection (sanitary) zone;
- There is no impact on water. The project activity doesn’t use water;
- There is no impact on flora and fauna. No rare or endangered species will be impacted. Project activity is not located in the vicinity of national parks or protected areas;
- Noise impact is limited. Main source of noise will be located at the minimum required distance from residential areas and will be in compliance with local standards;
- There is no impact on land. The project equipment situated at industrial site of enterprise.
- Transboundary impacts are not observed. There are no impacts that manifest within the area of any other country and that are caused by a proposed project activity which wholly physically originates within the area of Ukraine.

Key findings of EIA for the Sub-project 2 are summarized below:

- There is no impact on air;
- There is no impact on water. The project activity doesn’t use water;
- There is no impact on flora and fauna. No rare or endangered species will be impacted. Project activity is not located in the vicinity of national parks or protected areas;
- Noise impact is limited. Main source of noise will be located at the minimum required distance from residential areas and will be in compliance with local standards;
- There is no impact on land. The project equipment situated at site of existing Nitrogen-Oxygen Plant.
- Transboundary impacts are not observed. There are no impacts that manifest within the area of any other country and that are caused by a proposed project activity which wholly physically originates within the area of Ukraine.

[26] *State Construction Standard DBN A.2.2.-1-2003 :"Structure and Contents of the Environmental Impact Assessment Report (EIR) for Designing and Construction of Production Facilities, Buildings and Structures"* State Committee Of Ukraine On Construction And Architecture, 2004

The list of available EIA documentation includes:

1. Project of the building of Pressure Swing Adsorption Unit. *Explanatory Note. Environmental Impact Assessment. 1819.008-RP-OVOS,* "Ukrinterenergoinzhiniring", Severodonetsk, 2007.
2. Reconstruction of AK-1.5 units at Nitrogen-Oxygen Plant. *Volume 4. Book 1. Section 6/ Environmental Impact Assessment. 846KB7.06.57-1.00-OVOS* JSC "Severodonetskiy ORGHIM", Severodonetsk, 2006.

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:

The full scope EIA in accordance with the Ukrainian legislation has been conducted for the Sub-project 1 in 2007 by the local developer Ltd. "Ukrinterenergoinzhiniring" and for the Sub-project 2 in 2006 by the local developer JSC "Severodonetskiy ORGHIM". The findings of the reports are summarized in the section F.1. above. The report has been reviewed by the competent authorities of Ukraine. The environmental impact of the project has not been considered significant or prohibitive. Completion of Environmental Impact Assessment reports and positive findings of the competent state authority conclude the procedure of the environmental impact assessment according to the Ukrainian laws and regulations.

SECTION G. Stakeholders' comments

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

No stakeholder consultation process for the JI projects is required by the Host Party. Stakeholder comments will be collected during the time of this PDD publication in the internet during the determination procedure.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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E-mail:	MVGrekov@tnk-bp.com
URL:	http://www.tnk-bp.com.ua/company/
EDRPOU Code (Code in the State Unified Register of Companies and Enterprises of Ukraine):	32292929
KVED types of economic activities:	23.20.0 Production of refined oil products
Represented by:	
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Salutation:	Mr.
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Represented by:	
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Personal e-mail:	deklerk@global-carbon.com

Annex 2

BASELINE INFORMATION

Sub-project 1. Construction of Pressure Swing Adsorption Unit for hydrogen production

Specific electricity consumption per tonne of hydrogen in baseline scenario:

$$SEC_{SP1,H2,BL} = \frac{\sum_1^y \frac{EC_{SP1,BL,y}}{P_{H2,SP1,BL,y}}}{3}$$ (Equation A2-1)

where:

$EC_{SP1,BL,y}$ Electricity consumption for hydrogen production in period y before project implementation, MWh;

$P_{H2,SP1,BL,y}$ Hydrogen produced in period y before project implementation, t.

Specific natural gas consumption (as fuel) per tonne of hydrogen in baseline scenario:

$$SFC_{SP1,H2,BL} = \frac{\sum_1^y \frac{FC_{SP1,BL,y}}{P_{H2,SP1,BL,y}}}{3}$$ (Equation A2-2)

where:

$FC_{SP1,BL,y}$ Natural gas consumption (as fuel) for hydrogen production in period y before project implementation, 1000 m^3;

$P_{H2,SP1,BL,y}$ Hydrogen produced in period y before project implementation, t.

Specific natural gas consumption (as material) per tonne of hydrogen in baseline scenario:

$$SMC_{SP1,H2,BL} = \frac{\sum_1^y \frac{MC_{SP1,BL,y}}{P_{H2,SP1,BL,y}}}{3}$$ (Equation A2-3)

where:

$MC_{SP1,BL,y}$ Natural gas consumption (as material) for hydrogen production in period y before project implementation, 1000 m^3;

$P_{H2,SP1,BL,y}$ Hydrogen produced in period y before project implementation, t.

Table A2-1 Data for calculation ex-ante parameters for Sub-project 1

Data for calculation ex-ante parameters	Unit	2006	2007	01.01.2008-14.11.2008
Hydrogen produced in period y before project implementation	t	14 938	20 712	17 148
Electricity consumption for hydrogen production in period y before project implementation	MWh	28340.300	33380.780	29644.281
Specific electricity consumption per tonne of hydrogen in period y before project implementation	MWh/t	1.897	1.612	1.729
Specific electricity consumption per tonne of hydrogen in baseline scenario	MWh/t			**1.746**
Natural gas consumption (as fuel) for hydrogen production in period y before project implementation	1000 m^3	23863.30	28949.30	25219.20
Specific natural gas consumption (as fuel) per tonne of hydrogen in period y before project implementation	1000 m^3/t	1.597	1.398	1.471
Specific natural gas consumption (as fuel) per tonne of hydrogen in baseline scenario	1000 m^3/t			**1.489**
Natural gas consumption (as material) for hydrogen production in period y before project implementation	1000 m^3	40888.424	57268.258	47370.266
Specific natural gas consumption (as material) per tonne of hydrogen in period y before project implementation	1000 m^3/t	2.737	2.765	2.762
Specific natural gas consumption (as material) per tonne of hydrogen in baseline scenario	1000 m^3/t			**2.755**

Sub-project 2. Reconstruction of АК-1.5 units at Nitrogen-Oxygen Plant

Electricity consumption for nitrogen production in baseline scenario:

$$EC_{SP2,BL} = \frac{\sum_1^y EC_{SP2,BL,y}}{3}$$ (Equation A2-4)

where:

$EC_{SP2,BL,y}$ Electricity consumption for nitrogen production in period y before project implementation, MWh;

$EC_{SP2,BL}$ Electricity consumption for nitrogen production in baseline scenario, MWh.

Table A2-2 Data for calculation ex-ante parameters for Sub-project 2

Data for calculation ex-ante parameters	Unit	2006	2007	01.01.2008-30.11.2008
Electricity consumption for nitrogen production in period y before project implementation	MWh	23352.825	22216.84	20896.52
Electricity consumption for nitrogen production in baseline scenario	MWh			**22 155**

Annex 3

MONITORING PLAN

For the monitoring plan please refer to section D of this PDD.

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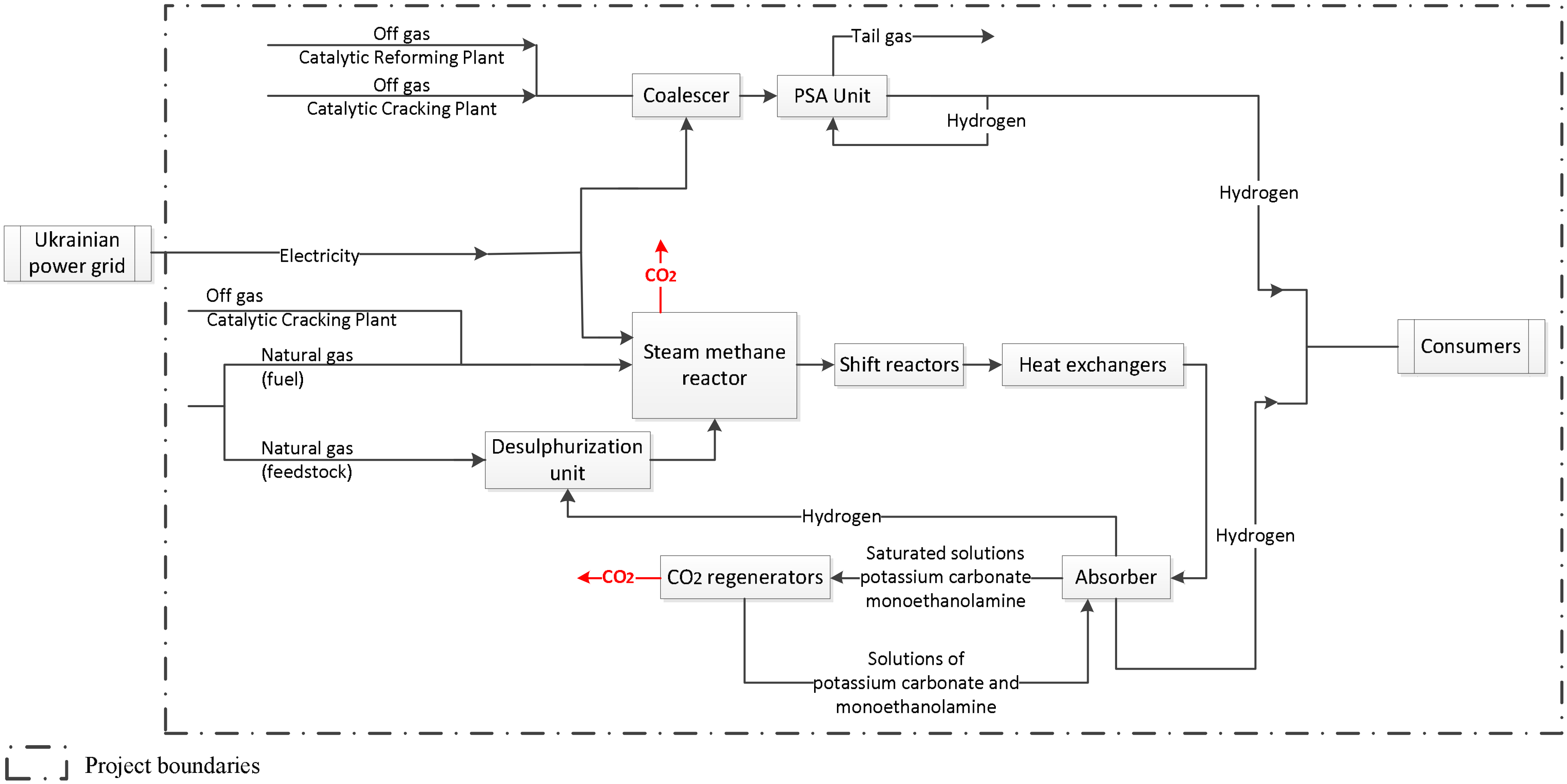
Annex 4

PROCESS DIAGRAMM



Annex 5

ADDITIONALITY INFORMATION

Discount rate for NPV calculations

An access to the international and domestic financial market for a project similar to the proposed JI activity in Ukraine is very limited. Currently, investment climate is weak in Ukraine, especially in comparison with the neighbouring countries. An example of Fitch sovereign credit ratings for Ukraine compared to some other countries of Eastern Europe:

- Ukraine	B
- Poland	A-
- Hungary	BBB
- Slovak Republic	A+
- Russia	BBB

The benchmark discount rate is based on the cost of equity for comparable projects in the developed economies and can be calculated as follows based on the general approach of the Capital Asset Pricing Model (CAPM). According to this model the discount rate for investment decision can be presented as the return that investors require from it. This expected return is estimated as[27]:

$$ExpectedReturn = RiskFreeRate + \sum_{j=1}^{k} \beta_j (RiskPremium_j)$$

Where:

β_j – is the Beta of investment specifically relative to factor j.

From the point of view of the investor the expected return will consist of the risk-free rate increased by the suitable risk premiums. The risk-free rate taken for this assessment is the minimum cost of equity for comparable projects in the developed economies. The suitable risk premiums in our case will include:

- Country risk premium. This portion of the risk reflects unique risks of investment being made in Ukraine. The additional return (premium) is required to cover political uncertainty, ownership risks, profit repatriation risk etc.

- The equity risk premium. Which is derived from the long-term historical returns on equity in the US market relative to the return of bonds.

- Technological or Expected return risk premium. This risk is associated with failure to reach projected income due to primarily technical, technological and organizational decisions of the project, as well as random fluctuations in production volumes and prices of products and resources. Correction for this kind of risk is determined by taking into account the technical feasibility and merits of the project, detailed design decisions, the availability of the necessary research and state of the proposed technology. This project does carry some unpredictability in production volumes and utilizes new technology in Ukraine.

Taking this into account, we suggest that this project in Ukraine has a considerably high amount of technological risk associated with it and appropriate risk adjustment factor should be used.

[27] Investment Valuation: Tools and Techniques for Determining the Value of Any Asset, Second Edition, A. Damodaran, 992 pages Publisher: Wiley; 2nd edition (January 18, 2002), page 218.

Rate description	Level p.a.	Source:
Risk-free rate (long term returns on US Government bonds)	3.00%	Appendix Default values for the expected return on equity Para 2 URL: http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf (last reference – 20/05/2012)
Equity risk premium (long-term historical returns on equity in the US market relative to the return of bonds)	6.50%	Appendix Default values for the expected return on equity Para 3 URL: http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf (last reference – 20/05/2012)
Country risk premium for Ukraine	6.75%	URL: http://www.stern.nyu.edu/~adamodar/pc/archives/ctryprem03.xls (last reference – 20/05/2012)
Expected return risk (introduction of the new technology for Ukraine)	5.00%	Table11.1 URL: http://www.rosteplo.ru/Npb_files/npb_shablon.php?id=329 (last reference – 20/05/2012)
Cost of equity can be derived as follows:	21.25%	Sum of the above
Foreign currency lending rate for Ukraine	12%	As of 01/05/2005 URL: http://www.bank.gov.ua/doccatalog/document?id=51802 (last reference – 20/05/2012)
Nominal Weighted Average Cost of Equity at 50/50 debt-equity ratio	(21.25%+12%)/2=16.63%	
Also:		
Inflation in Euro Area (Average 1997 - 2004)	1.83%	URL: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&language=en&pcode=tsieb060&tableSelection=1&footnotes=yes&labeling=labels&plugin=1 (last reference – 20/05/2012)
Real discount rate for Ukraine can be derived as follows:	(1+16.63%)/(1+1.83%)-1=15%	

The figure of 15% serves as the discount rate for NPV calculation of the project.