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

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SECTION A. General description of the project

A.1. Title of the project:

Introduction of energy efficiency measures at OJSC “Enakievo Metallurgical Works”
Sector: (9) Metal production; (3) Energy demand; (1) Energy industries (renewable/non-renewable sources)

Version 2.21
Date: 14/07/2010

A.2. Description of the project:

The project aims at introduction of energy efficiency measures that will improve environmental conditions at the plant and on a local level; greenhouse gas emission reductions will be achieved. The project measures will also reduce energy costs per unit of iron and steel, it will increase the company’s competitive ability on the steel market.

Historical background

Enakievo Metallurgical Works was founded in 1895. In 1996 the company was privatized with the creation of OJSC “EMW”. EMW is currently specializing in the production of continuous casting billets and rolled square billets, sections and structurals of carbon, low-carbon and low alloyed steel grades. The company has a complete metallurgical production cycle: from sinter and hot metal till production of tradable ingot and hot-rolled square billet, roller section and wire rod. OJSC “EMW” consists of the following shops: sinter, blast furnace, basic oxygen furnace, cogging and rolling shop.

Project scenario

Production of hot metal and steel making requires significant energy consumption. The proposed JI project involves a large-scale modernization of Blast Furnace Shop (BF Shop) of the enterprise. The project foresees reconstruction of blast furnaces №3 and №5 with the further introduction of the use of pulverized coal in the blast furnaces, installation of new oxygen unit, installation of a new compressor unit and reconstruction of the power plant that provides compressed air to the blast furnaces and produces steam and electricity (CHPP). The total investments to the reconstruction of OJSC “EMW” will be over US $ 690 million. The project implementation will result in significant reductions of coke and electricity consumption, therefore reducing greenhouse gases emission reductions to the atmosphere.

Baseline scenario

The baseline scenario assumes the continued use of the existing equipment with routine maintenance without significant investment. Justification of the baseline scenario is given in section B.

Project benefits

In addition to greenhouse gas emission reductions, the implementation of project energy saving measures at Enakievo Metallurgical Works has the following advantages:

- Creation of new jobs associated with the use of new equipment, construction and reconstruction of the production units;
- Reduction of hazardous emissions due to reduction of specific coke consumption;
- Reduction of production costs.

JI project implementation will result in greenhouse gas emission reductions by reducing coke and natural gas consumption; the project will lead to greenhouse gas emission reductions from electricity production in the national grid. Thus, the project will reduce greenhouse gas emissions and prevent their further accumulation in the atmosphere, therefore contributing to abating climate change.

A.3. Project participants:

Party Involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ukraine (host)	OJSC "Enakievo Metallurgical Works "	No
Netherlands	ING Bank NV	No
Germany	GreenStream Network GmbH	No

OJSC "Enakievo Metallurgical Works"

Enakievo Metallurgical Works was founded in 1895. In 1996 the enterprise was privatized with creation of OJSC "EMW". Nowadays the OJSC "EMW" is the main employer in the town of Yenakiyeve. The company employs over 8000 people. OJSC "EMW" belongs to Metinvest Group.

ING Bank NV (the Netherlands)

A team of Emissions Products, which is a part of ING Wholesale Banking, is concentrating its efforts on projects aiming at greenhouse gases emission reduction under the Kyoto Protocol. The team, which is based in Amsterdam and Shanghai, helps to identify joint implementation (JI) and Clean Development Mechanism (CDM) projects to reduce greenhouse gas emissions and create units of emission reductions, which are called "carbon credits". The team is using the international ING network to communicate with clients for identifying and development of the projects. The team also provides brokerage services for selling of generated carbon credits to governments or companies participating in the European Union Emissions Trading Scheme.

GreenStream Network

GreenStream Network (GSN) is a group of companies with approximately 60 employees; offices are located in Germany, Finland, Latvia, Norway, Sweden, Estonia and China. Main offices are located in Finland (Helsinki) and Germany (Hamburg). GSN is offering advisory services, brokerage, financial and other services related to renewable energy, emissions trading, such as the EU ETS, and greenhouse gas offset projects, such as JI and CDM. GSN is a member of the IETA (International Emissions Trading Association), the RECS (Renewable Energy Certificate System) and a registered participant in the Paris-based exchange Powernext Carbon Exchange for EU allowances. GSN key personnel has a long experience in energy markets, emissions trading, green certificates, CDM/JI project development and advisory activities. GSN has participated, among others, in one of the first transatlantic CO2 trades, in the first EU emission allowance trade between Nordic companies, in the first JI and CDM projects developed by Nordic governments, in the establishment of some of the first energy companies in the Baltic States' liberalized energy markets and in numerous advisory assignments for energy and industrial enterprises as well as public organizations. GSN has closely followed the key JI and CDM countries' climate policies and the developments of the carbon markets, e.g. through the IETA (activities in several working groups) and BALTREL cooperation (e.g. chairmanship of the Task Force on JI), the World Bank (cooperation on marketing the CDM-fund Community Development Carbon Fund to companies in Northern Europe) and NEFCO (cooperation on preparing documentation for and launching the JI-fund Testing Ground Facility to companies).

A.4. Technical description of the project:

A.4.1. Location of the project:

"Enakievo Metallurgical Works", where the proposed JI project is scheduled, is located in the town of Yenakiyeve, Donetsk oblast (see Fig. 1 and 2). The city is located in the eastern part of Donetsk oblast at the confluence of the Sadky and Bulavyn rivers to Krynka river.

A.4.1.1. Host Party(ies):

Ukraine

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

Donetsk oblast

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

Yenakiyeve

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

The plant is located in the eastern part of the town of Yenakiyeve. Geographical coordinates of the plant are: Latitude: 48°13', Longitude 39°13'.

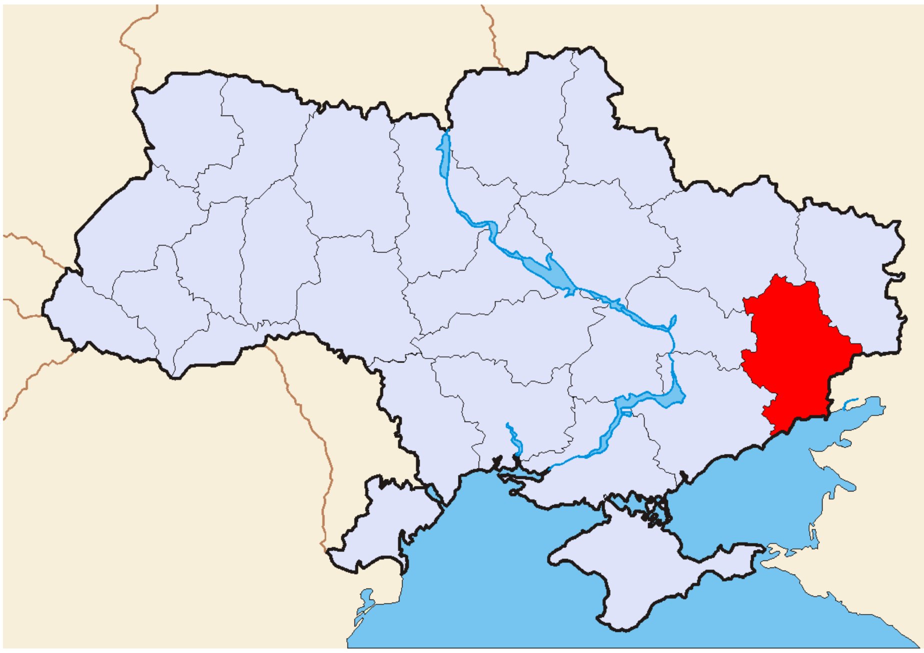

Figure 1: Location of the Donetsk Oblast on the map of Ukraine (Source: http://uk.wikipedia.org)

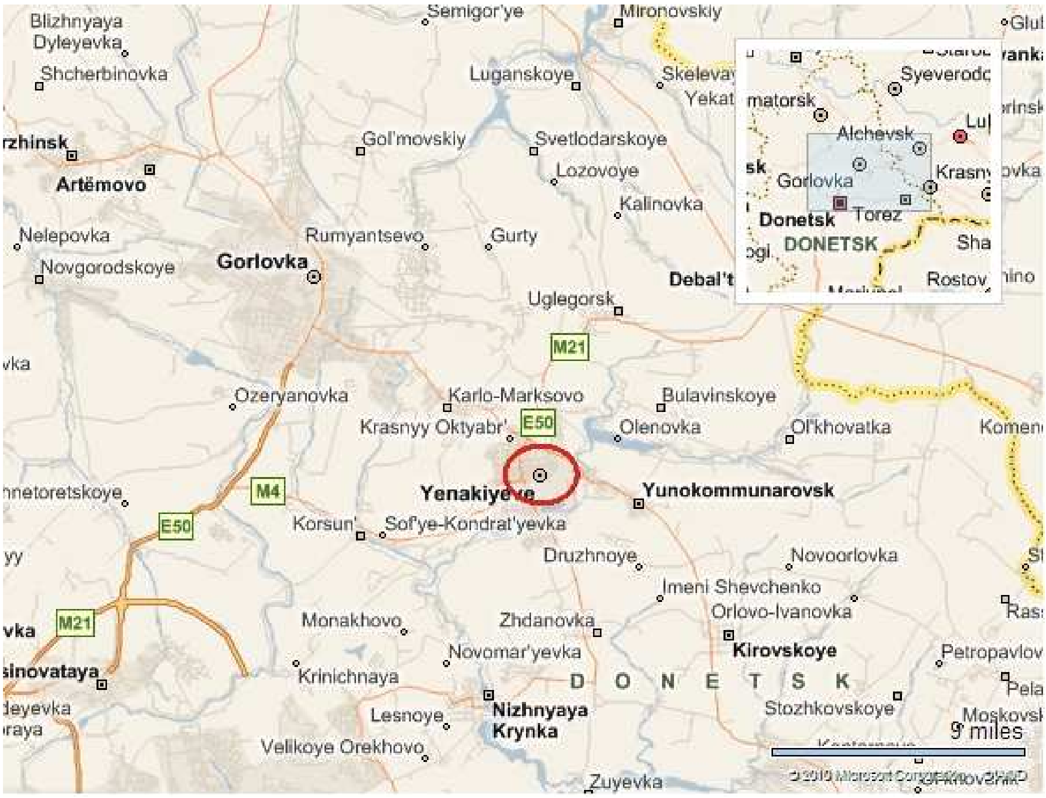

Figure 2. Yenakiyeve and neighboring towns

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

Project goal:

The technical goal of the project is introduction of a number of energy saving measures at Enakievo Metallurgical Works , namely: reconstruction of blast furnaces number 3 and number 5, reconstruction of CHPP, installation of a new oxygen unit Linde, construction of a new compressor K-1700. These measures will reduce consumption of energy resources, such as coke, natural gas and electricity, and will significantly reduce greenhouse gas and hazardous pollutants emissions to the atmosphere at OJSC “EMW”.

OJSC “EMW” consists of the following shops (Fig. 3):

- Sinter Shop;
- BF Shop;
- BOF Shop;
- Cogging and Rolling Shops

Energy Shop supplies hot metal and steel making process with energy resources. The shop consists of the following branches:

- CHPP;
- Oxygen Shop;
- Networks and Substation Shop;
- Water Supply Shop;
- Gas Shop.

The finished products of “EMW” are rolled steel products. A steel processing chain includes the following steps:

- Raw materials preparation;
- Hot metal production;
- Steel making;
- Steel Processing

Iron ore preparation for smelting takes place in Sinter Shop. Then sinter, coke and limestone are charged to a blast furnace, where iron smelting takes place. Slag is separated from hot metal and then liquid hot metal is delivered to BOF Shop. Basic oxygen furnaces are filled with liquid hot metal and waste metal. Oxygen is blasted to basic oxygen furnaces and reacts with carbon and other impurities; it allows to increase significantly the inner temperature, melt the waste metal and remove unwanted chemical elements. Then steel is delivered to continuous casting machines or to the rolling shop.

Measures description

The BF Shop of OJSC "EMW" consists of four blast furnaces and smelts liquid hot metal for BOF Shop as well as pig iron for machine building. General scheme of steel making at the plant is represented in Figure 3. The blast furnace №1 has a volume of 1386 m^3, blast furnaces №3, №4 and №5 have a volume of 1033 m^3 each. Annual capacity of BF Shop of Enakievo Metallurgical Works is 3 100 thousand tons of hot metal per year.

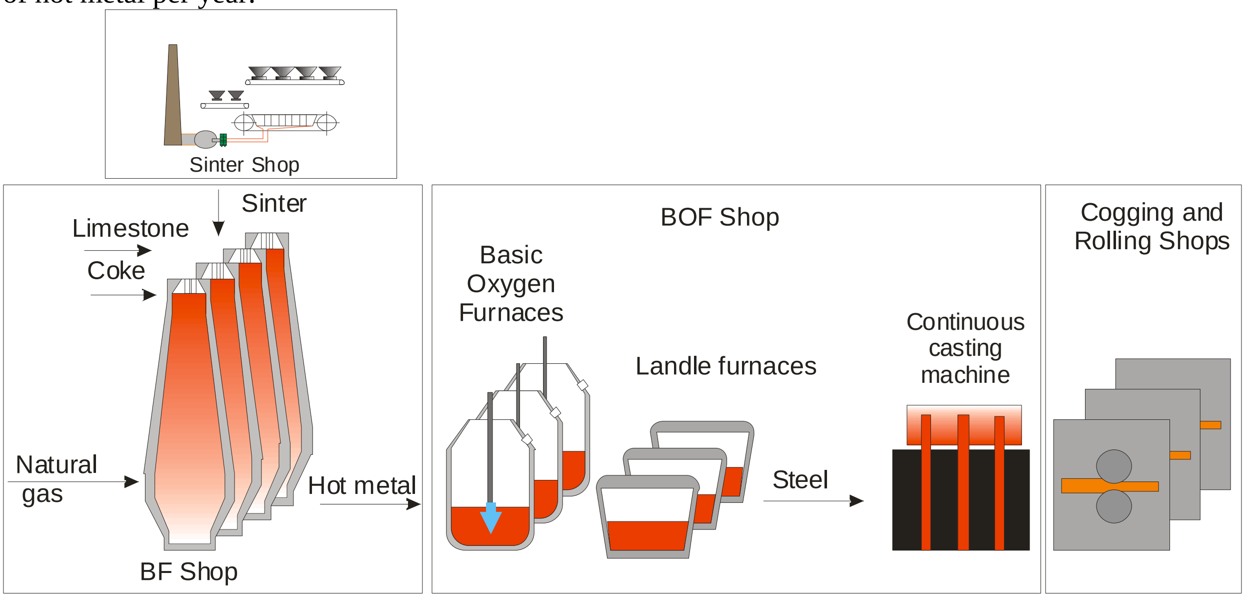

Fig. 3 General scheme of steel making at the plant

Reconstruction of the blast furnace (BF) №5 foresees the increase of its volume to 1513 m^3; thus will allow increasing the amount of hot metal smelting at the reconstructed furnace. In comparison with the existing blast furnaces BF №5 will have the increased height of burning hearth which will allow improving of working parameters of the furnace. The replacement of furnace shell with the increasing of shell width to 40-50 mm will be implemented. Existing columns of the hearth and shafts will be removed; the forth-pillar support system will be constructed instead. Existing stoves will be replaced by new non-shafted stoves. The reconstructed BF №5 became operational in 2007.

Reconstruction of the blast furnace (BF) №3 foresees construction of new blast furnace №3 with volume 1513 m^3 and annual capacity 1050 thousand tons; it has modern foundry, two tapholes for hot metal, four-point support system. Belt-conveyor trestle will be reconstructed with replacement of car-scales to a conveyor burden feeding system; modern nopit-type stoves will be installed, which have central station of air combustion, new gas cleaning facilities for blast furnace gas and flue gas heat recovery. Reconstruction of the furnace control building with installation of modern equipment and automated control of the technical processes will also included. The construction of new blast furnace is planned on the place of the old blast furnace. Commissioning of the reconstructed blast furnace № 3 is expected in late 2010.

Modernization of BF №3 and BF №5 will allow reducing specific fuel consumption – coke and natural gas in the process of hot metal smelting. At the same time, modernization will lead to lime consumption increase, leading further to increase of carbon dioxide emissions. The existing blast furnace №1 will go offline with the possibility of further reconstruction after BF №3 and BF №5 are reconstructed; BF №4 will be mothballed.

The second modernization stage of both blast furnaces foresees the implementation of pulverized coal. The use of pulverized coal will allow to avoid gas consumption at the process of hot metal smelting in the blast furnaces №3 and №5 and will also allow to decrease coke consumption. Total effect from reconstruction of blast furnaces will be significant reduction of specific fuel consumption for hot metal smelting and reduction of CO_2 emissions to the atmosphere respectively.

Reconstruction of the CHPP
CHPP provides the plant with thermal energy in the form of steam and hot water; it produces electricity and compressed air. Blast furnace gas mixed with natural gas is used as a main fuel. The steam is generated in BKZ type steam boilers; steam pipes from the boilers are incorporated with the main steam pipe. Steam goes from the steam pipe for the technological needs to the steam turbines that are driving turbo blower units or power generators. Simplified scheme of CHPP is shown in Figure 4.

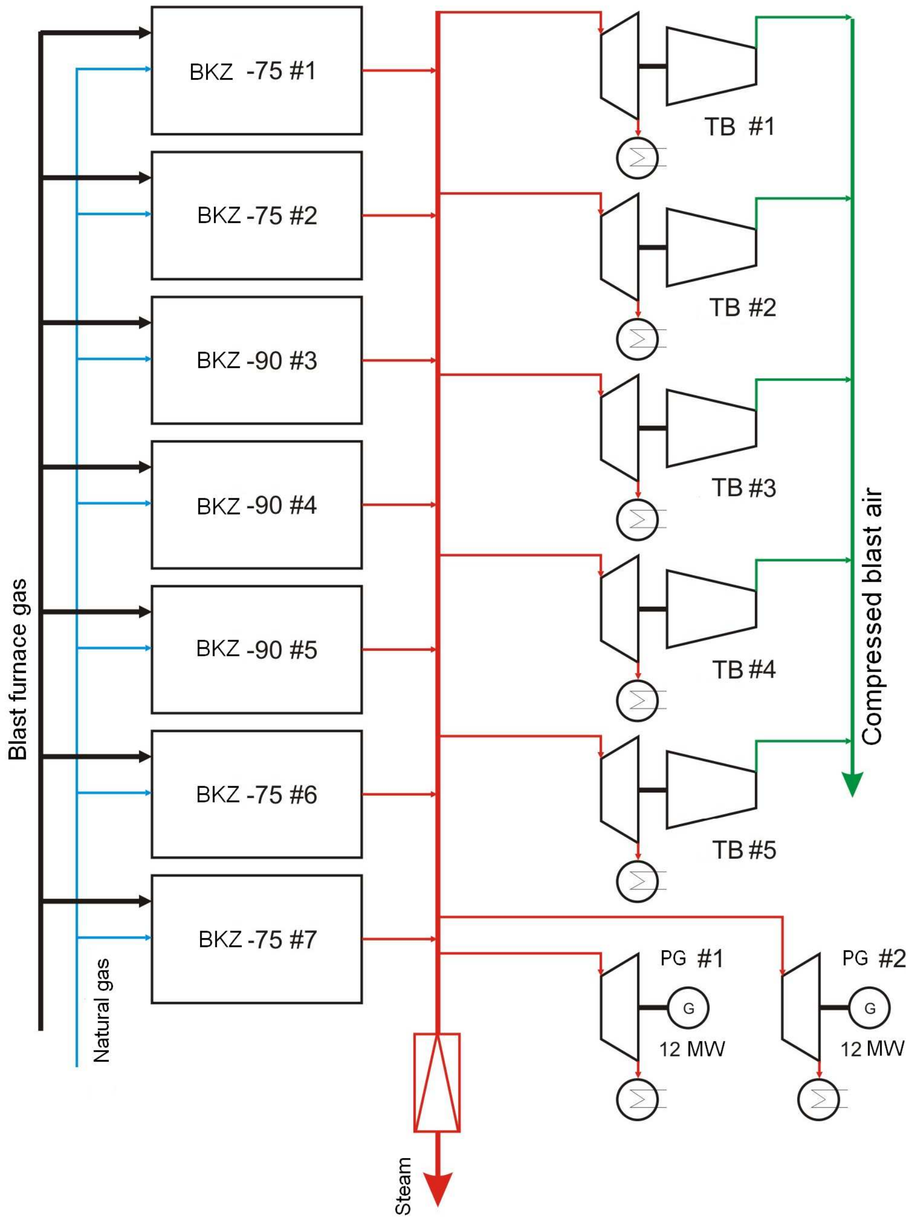

Figure 4. Principle diagram of CHPP

The existing equipment at CHPP is significantly depreciated, its characteristics and performance are much weakened and do not meet the original specifications. Reconstruction of CHPP is designed in order to improve efficiency of equipment and to increase blast furnace gas consumption (at present, part of blast furnace gas is burned on a flare). The reconstruction will include 2 stages. In the proposed project only the first step is considered because the second phase will go beyond the Kyoto Protocol period.

The first phase of the CHPP reconstruction includes the following measures:

- installation of two turbo-blowers (TB) TB-6 and TB-1bys (existing TB-1 is to be decommissioned);
- installation of two fan coolers and circulation pump station;
- upgrading of water supply system of CHPP;
- reconstruction of boilers № 6, 7 with increasing of steam generation to 90 tons per hour;
- deaeration unit rehabilitation.

Planned activities will increase the volume of compressed air production, which will significantly reduce the production of compressed air by electric compressors. Thus, CHPP reconstruction will lead to reduction of electricity consumption for compressed air production.

Installation of oxygen unit Linde
The existing oxygen units BR-2M and KTK-35-3 provide blast furnace and BOF Shops with technological oxygen demands. Installation of new oxygen unit Linde will allow reduction of specific power consumption for oxygen generation by the Oxygen Shop of OJSC "EMW" by 705.5 kWh/ths. m^3 compared with the previous level of power consumption of 841.6 kWh/ths. m^3 of oxygen. The reduction of specific power consumption will further reduce CO_2 emissions reduction from the grid of Ukraine.

Construction of a new compressor unit K-1700
The generation of compressed air demands significant power consumption. The existing K-1500 compressor could satisfy the needs of OJSC "EMW" for compressed air at least by 2012. The construction of new K-1700 compressor will allow to reduce specific power consumption for compressed air generation to 88.6 kWh/ ths. m^3 compared with 107 kWh/ ths. m^3 for existing compressor unit; the new compressor will provide a reserve during repairs or in case of emergency. This measure will reduce electricity consumption and consequently reduce CO_2 emissions associated with electricity production in the national grid.

Schedule of the measures' implementation

Investment phase of the project was started in 2006 and will be finished by mid-2012. Additional income from ERUs sale was taken into account when making decisions regarding finalizing the construction of Linde oxygen unit and reconstruction of blast furnace №5. The management of Enakievo Metallurgical Works held a number of meetings with potential buyers of ERUs in 2005, when the construction phase of Linde oxygen unit and BF №5 started. The total investment cost of the Linde oxygen unit and BF №5 reconstruction is 172 697 thousand USD. As of 01.01.2006 some 58.6% (101 155 thousand USD) of the expected costs were spent, and the substantial capital investment was still needed to finalize the construction of both units. Therefore, the expected income from ERUs played an important role in the final decision of EMW to finalize the construction of Linde oxygen unit and BF №5 rehabilitation, as well as to proceed with other energy efficiency measures implementation.

The expected schedule of measures' implementation is given in the table 1 below.

Table 1. Preliminary schedule of the JI project measures implementation

№	*Title*	*Beginning of design phase*	*Beginning of construction*	*Commissioning*
1	Construction of Linde oxygen unit	March 2003	November 2003	December 2006
2	Reconstruction of blast furnace №5	March 2003	April 2004	December 2007
3	Reconstruction of blast furnace №3	July 2006	June 2007	October 2010
4	K-1700 compressor	January 2010	March 2010	January 2011
5	Reconstruction of CHPP	May 2007	July 2007	October 2010
6	Implementation of pulverized coal as a fuel for blast furnace №3	April 2007	July 2010	July 2012
7	Implementation of pulverized coal as a fuel for blast furnace №5	April 2007	July 2010	July 2012

Using modern industrial control systems, installation equipment from world known manufacturers and last achievements in air heating (Kalugin's non-shafted stoves) reflects current good practices in metallurgical industry. Blast furnaces reconstruction with using modern technology allows significantly reduce average specific coke consumption per ton of pig iron from 530 kg of coke per ton of pig iron up to 470 kg/t. In comparison average specific coke consumption in Ukraine is 534.5 kg/t in 2004[1].

No changes into the reconstruction project are foreseen throughout the whole project lifetime.

Commissioning of the new equipment (Linde and blast furnace #5) required training of personnel. OJSC "EMW" provided training for personnel to operate Linde oxygen unit and blast furnace #5. Special training was done for personnel of Linde at OJSC MK "Azovstal" and training and courses for personnel of blast furnace at OJSC MK "Azovstal", OJSC "Zaporizhstal" and LLC "VDT Toliyatti".

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

The project will lead to greenhouse gas emission reductions by reducing consumption of coke and natural gas, the project will also reduce greenhouse gas emissions from electricity production in the national grid.

There is no legislation at the national level, which would have forced the shareholders of OJSC "EMW" to invest in the project.

Implementation of the proposed reconstruction project requires substantial amounts of financing. Currently, project finance on the domestic market is available for a small period of time (up to three years) with high interest rates. Obtaining project financing on foreign markets for Ukrainian companies is difficult due to low international ratings of Ukraine and, consequently, the perception of high country-related risks. Additional income from the sale of ERUs was one of the decisive factors for the company's owners when making a decision regarding investing into the proposed project. Ability to receive ERUs has been considered at the stage of master plan development, before the decision on investment was made.

The additional income from the use of Joint Implementation mechanism positively affects the economic performance of the project. JI project implementation improves internal rate of return and reduce the payback period.

Existing blast furnaces № 1, № 3, № 4 and № 5, equipment CHPP and oxygen plant of Enakievo Metallurgical Works can continue operating at least until 2012 upon condition of periodic routine repairs of the existing equipment. Based on the above, the project can be realized only through a JI mechanism.

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

Depending on the decision of the Ukrainian authorities, the "early credits" for the 2007 can be received upon condition of proper completion of the monitoring and verification of project activities. Emission reductions before the Kyoto crediting period are:

[1] *www.me.gov.ua/file/link/78897/file/Burkinski_4_06_U.pdf*

	Years
Length of crediting period	1
Year	Estimate of annual emission reductions in tons of CO_2 equivalent
2007	260 001
Total estimated amount of emission reductions over the crediting period, (tons of CO2-equivalent)	260 001
Annual average emission reductions over the crediting period, (tons of CO_2 equivalent)	260 001

	Years
Length of crediting period	5
Year	Estimate of annual emission reductions in tons of CO_2 equivalent
2008	360 165
2009	298 249
2010	315 459
2011	707 017
2012	523 044
Total estimated amount of emission reductions over the crediting period, (tons of CO2-equivalent)	2 470 498
Annual average emission reductions over the crediting period, (tons of CO_2 equivalent)	440 787

Emission reduction after the Kyoto crediting period are:

	Years
Length of crediting period	9
Year	Estimate of annual emission reductions in tons of CO_2 equivalent
2013	523 044
2014	523 044
2015	523 044
2016	523 044
2017	523 044
2018	523 044
2019	523 044
2020	523 044
2021	523 044
Total estimated amount of emission reductions over the crediting period, (tons of CO2-equivalent)	4 707 398
Annual average emission reductions over the crediting period, (tons of CO_2 equivalent)	523 044

A.5. Project approval by the Parties involved:

The project has received a Letter of Endorsement from the National Environmental Investments Agency of Ukraine on 19 November 2009.

Investor Country Approval and Host Country Approval will be received later.

SECTION B. Baseline

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

Step 1. Identification and description of the approach used to identify the baseline scenario

Currently, there is no approved CDM methodology, which can be directly applied to identify the baseline scenario, as well as calculate baseline and project emission levels. The approach described below has been developed specifically for the project "Implementation of energy efficiency measures at OJSC "Enakievo Metallurgical Works" and based on the key principles of CMP decisions.[2].

The proposed approach consists of the following methodological guidelines:

- "Combined tool to identify the baseline scenario and demonstrate additionality" Version 02.2.
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 02

Applicability

The proposed approach can be used for the project activities covering energy efficiency measures in iron and steel making and for the modernization of blast furnaces.

- A project shall comprise only those measures that foresee the capital investments inflow. Maintenance, regular inspections and repair works cannot be included into project activities;
- All the equipment, which was in use before the project start, has the lifetime exceeding or equal to the proposed crediting period;
- The life time of the new equipment has to be equal to or exceed the project's crediting period;

Step 2. Application of the chosen approach

Procedure to identify an applicable baseline scenario and additionality assessment

To identify an applicable baseline scenario and prove the project additionality, the "Combined tool to identify the baseline scenario and demonstrate additionality" Version 02.2 is used. Description and applicability of the chosen tool is provided in Section B.2.

Project boundaries

Project boundaries have to involve the GHG emission sources being under control of the project participants and associated with the proposed project activities.

The boundaries cover BF Shop (with all blast furnaces), Oxygen Shop as well as reconstruction of the power plant. All units included into the project boundaries are located on the territory of the OJSC "EMW". The detailed description of the project boundaries is provided in the Section B.4.

Baseline Scenario

Baseline scenario foresees the further usage of existing equipment while the regular maintenance is done without any significant capital investments. Existing technological and investment barriers have no impact on this scenario so it is most credible future scenario. Other future scenarios and the detailed baseline study are provided in the Section B.2.

The baseline scenario includes CO_2 emissions originating from hot metal production in the blast furnaces №1, №3, №4 and №5, as well as emissions from fossil fuel combustion by the BKZ boilers of

[2] Decision 9/CMP.1, Appendix B

CHPP. The emissions of other greenhouse gases, including methane and nitrous oxide, have not been included into the calculations. The national emission grid factor calculated for JI project 0018 “Introduction of energy efficiency measures at ISTIL mini steel mill” has been applied to estimate emissions reduction due to a decrease in power consumption. In case of changes made to the electricity baseline or in case of approval of another baseline for United Energy System of Ukraine (UES), the relevant changes in the calculations will be made.

The JI specific approach uses historical data on raw material and energy consumption to estimate specific consumption level per unit produced (ex ante). These calculations are based on the historical data for the 3 years preceding the project activities start. One ton of the produced hot metal is accepted as one production unit.

To calculate a baseline emission level, actual (ex post) data on the hot metal production will be used.

Determination of the remaining life time of the existing equipment

The lifetime of the blast furnaces can be extended by 15-20 years if the major overhauls of 1st and 2nd grades are undertaken. The major overhauls require less funding and do not lead to any significant improvements in energy consumption. Blast furnace №1 after the completion of the major overhauls of the 2nd grade has been operating for 16 years. Blast furnace №3 after the completion of the major overhauls of the 2nd grade was operating for 16 years. Blast furnace №4 after the completion of the major overhauls of the 1st grade has been operating for 17 years. Dates of commissioning and overhauls (1st and 2nd grades) completion of the 1st and 2nd grades are presented in Table 2. Length of crediting period of 15 years is taken; that is less than historical data of blast furnaces operating at EMW.

Table 2. Dates of commissioning of blast furnaces at Enakievo Metallurgical Works and dates of overhauls (1st and 2nd grades) completion

Blast furnace	№1	№3	№4	№5
Commissioning year	1970	1960	1968	1963
Date of overhaul (1st grade)	14.09.1986	26.12.1982	-	-
Date of overhaul (2nd grade)	19.01.1994	12.01.1992	14.01.1993	-

Therefore, if necessary, the lifetime of the blast furnaces can be significantly extended. The other units will be also operated beyond the project crediting period as both new (compressor K-1700, Linde oxygen unit, new turbo blowers and boilers) and the existing equipment will be operating at the same time. Tables 3 and 4 provide the commissioning dates of the existing equipment.

Table 3. The main equipment of CHPP, which is covered by the project activities, as well as commissioning dates

Boiler	BKZ 1	BKZ 2	BKZ 3	BKZ 4	BKZ 5	BKZ 6	BKZ 7
Year	1960	1960	1961	1966	1968	1972	1977
Turbo blower	TB 1	TB 2	TB 3	TB 4	TB 5	-	-
Year	1960	1960	1967	1969	2006		
Compressor	K-250	K-250	-	-	-	-	-
Year	1968	1968					

Table 4. The main equipment of the oxygen unit included into the project activities as well as commissioning dates

Oxygen unit	BR2M №1	BR2M №2	KTK-35	Linde	-
Year	1968	1969	1975	2006	
Compressor	K-1500 #1	K-1500 #2	K-1500 #3	K-1500 #4	K-1500 #5
Year	1969	1969	1968	1968	1968
Compressor	K-1500 #6	K-1500 #7	K-1500 #8	K-525 #1	K-500 #2
Year	1975	1975	1976	2004	1964

Emissions under the baseline scenario

Baseline emissions consist of emissions stemming from the hot metal production in the blast furnaces, electricity consumption for oxygen and compressed air production at Enakievo Metallurgical Works, as well as from the power plant, which covers the energy needs of the BF Shop and emissions related to coke production that would be reduced due to blast furnace modernization. Emissions from electricity consumption are derived from the fossil fuel combustion within the UES of Ukraine. Therefore, baseline emissions amount to:

$$BE_y = BE_{BF,y} + BE_{El,y} + BE_{CHP,y} + BE_{CP,y} ,$$

where

BE_y = baseline emissions, t CO_2e;

$BE_{BF,y}$ = baseline emissions from the blast furnaces, t CO_2e;

$BE_{El,y}$ = baseline emissions from the electricity consumption for oxygen and compressed air production, t CO_2e;

$BE_{CHP,y}$ = baseline emissions from the power plant, t CO_2e;

$BE_{CP,y}$ = baseline emissions from coke production reduced due to blast furnace modernization, t CO_2e;

y = reference year.

Emissions of CO_2 are calculated based on total consumption of materials containing carbon for pig iron production such as natural gas, coke, limestone, coal. Blast furnace gas is a product of oxidation and decomposition of these materials. Therefore, including burning blast furnace gas into the sources of emissions would lead to double counting. Direct emissions from blast furnace gas combustion are excluded from the calculations.

The balance of carbon within blast furnaces is given below. Carbon is being loaded to the blast furnaces with raw materials and fuel and released in the form of blast furnace gas and hot metal:

$$C_{fuel} + C_{raw} = C_{BFG} + C_{output},$$

where

C_{fuel} = mass fraction of carbon in fuel, %;

C_{raw} = mass fraction of carbon in materials, %;

C_{BFG} = mass fraction of carbon in blast furnace gas, %;

C_{output} = mass fraction of carbon in the end product, %.

Since the production volumes under both project and baseline scenarios are the same, the mass fraction of carbon C_{output} in the end product will be omitted to simplify the calculations. As modernization of the blast furnaces foresees essential changes to the auxiliary equipment, the baseline emissions from blast furnaces also cover their own electricity consumption.

Therefore, the calculation of emissions from blast furnaces is reflected below:

$$BE_{BF,y} = \sum_i FC_{BL,i,y} \cdot EF_{CO_2,i} + \frac{44}{12} \sum_j M_{BL,raw,j,y} \cdot C_{raw,j} \cdot OXID_j + EC_{BL,BF,y} \cdot EF_{BL,y},$$

where

$FC_{BL,i,y}$ = fuel (type i) consumed for pig the iron production in blast furnaces during the year y under the baseline scenario, TJ;

$EF_{CO2,i}$ = carbon emission factor for fuel i, including oxidation, tCO_2/TJ;

$M_{BL,raw,j,y}$ = weight of the consumed material j for hot metal production during year y under the baseline scenario, t;

$C_{raw,j}$ = mass fraction of carbon in material j, %;

$OXID_j$ = oxidation factor for the material j, %;

$EC_{BL,BF,y}$ = own fuel consumption by the blast furnaces, MWh;

$EF_{BL,y}$ = national emission factor for the UES of Ukraine for projects aiming at a decrease of electricity consumption, t CO_2e/MWh;

$\frac{44}{12}$ = carbon to carbon dioxide conversion factor.

The fuel and material consumption is based on the specific consumption historical data.

$$FC_{BL,y,i} = BSEC_i \cdot P_y,$$

where

$FC_{BL,i,y}$ = fuel i consumption for hot metal production in the blast furnaces during year y under the baseline scenario, TJ;

$BSEC_i$ = specific fuel i consumption, TJ/t ;

P_y = hot metal production during year y, t;

Specific consumption is being calculated as ratio of total fuel consumption during the historical period to hot metal production during the historic period. Historical data correspond to the actual archive data for three preceding years to the project start.

$$BSEC_i = \frac{FC_{hist,i}}{P_{hist}},$$

where

$BSEC_i$ = specific fuel *i* consumption, TJ/t ;

$FC_{hist,i}$ = aggregated historical consumption of fuel *i*, TJ;

P_{hist} = aggregated historical production of hot metal (over 3 years), t;

$$FC_{hist,i} = FF_{hist,i} \cdot NCV_{hist,i}$$

$FC_{hist,i}$ = aggregated historical consumption of fuel *i*, TJ;

$FF_{hist,i}$ = historical volume of consumed fuel *i*, m^3 or t;

$NCV_{hist,i}$ = average historical NCV for fuel *i*, TJ/t or TJ/m^3

$$M_{BL,raw,j,y} = BSMC_j \cdot P_y,$$

where

$M_{BL,raw,j,y}$ = weight of consumed material *j* for hot metal production in year *y* under the baseline scenario, t;

$BSMC_i$ = specific consumption of material *j*, t/t;

P_y = hot metal production per year *y*, t;

$$BSMC_j = \frac{M_{raw,hist,j}}{P_{hist}},$$

$BSMC_i$ = specific consumption of the material *j*, t/t ;

$M_{raw,hist,j}$ = aggregated historical consumption of material *j*, t;

P_{hist} = aggregated historical (over 3 years) production of hot metal, t.

Own electricity consumption:

$$EC_{BL,BF,y} = BSEEC_{BF} \cdot P_y,$$

$EC_{BL,BF,y}$ = own electricity consumption by the blast furnaces, MWh;

$BSEEC_{BF}$ = own specific electricity consumption by the blast furnaces, MWh/t;

P_y = hot metal production per year *y*, t;

$$BSEEC_{BF} = \frac{EC_{BF,hist}}{P_{hist}},$$

$BSEEC_{BF}$ = own specific electricity consumption by the blast furnaces, MWh/t;

$EC_{BF,hist}$ = own historical specific electricity consumption by the blast furnaces (over 3 years), MWh;

P_{hist} = aggregated historical production of hot metal (over 3 years), t.

Baseline emissions from electricity consumed for production of oxygen and compressed air:

$$BE_{El,y} = EC_{BL,O_2,y} EF_{BL,y} + EC_{BL,Air,y} EF_{BL,y},$$

where

$BE_{El,y}$ = baseline emissions from electricity consumed for production of oxygen and compressed air, t CO_2e;

$EC_{BL,O2,y}$ = electricity consumed for production of oxygen per year *y* under the baseline scenario, MWh;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption t CO_2e/MWh;

$EC_{BL,Air,y}$ = electricity consumed for production of compressed air per year *y* under the baseline scenario, MWh.

Under the baseline scenario, the calculations of electricity consumption for production of oxygen and compressed air by the electric compressors are based on specific electricity consumption before the project start.

$$EC_{BL,O_2,y} = BSEEC_{O_2} \cdot P_y,$$

where

$EC_{BL,O2,y}$ = electricity consumed for oxygen production per year *y* under the baseline scenario, MWh;

$BSEEC_{O2}$ = specific electricity consumption for oxygen production, MWh/t ;

P_y = production of hot metal per year *y*, t;

$$BSEEC_{O_2} = \frac{EC_{hist,O_2}}{P_{hist}},$$

$BSEEC_{O2}$ = specific electricity consumption for oxygen production MWh/t ;

$EC_{hist,O2}$ = historical electricity consumption for oxygen production (over 3 years), MWh

P_{hist} = aggregated historical production of hot metal (over 3 years), t;

$$EC_{BL,Air,y} = BSEEC_{Air} \cdot P_y,$$

where

$EC_{BL,Air,y}$ = electricity consumed for production of compressed air per year *y* under the baseline scenario, MWh

$BSEEC_{Air}$ = specific electricity consumption for production of compressed air, MWh/t;

P_y = production of hot metal per year *y*, t;

$$BSEEC_{Air} = \frac{EC_{hist,Air}}{P_{hist}},$$

$BSEEC_{Air}$ = specific electricity consumption for production of compressed air, MWh/t;

$EC_{hist,Air}$ = historical electricity consumption for production of compressed air (over 3 years), MWh

P_{hist} = aggregated historical production of hot metal (over 3 years), t.

Baseline emissions from the power plant consist of emissions associated with natural gas consumption and own electricity consumption by CHPP.

$$BE_{CHP,y} = FC_{BL,CHP,NG,y} EF_{CO_2,NG} + EC_{BL,Aux,y} \cdot EF_{BL,y} ,$$

де

$BE_{CHP,y}$ = baseline emissions from power plant operation, tCO_2e;

$FC_{BL,CHP,NG,y}$ = consumption of natural gas per year *y* under the baseline scenario, TJ;

$EF_{CO2,NG}$ = emission factor for natural gas, tCO_2/TJ;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption tCO_2e/MWh;

$EC_{BL,Aux,y}$ = own electricity consumption by power plant per year *y* under the baseline scenario, MWh.

The calculations of baseline emissions for power plant are based on specific consumption, alike the calculations of electricity consumed for oxygen and compressed air production.

$$FC_{BL,CHP,NG,y} = BSEC_{NG,CHP} \cdot P_y ,$$

where

$FC_{BL,CHP,NG,y}$ = consumption of natural gas by the power plant for the needs of BF Shop per year *y* under the baseline scenario, TJ;

$BSEC_{NG,CHP}$ = specific consumption of natural gas by the power plant, TJ/t ;

P_y = production of hot metal per year *y*, t;

$$BSEC_{NG,CHP} = \frac{FC_{CHP,NG,hist}}{P_{hist}} ,$$

$BSEC_{NG,CHP}$ = specific consumption of natural gas by the power plant, TJ/t ;

$FC_{CHP,NG,hist}$ = historic consumption of natural gas by the power plant to cover the BF Shop's demand, TJ;

P_{hist} = aggregated historical production of hot metal (over 3 years), t.

The consumption of natural gas for the needs of BF Shop consists of demand for steam to generate compressed air and demand derived from the technology needs.

$$FC_{CHP,NG,hist} = SNGC_{CHP,hist} \left(SC_{Air,hist} + SC_{Tech,hist} \right),$$

where

$FC_{CHP,NG,hist}$ = historic consumption of natural gas by the power plant to cover the BF Shop's demand (over 3 years), TJ;

$SNGC_{CHP,hist}$ = historical specific consumption of natural gas, TJ/t;

$SC_{Air,hist}$ = steam consumption to produce compressed air, t;

$SC_{Tech,hist}$ = steam consumption to cover technological needs of the BF Shop, t;

$$SNGC_{CHP,hist} = \frac{FC_{CHPtotal,NG,hist}}{SC_{total,hist}},$$

$SNGC_{CHP,hist}$ = historical specific consumption of natural gas, TJ/t;

$FC_{CHPtotal,NG,hist}$ = historical aggregated consumption of natural gas by the power plant (over 3 years), TJ;

$SC_{total,hist}$ = historical aggregated steam generation by the power plant (over 3 years), t.

$$FC_{CHPtotal,NG,hist} = FF_{CHPtotal,NG,hist} \cdot NCV_{NG,hist}$$

$FC_{CHPtotal,NG,hist}$ = historical aggregated consumption of natural gas by the power plant (over 3 years), TJ;

$FF_{CHPtotal,NG,hist}$ = historical aggregated consumption of natural gas by the power plant (over 3 years), m^3;

$NCV_{hist,NG}$ = historical NCV for natural gas, TJ/m^3

Own electricity consumption.

$$EC_{BL,Aux,y} = BSEC_{Aux,CHP} \cdot P_y,$$

$EC_{BL,Aux,y}$ = own electricity consumption by the power plant per year y under the baseline scenario, MWh.

$BSEC_{Aux,CHP}$ = own specific electricity consumption by the power plant, MWh/t;

P_y = production of hot metal per year y, t;

$$BSEC_{Aux,CHP} = \frac{EC_{Aux,CHP,hist}}{P_{hist}},$$

$BSEC_{Aux,CHP}$ = own specific electricity consumption by the power plant, MWh/t;

P_{hist} = historical aggregated production of hot metal (over 3 years), t.

$EC_{Aux,CHP,hist}$ = historical own electricity consumption by the power plant (over 3 years), MWh.

The BF modernization is reducing coke consumption at EMW. It leads to decrease of coke production.

$$BE_{CP,y} = EF_{CO_2,CP} M_{DCC,y}$$

$BE_{CP,y}$ = baseline emissions from coke production reduced due to blast furnace modernization, t CO_2e;

$M_{DCC,y}$ = Mass of reduced coke consumption at EMW, t;

EF_{CO2CP} = Emission factor[3] during coke production tCO_2/t;

Mass of reduced coke consumption calculated as difference between coke consumption in the baseline and project scenario

$$M_{DCC,y} = M_{BL,coke,y} - M_{P,coke,y}$$

$M_{DCC,y}$ = Mass of reduced coke consumption at EMW, t;

$M_{BL,coke,y}$ = Coke consumption at EMW in baseline scenario, t;

$M_{P,coke,y}$ = Coke consumption at EMW in project scenario, t;

Project emissions

[3] Emission factor in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 4, Table 4.1

$$PE_y = PE_{BF,y} + PE_{El,y} + PE_{CHP,y},$$

where

PE_y = project GHG emissions, tCO_2e;
$PE_{BF,y}$ = project emissions from blast furnaces, tCO_2e;
$PE_{El,y}$ = project emissions from electricity consumption to produce oxygen and compressed air, tCO_2e;
$PE_{CHP,y}$ = project emissions from the power plant, tCO_2e;
y = reference year.

Emissions from the blast furnaces:

$$PE_{BF,y} = \sum_i FC_{i,y} \cdot EF_{CO_2,i} + \frac{44}{12}\sum_j M_{raw,j,y} \cdot C_{raw,j} \cdot OXID_j + EC_{PE,BF,y} \cdot EF_{BL,y},$$

where

$FC_{i,y}$ = fuel *i* consumption for hot metal production by the blast furnaces per year *y*, TJ;

$EF_{CO2,i}$ = emission factor for fuel *i*, including oxidation tCO_2/TJ;

$M_{raw,j,y}$ = weight of consumed material *j* for production of hot metal by the blast furnaces per year *y*, t;

$C_{raw,j}$ = mass fraction of carbon in material *j*, %;

$OXID_j$ = oxidation rate of material *j*, %;

$EC_{PE,BF,y}$ = own electricity consumption by the blast furnaces, MWh;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption tCO_2e/MWh;

$\frac{44}{12}$ = carbon to carbon dioxide conversion factor.

$$FC_{i,y} = FF_{i,y} \cdot NCV_{i,y}$$

$FC_{i,y}$ = fuel *i* consumption for production of hot metal by the blast furnaces per year *y*, TJ;

$FF_{i,y}$ = consumed fuel, m^3 or t;

$NCV_{i,y}$ = average NCV for fuel *I* consumed per year *y*, TJ/t or TJ/m^3

Project emissions from electricity consumed for production of oxygen and compressed air:

$$PE_{El,y} = EC_{O_2,y}EF_{BL,y} + EC_{Air,y}EF_{BL,y},$$

where

$PE_{El,y}$ = emissions from electricity consumption for production of oxygen and compressed air, tCO_2e;
$EC_{O2,y}$ = electricity consumed for production of oxygen per year *y*, MWh;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption tCO_2e/MWh;

$EC_{Air,y}$ = electricity consumed for production of compressed air per year *y*, MWh.

Project emissions from the power plant

$$PE_{CHP,y} = FC_{CHP,NG,y} EF_{CO_2,NG} + EC_{Aux,y} \cdot EF_{BL,y},$$

$PE_{CHP,y}$ = emissions from the power plant, tCO_2e;

$FC_{CHP,NG,y}$ = consumption of natural gas by power plant to cover the demand of BF Shop per year y, TJ;

$EF_{CO2,NG}$ = emission factor for natural gas, tCO_2/TJ;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption tCO_2e/MWh;

$EC_{Aux,y}$ = own consumption of electricity by the power plant per year y, MWh.

The consumption of natural gas, covering demand of the BF Shop, consists of demand for steam to generate compressed air as well as to meet the shop's technological needs.

$$FC_{CHP,NG,y} = \frac{SC_{Air,y} + SC_{Tech,y}}{SC_{CHP,y}} \cdot FF_{CHP,NG,y} \cdot NCV_{NG,y},$$

where

$FC_{CHP,NG,y}$ = consumption of natural gas by the power plant to cover the BF Shop's demand, TJ;

$SC_{CHP,y}$ = steam consumption at the power plant, TJ/t;

$SC_{Air,y}$ = steam consumption in order for compressed air production, t;

$SC_{Tech,y}$ = steam consumption to meet the technological needs of the BF Shop, t;

$FF_{CHP,NG,y}$ = natural gas consumed, m^3;

$NCV_{i,y}$ = average NCV for natural gas, TJ/m^3

Leakages

The project leakages comprise emissions associated with project implementation at Yenakiyevo Iron and Steel Works (leakages from transportation of equipment and materials and consumption of energy resources during construction works). To simplify calculations, the abovementioned emissions were omitted. This is a conservative assumption. The other emission sources or any emission increases from already existing emission sources beyond the project boundaries have not been identified.

Emission reductions

The emission reductions are calculated below:

$$ER_y = BE_y - PE_y - LE_y$$

where

ER_y = emission reduction in year y, t CO_2e;
BE_y = baseline GHG emission reductions in year y, t CO_2e;
PE_y = GHG emissions from the project activities in year y, t CO_2e;
LE_y = leakages in year y , t CO_2e;

Historical period

According to the JI specific approach, 2003-2005 period will be used as a historical period, preceding project activities start. In 2008, due to the market circumstances the company had to abandon consumption of natural gas by the blast furnaces, increasing the coke consumption instead. The use of furnace charge without natural gas was a forced decision and does not depend on the project implementation. Therefore, any blast furnace of EMW can operate without the use of the natural gas. The use of furnace charge without gas requires no technical intervention or alteration of the blast furnace design. The decision about the mode of blast furnace operation (either with or without the use of natural gas) is therefore commercial and depends only on the current situation in the market of natural gas. Therefore, effective 2008 the actual fuel consumption over the 2008-2009 period will be referred as the historical baseline data for BF1 and BF4. The absence of a proper historical period for BF3 using the charge without natural gas will only increase the baseline emission level since the specific consumption of the BF3 is worse compared to BF1 and BF4. To ensure the conservative approach to emission calculations, 2003-2005 period will be also referred as the historical period after the switch to pulverized coal.

Key parameters to be monitored.

Data / Parameter:	*Remaining lifetime of the equipment RL*
Data unit:	Years
Description:	Date when the existing equipments are to be changed
Time of determination/monitoring	
Source of data (to be) used	Analysis of data provided by Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	16
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Defined in Section B.1, page 13
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	*Historical aggregated production of hot metal,* P_{hist}
Data unit:	t
Description:	Aggregated production of hot metal by the blast furnaces at Enakievo Metallurgical Works before the project start (2003-2005)
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	6 191 071
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical consumption of coke, $FF_{hist,i}$
Data unit:	t

Description:	Aggregated consumption of coke by the blast furnaces to produce hot metal over three years, preceding to the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	3,286,372
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical consumption of natural gas, $FF_{hist,i}$
Data unit:	m^3
Description:	Aggregated consumption of natural gas by the blast furnaces to produce hot metal over three years, preceding to the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	681,501,000
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical net calorific value for natural gas, $NCV_{hist,i}$
Data unit:	kJ/m^3
Description:	
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	33,938
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical consumption of limestone, $M_{raw,hist,j}$
Data unit:	t
Description:	Aggregated consumption of limestone by the blast furnaces to produce hot metal over three years, preceding to the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	435,012
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical own consumption of electricity by the blast furnaces, $EC_{BF,hist}$
Data unit:	MWh
Description:	Aggregated consumption of electricity by the blast furnaces to produce hot metal over three years, preceding to the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	33,065
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Value for 2003-2005 period
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical consumption of electricity for oxygen production, $EC_{hist,O2}$
Data unit:	MWh
Description:	Aggregated consumption of electricity for oxygen production over three years, preceding to the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	1,203,398

Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical consumption of electricity for compressed air production, $EC_{hist,Air}$
Data unit:	MWh
Description:	Aggregated consumption of electricity for compressed air production before the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	176,860
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical aggregated consumption of natural gas by the power plant, $FF_{CHPtotal,NG,hist}$
Data unit:	m^3
Description:	Aggregated consumption of natural gas by the power plant before the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	57,299,000
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical aggregated steam generation by the power plant $SC_{total,hist}$

Data unit:	Gcal
Description:	Aggregated steam generation by the power plant over three years, preceding the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	5,163,089
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period.
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Steam consumption for compressed air generation, $SC_{Air,hist}$
Data unit:	Gcal
Description:	Aggregated steam consumption by the power plant to generate compressed air over three years, preceding the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	3,068,204
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Steam consumption to cover the technological needs of the BF Shop, $SC_{Tech,hist}$
Data unit:	t
Description:	Aggregated steam consumption by the power plant to cover the technological needs of the BF Shop over three years, preceding the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	1,641,918
Justification of the choice of data or description of measurement methods and	Values for 2003-2005 period

procedures (to be) applied	
QA/QC procedures (to be) applied	
Any comment:	

Data / Parameter:	Historical own consumption of electricity by the power plant, $EC_{Aux,CHP,hist}$
Data unit:	MWh
Description:	Own aggregated consumption of electricity by the power plant over three years, preceding the project start
Time of determination/monitoring	
Source of data (to be) used	Enakievo Metallurgical Works
Value of data applied (for ex ante calculations/determinations)	138,951
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Values for 2003-2005 period
QA/QC procedures (to be) applied	
Any comment:	

Monitoring parameters are provided in Table D.1.1.1. and Table D.1.1.3 of Section D.

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:

GHG emissions will be reduced due to reconstruction of blast furnaces №3 and BF №5, modernization of CHPP, installation of a new oxygen unit and a compressor. These measures decrease consumption of coke, power and natural gas for pig iron production. In case of project absence the iron will be produced by old furnaces with inefficient consumption of coke and natural gas, oxygen and compressed air will be produced by existing units that have less efficiency in comparison with new equipment.

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

To chose the best realistic baseline scenario and additionality analysis, the methodological tool "Guidance on criteria for baseline setting and monitoring **"**Combined tool to identify the baseline scenario and demonstrate additionality**"** Version 02.2[4] were applied.

This methodological tool can be applied under following condition:

- *Methodologies using this tool are only applicable if all potential alternative scenarios to the proposed project activity are available options to project participants*

Proposed project activity meets the abovementioned requirement since all the alternatives listed below are available for the project owner.

[4] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf

Project participants shall apply the following four steps:

Step 1. Identification of alternative scenarios;
Step 2. Barrier analysis;
Step 3. Investment analysis (if applicable);
Step 4. Common practice analysis.

Step 2. Application of the approach chosen

Step 1. Identification of alternative scenarios

This step serves to identify all alternative scenarios to the proposed project activity(s) that can be the baseline scenario.

Step 1a: Define alternative scenarios to the proposed JI project activity

All the realistic alternatives similar to the proposed JI project activity can be the alternative options of the baseline scenario.

These alternatives cover:

- The proposed project activity undertaken without being registered as a JI project activity;
- All other plausible and credible alternative scenarios to the project activity scenario, including the common practices in the relevant sector, with comparable capacities;
- If applicable, continuation of the current situation.

There are three alternative options of the baseline scenario, being discussed before the project start, which are:

A.1	Reconstruction of blast furnaces №3 and №5, modernization of CHPP, installation of a new oxygen unit and a compressor (project activity without JI project registration).
A.2	Running the current capacities for production of hot metal and the existing equipment for compressed air and oxygen production, without implementation of modernization works.
A.3	Installation of new blast furnaces, new auxiliary equipment and new power plant.

Outcome of Step 1a: List of plausible alternative scenarios to the project activity

All the abovementioned alternatives correspond to the existing legislation. National policies in the field of metallurgy are presented in the decree of Ukrainian Cabinet of Ministers #967 dated 28.07.2004 'National program of development and reforming of mining and metallurgical sector for the period till 2011'. This program foresees modernization of blast furnaces and using pulverized coal instead of natural gas. But regulations presented in this program are not mandatory. Other existing laws of Ukraine also do not enforce any of the proposed alternative options.

Step 2: Barrier analysis

Sub-step 2a: Identify barriers that would prevent the implementation of alternative scenarios

Technological barriers

While the new equipment being installed, there are a number of risks that can affect the project implementation:

A) Risks associated with the suspension of production due to the launch of new equipment

The operation of blast furnaces involves complicated technological processes. At the same time, the project poses some risks related to the modernization and further maintenance of the blast furnaces. Also, the failure of new equipment may lead to the unpredictable suspensions of the production cycle.

B) Risks associated with losing a market share
As mentioned above, the installation of new technologies can be followed by the unpredictable suspensions and delays. This can have an impact on the final production rate and therefore reduce the expected company's income or materialize in losing the company's position on the market. An additional income from the sale of ERUs can contribute to eliminating these risks.

Investment barriers
The project implementation at the Enakievo Metallurgical Works strongly depends on the global prices for hot metal and steel as well as the energy prices. A recent drop of price for hot metal and steel on the global market significantly undermined the company's capability to invest into new technologies and equipment. A good illustration of the difficult conditions currently faced by the iron and steel sector of Ukraine could be the recent acquisition[5] of the Industrial Union of Donbass (IUD). The modernization projects at Alchevsk Iron and Steel Works owned by IUD were implemented with the use of JI mechanism[6]. However, the additional income from JI was insufficient to prevent the IUD's acquisition due to the lack of financing. Therefore, the example of IUD being unable to serve its debt originating from modernization activities is a proof of the investment barriers for iron and steel producers in Ukraine.

In addition to the abovementioned, sharp increase in energy prices negatively affects the project implementation. The company faces the scarce access to the financial resources on the international level. The investment climate in Ukraine seems to be rather challenging, in particularly compared to the neighbor countries. The sovereign ratings for Ukraine and a few selected countries developed by Fitch can be a proof of it.

- Ukraine B-
- Poland A-
- Hungary BBB
- Slovakia A+

Taking into account the substantial amount of capital investments, which is necessary to implement the project, funding from the international sources can be a complicated issue. The access to project financing on the national level is also restricted. Currently, commercial banks in Ukraine offer project financing at a 30 per cent interest rate in the national currency, with a maximum maturity period of 3 years. The largest banks in Ukraine – Raiffeisen Bank Aval (www.aval.ua), Privatbank (www.privatbank.com.ua), and Pravex Bank (www.pravex.com.ua) can be an example.
As of today, the aggregated delays in the reconstruction of BF 3 is six months compared to the schedule, the commissioning of K-1700 compressor is delayed by twelve months. Therefore, the limited access to the financial resources and scarce company's finance are the essential impediments on a way to the project implementation. The proposed project's registration would allow to overcome the investment barrier and enable finalizing the measures being currently under construction.

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[5] http://www.bbc.co.uk/ukrainian/business/2010/01/100111_isd_analysis_it.shtml

[6] http://ji.unfccc.int/UserManagement/FileStorage/ETVRLX61BH8MDPQ4JK9YWZI20UGO37

http://ji.unfccc.int/UserManagement/FileStorage/AQF0TM19HROY38IC7WXLBPK5EDZV2U

Outcome of Step 2a: The identified investment and technical barriers do have a strong effect on project; in particular these barriers impact alternatives A.1 and A.3

Sub-step 2b: Eliminate alternative scenarios which are prevented by the identified barriers
Alternative A.1 «Modernization without JI project registration» and A.3 «Installation of new blast furnaces, new auxiliary equipment and new power plant» have to be ruled out from further consideration as both these are affected by the abovementioned barriers. Scenario A.2 «Running the current capacities for production of hot metal and equipment for compressed air and oxygen production, without implementation of modernization works» is the only applicable alternative, which does not require massive investment and new equipment installation.

Outcome of Step 2b: Only alternative A.2 cannot be prevented by any barrier.

Since only one alternative A.2 is not affected by any barriers and is not the proposed project without being registered as a JI activity, this scenario is chosen as the baseline scenario.

Step 3: Investment analysis

“Combined tool to identify the baseline scenario and demonstrate additionality**”** Version 02.2 determines that investment comparison analysis can be conducted for remaining alternative scenarios after Step 2. As only one scenario remained after Step 2, we skip the investment comparison analysis for this project activity.

Step 4: Common practice analysis
A large-scale reconstruction of a blast furnace is not a common practice in Ukraine. To date, only two companies except Enakievo Metallurgical Works undertake reconstruction of blast furnaces: OJSC “Alchevsk Iron and Steel Works” (BF #2 with the capacity of 4450 m^3) and OJSC “Dniprovsky Iron and Steel Works named after Dzerzhynsky” (BF capacity of 1680 m^3). Both companies, however, plan to register the reconstruction activities as JI projects.

Conclusion: All the required steps are accomplished. The proposed JI activity will eliminate technological, economic, and financial risks and assist the project owner to implement it. Therefore, the project is additional.

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

Project boundaries

The project covers emission of CO_2 generated from the production of hot metal at blast furnaces №1, №3, №4, and №5 as well as combustion of fossil fuels by boilers BKZ №1, №2, №3, №4, №5, №6, and №7 installed at the power plant. Also, the project boundaries include indirect emissions from electricity consumption, including electricity consumed for production of compressed air and oxygen. The electrical compressors are located in the Oxygen Shop and power plant, oxygen units BR-2M, KTK-35-3, and Linde located in the Oxygen Shop. These objects are the sources of CO_2 emissions and are included into the project boundaries. Figure 4 shows the project boundaries (marked with solid line). All the mentioned objects are located within the premises of Enakievo Metallurgical Works .

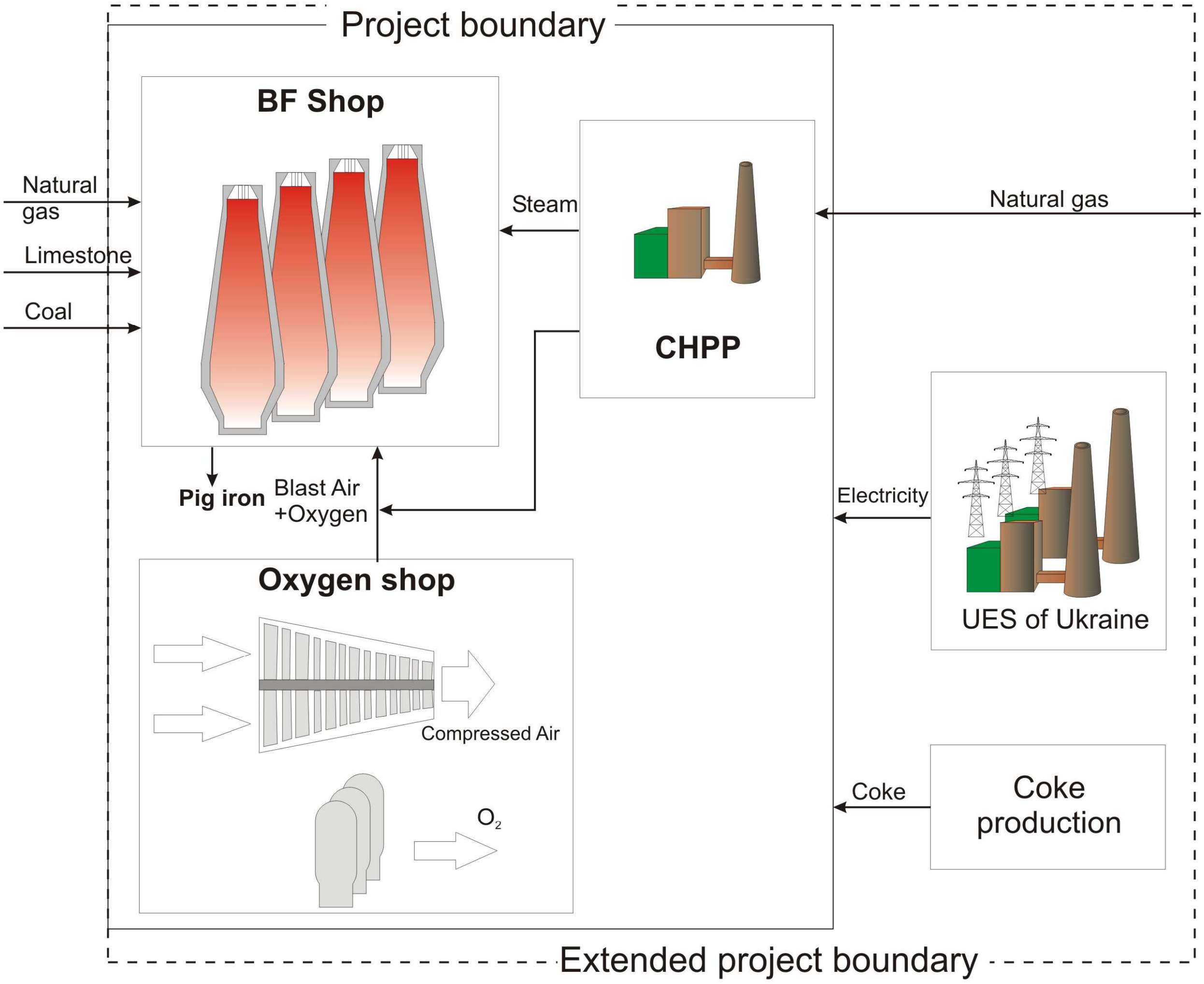

Figure 4. Project boundaries

The greenhouse gases and their sources included into the project boundaries are listed in the Table 3.

Table 3. Greenhouse gases and their sources included into the project boundaries

	Source	GHG	Covered	Comment
Baseline scenario	Emissions from the coke oxidation in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source. Conservative simplification.
		N_2O	N	Insignificant source. Conservative simplification.
	Emissions from consumption of limestone in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source. Conservative simplification.
		N_2O	N	Insignificant source. Conservative simplification.
	Emissions from combustion of natural gas in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source. Conservative simplification.
		N_2O	N	Insignificant source. Conservative simplification.
	Emissions from combustion of fossil fuels to produce electricity.	CO_2	Y	CO_2 is a core source of GHG emissions
	Emissions from combustion of natural gas at the power plant.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source. Conservative simplification.
		N_2O	N	Insignificant source. Conservative simplification.
	Emissions from the coke production	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source. Conservative simplification.
		N_2O	N	Insignificant source. Conservative simplification.
Project scenario	Emissions from the coke oxidation in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source.
		N_2O	N	Insignificant source.
	Emissions from consumption of limestone in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source.
		N_2O	N	Insignificant source.
	Emissions from combustion of natural gas in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source.
		N_2O	N	Insignificant source.

	Emissions from combustion of natural gas in blast furnaces.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source.
		N_2O	N	Insignificant source.
	Emissions from combustion of fossil fuels to produce electricity.	CO_2	Y	CO_2 is a core source of GHG emissions
	Emissions from combustion of natural gas at the power plant.	CO_2	Y	CO_2 is a core source of GHG emissions
		CH_4	N	Insignificant source.
		N_2O	N	Insignificant source.

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 11/12/2009.

The baseline study was performed by Greenstream Network GmbH (project participant)

Contact:

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Contact person: Yevgen Groza
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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

01/01/2006

C.2. Expected operational lifetime of the project:

16 years (192 months) of the BF lifetime before the first complete overhaul.

C.3. Length of the crediting period:

Total length of crediting period is 15 years (180 months)
The starting date of the crediting period is 01/01/2007.
Length before Kyoto crediting period is 1 year (12 months)
The starting date of Kyoto crediting period is 01/01/2008 equal to the length of Kyoto crediting period 5 years (60 months)
Length post Kyoto crediting period is 9 years (108 months)

The status of emission reductions or enhancements of net removals generated by JI projects after the end of the first commitment period may be determined by any relevant agreement under the UNFCCC and is subject to the approval by the host Party.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The data collected for the purposes of monitoring shall be stored in electronic and/or paper formats. All measurements are to be done by calibrated measurement equipment in accordance with the relevant industrial standards. The main parameter showing the actual CO_2 emission reductions is the decrease of effective coke and power consumption per ton of hot metal produced.

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Key parameters, which are to be monitored during the crediting period, are presented below. Parameters that have to be defined once for a whole crediting period and will not be monitored further on are provided in the Section **B.1**. Other parameters excluded from the monitoring plan are dependent on the monitored parameters and shall be calculated using the primary parameters presented in the monitoring plan or under the Section **B.1**.

For the project scenario emissions the following parameters are to be monitored:

$M_{raw,j,y}$ = the weight of consumed material *j* for production of hot metal per year *y* (limestone), t;

$FF_{i,y}$ = consumed fossil fuel (coke, natural gas, and coal), m^3 or t;

$NCV_{i,y}$ = net calorific value for fuel *i* consumed per year *y*, kJ/kg or kJ/m^3

$C_{raw,j}$ = carbon content in material *j*, %;

$EC_{PE,BF,y}$ = own consumption of electricity by the blast furnaces, MWh;

$EC_{O2,y}$ = electricity consumed for oxygen production per year *y*, MWh;

$EC_{Air,y}$ = electricity consumed for production of compressed air per year *y*, MWh.

$EF_{BL,y}$ = national emission factor for UES of Ukraine for projects, aiming at a decrease of electricity consumption t CO_2e/MWh;

$EC_{Aux,y}$ = own consumption of electricity by the power plant per year *y*, MWh.

$FF_{CHP,NG,y}$ = consumption of natural gas, m^3;

$SC_{CHP,y}$ = steam consumption by the power plant, TJ/t;

$SC_{Air,y}$ = steam consumption to produce compressed air, t;

$SC_{Tech,y}$ = steam consumption to cover technological needs of the BF Shop, t;

$EF_{CO2,i}$ = Carbon emission factors for various fuels, t CO_2e/TJ;

For the baseline emissions:
P_y = production of hot metal per year *y*, t;

Carbon content in limestone and dolomite is determined from chemical composition obtained by Laboratory of EMW. Laboratory determines the composition of limestone and dolomite to verify by measurement correspondence of chemical composition to approved technical standard TU U 14.1-00191827-001-2003 "Fluxing limestone". Measurements are performed in accordance to the approved standards and methodologies

- GOST 23581.20-81 'Iron ores, concentrates, sinters, pellets. Methods of sulfur determination',
- 'Methodology of measurement performance to determine mass fraction of insoluble residue in limestones and dolomites',
- 'Methodology of measurement performance to determine mass fraction of calcium and magnesium oxides in limestones and lime'

The system of data collection and management is presented in the Section D.3.
The verification of ERUs will be based on the actual annual data. The project owner is responsible for preparing the respective reports and their submission to an independent entity.

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
2. $M_{raw,Coke,y}$	*Consumption of coke*	*Weight hopper*	*t*	*m*	*daily*	*100 %*	*electronic/paper*	
3. $M_{raw,Limestone,y}$	*Consumption of limestone*	*Track scales; Bunker scales*	*t*	*m*	*daily*	*100%*	*electronic/paper*	
23. $M_{raw,Dolomite,y}$	*Consumption of dolomite*	*Track scales; Bunker scales*	*t*	*m*	*daily*	*100%*	*electronic/paper*	
4. $FF_{NG,y}$	*Consumption of natural gas*	*Pressure meter*	*thousand m3*	*m*	*daily*	*100 %*	*electronic/paper*	

5.	$FF_{Coal,y}$	Consumption of coal	Track scales	t	m	daily	100 %	electronic/paper	
6.	$NCV_{NG,y}$	NCV of natural gas	Certificate from supplier	kJ/m^3	m	monthly	100 %	electronic/paper	
7.	$NCV_{Coal,y}$	NCV of coal	Certificate from supplier	kJ/kg	m	monthly	100 %	electronic/paper	
8.	$C_{raw,Coke}$	Carbon content in coke	Certificate from supplier	%	e	monthly	100 %	electronic/paper	In accordance with ТУ У 322-00190443-114-96 «Coke for blast furnaces »
9.	$C_{raw,Limestone}$	Carbon content in limestone	Laboratory of EMW	%	e	monthly	100 %	electronic/paper	In accordance with ТУ У 14.1-00191827-001-2003 “Fluxing limestone”
10.	$C_{raw,Dolomite}$	Carbon content in dolomite	Laboratory of EMW	%	e	monthly	100 %	electronic/paper	In accordance with ТУ У 14.1-00191827-001-2003 “Fluxing limestone”
11.	$EC_{PE,BF,y}$	Own consumption of electricity by the blast	Meter	MWh	c	monthly	100 %	electronic	

		furnaces							
12.	$EC_{O2,y}$	*Consumption of electricity for oxygen production*	*Meter*	*MWh*	*c*	*monthly*	*100 %*	*electronic*	
13.	$EC_{Air,y}$	*Consumption of electricity for compressed air production*	*Meter*	*MBm*	*c*	*monthly*	*100 %*	*electronic*	
14.	$EF_{BL,y}$	*Emission factor for UES of Ukraine for energy efficiency projects*		*t* CO_2e*/MWh*	*c*	*annually*	*100 %*		Grid emission factor is provided in the JI PDD 0018 “Introduction of energy efficiency measures at ISTIL mini steel mill, Ukraine”.
15.	$FF_{CHP,NG,y}$	*Consumption of natural gas by CHPP*	*Pressure meter*	*Thousand* m^3	*m*	*daily*	*100 %*	*Electronic/paper*	
16.	$EC_{Aux,y}$	*Own consumption of electricity by CHPP*	*meter*	*MWh*	*m*	*monthly*	*100 %*	*electronic*	
17.	$SC_{Air,y}$	*Steam consumption*	*Pressure meter*	*t*	*m*	*monthly*	*100 %*	*electronic/paper*	

		for technology needs							
18.	$SC_{Tech,y}$	*Steam consumption to produce compressed air*	*Pressure meter*	*t*	*m*	*monthly*	*100 %*	*electronic/paper*	
19.	$SC_{total,y}$	*Aggregated generation of steam by CHPP*	*Pressure meter*	*m*	*m*	*monthly*	*100 %*	*electronic/paper*	
20.	$EF_{CO2,NG}$	*Emission factor for natural gas*	*IPCC*	tCO_2/TJ	*c*	*annually*	*100 %*	*electronic/paper*	*In accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories*
21.	$EF_{CO2,Coal}$	*Emission factor for coal*	*IPCC*	tCO_2/TJ	*c*	*annually*	*100 %*	*electronic/paper*	*In accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories*

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

$$PE_y = PE_{BF,y} + PE_{El,y} + PE_{CHP,y},$$

where

PE_y = project scenario emissions, t CO_2e;
$PE_{BF,y}$ = project scenario emissions from blast furnaces, tCO_2e;
$PE_{El,y}$ = project scenario emissions from electricity consumption for oxygen and compressed air production, tCO_2e;
$PE_{CHP,y}$ = project scenario emissions from CHPP, tCO_2e;
y = year for which the calculations are made.

Emissions from the blast furnaces:

$$PE_{BF,y} = \sum_i FC_{i,y} \cdot EF_{CO_2,i} + \frac{44}{12} \sum_j M_{raw,j,y} \cdot C_{raw,j} \cdot OXID_j + EC_{PE,BF,y} \cdot EF_{BL,y},$$

where

$FC_{i,y}$ = consumption of fuel i for production of hot metal by blast furnaces in year y, TJ;

$EF_{CO2,i}$ = carbon emission factor for fuel i, including oxidation tCO_2/TJ;

$M_{raw,j,y}$ = weight of material j used to produce hot metal by blast furnaces in year y, t;

$C_{raw,j}$ = carbon content in material j, %;

$OXID_j$ = oxidation factor of material j, %;

$EC_{PE,BF,y}$ = own consumption of electricity by blast furnaces, MWh;

$EF_{BL,y}$ = National emission factor for UES of Ukraine for energy efficiency projects, t CO_2e/MWh;

$\frac{44}{12}$ = carbon to carbon dioxide conversion factor.

$$FC_{i,y} = FF_{i,y} \cdot NCV_{i,y}$$

$FC_{i,y}$ = consumption of fuel *i* for production of hot metal by blast furnaces in year *y*, TJ;

$FF_{i,y}$ = fuel consumed, m^3 or t;

$NCV_{i,y}$ = net calorific value for fuel *i* consumed in year *y*, TJ/t or TJ/m^3

Project scenario emissions from electricity consumption for production of oxygen and compressed air:

$$PE_{El,y} = EC_{O_2,y} EF_{BL,y} + EC_{Air,y} EF_{BL,y},$$

where

$PE_{El,y}$ = emissions from consumption of electricity for oxygen and compressed air production, tCO_2e;
$EC_{O2,y}$ = electricity consumed for oxygen production in year *y*, MWh;

$EF_{BL,y}$ = national emission factor for UES of Ukraine for energy efficiency projects, tCO_2e/MWh;

$EC_{Air,y}$ = consumption of electricity for oxygen and compressed air production in year *y*, MWh.

Project scenario emissions from CHPP:

$$PE_{CHP,y} = FC_{CHP,NG,y} EF_{CO_2,NG} + EC_{Aux,y} \cdot EF_{BL,y},$$

$PE_{CHP,y}$ = emissions from CHPP, tCO_2e;

$FC_{CHP,NG,y}$ = consumption of natural gas by CHPP to cover demand of BF Shop in year *y*, TJ;

$EF_{CO2,NG}$ = emission factor for natural gas, tCO_2/TJ;

$EF_{BL,y}$ = emission factor for UES of Ukraine for energy efficiency projects, tCO_2e/MWh;

$EC_{Aux,y}$ = own consumption of electricity by CHPP in year *y*, MWh.

The consumption of natural gas to cover demand of BF Shop consists of steam production to generate compressed air and technology needs.

$$FC_{CHP,NG,y} = \frac{SC_{Air,y} + SC_{Tech,y}}{SC_{CHP,y}} \cdot FF_{CHP,NG,y} \cdot NCV_{NG,y},$$

where

$FC_{CHP,NG,y}$ = consumption of natural gas by CHPP to cover demand of BF Shop, TJ;

$SC_{CHP,y}$ = steam consumption by CHPP, TJ/t;

$SC_{Air,y}$ = steam consumption to generate compressed air, t;

$SC_{Tech,y}$ = steam consumption to cover demand of BF Shop, t;

$FF_{CHP,NG,y}$ = natural gas consumed, m^3;

$NCV_{NG,y}$ = net calorific value for natural gas, TJ/m^3

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
1. P_y	*Hot metal production*	*Track scales*	*t*	*m*	*daily*	*100 %*	*Electronic/paper*	

22. EF_{CO2CP}	*Emission factor during coke production*	*IPCC*	tCO_2/t	*c*	*yearly*	*100%*	*Electronic/paper*	*In accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories*

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

The baseline scenario emissions are equal to:

$$BE_y = BE_{BF,y} + BE_{El,y} + BE_{CHP,y} + BE_{CP,y} ,$$

where

BE_y = baseline emissions, t CO_2e;
$BE_{BF,y}$ = baseline emissions from the blast furnaces, t CO_2e;
$BE_{El,y}$ = baseline emissions from the electricity consumption for oxygen and compressed air production, t CO_2e;
$BE_{CHP,y}$ = baseline emissions from the power plant, t CO_2e;
$BE_{CP,y}$ = baseline emissions from coke production reduced due to blast furnace modernization, t CO_2e;
y = reference year.

We consider a balance of carbon in blast furnaces. Carbon is being fed to kiln together with materials and fuel and carry out with BF gas and hot metal:

$$C_{fuel} + C_{raw} = C_{BFG} + C_{output} ,$$

where

C_{fuel} = carbon content in fuel, %;

C_{raw} = carbon content in materials, %;

C_{BFG} = carbon content in BF gas, %;

C_{output} = carbon content in product, %.

Taking into consideration that under baseline and project scenarios the production output is the same, the carbon content in product C_{output} will not be taken into account to simplify the calculations. Also, since the reconstruction of blast furnaces foresees substantial modernization of auxiliary equipment, own consumption of electricity has been included into GHG emissions from blast furnaces.

Thus, emissions from blast furnaces amounts to:

$$BE_{BF,y} = \sum_i FC_{BL,i,y} \cdot EF_{CO_2,i} + \frac{44}{12}\sum_j M_{BL,raw,j,y} \cdot C_{raw,j} \cdot OXID_j + EC_{BL,BF,y} \cdot EF_{BL,y},$$

where

$FC_{BL,i,y}$ = fuel i consumption for hot metal production in the blast furnaces in year y under the baseline scenario, TJ

$EF_{CO2,i}$ = emission factor for fuel i, including oxidation, tCO_2/TJ;

$M_{BL,raw,j,y}$ = material j consumed for hot metal production in blast furnaces in year y under the baseline scenario, t;

$C_{raw,j}$ = carbon content in material j, %;

$OXID_j$ = oxidation factor of material j, %;

$EC_{BL,BF,y}$ = own consumption of electricity by the blast furnaces, MWh;

$EF_{BL,y}$ = emission factor for UES of Ukraine for energy efficiency projects, tCO_2e/MWh;

$\frac{44}{12}$ = carbon to carbon dioxide conversion factor.

The consumption of fuel and materials is based on historical data of specific costs.

$$FC_{BL,y,i} = BSEC_i \cdot P_y,$$

where

$FC_{BL,i,y}$ = consumption of fuel i for hot metal production in the blast furnaces in year y under the baseline scenario, TJ;

$BSEC_i$ = specific fuel *i* consumption, TJ/t ;

P_y = hot metal production in year *y*, t;

Specific consumption is calculated as a ratio of aggregated consumption of fuel over the historical period to hot metal production over the historical period. Historical data correspond to actual data over the three years, preceding the start of the project activities.

where

$BSEC_i$ = specific fuel *i* consumption, TJ/t ;

$FC_{hist,i}$ = aggregated consumption of fuel *i* over historical period, TJ;

P_{hist} = aggregated production of hot metal over historical period (3 years), t;

$$FC_{hist,i} = FF_{hist,i} \cdot NCV_{hist,i}$$

$FC_{hist,i}$ = aggregated consumption of fuel *i* over historical period, TJ;

$FF_{hist,i}$ = fuel *i* consumed over historical period, m^3 or t;

$NCV_{hist,i}$ = average net calorific value for fuel *i* consumed over historical period, TJ/t or TJ/m^3

$$M_{BL,raw,j,y} = BSMC_j \cdot P_y ,$$

where

$M_{BL,raw,j,y}$ = material *j* consumed for hot metal production in the blast furnaces in year *y* under baseline scenario, t;

$BSMC_i$ = specific consumption of material *j*, t/t ;

P_y = hot metal production in year *y*, t;

$$BSMC_j = \frac{M_{raw,hist,j}}{P_{hist}},$$

$BSMC_i$ = specific consumption of material *j*, t/t ;

$M_{raw,hist,j}$ = aggregated consumption of material *j* over historical period, t;

P_{hist} = aggregated production of hot metal over historical period (3 years), t.

Own consumption of electricity

$$EC_{BL,BF,y} = BSEEC_{BF} \cdot P_y,$$

$EC_{BL,BF,y}$ = own consumption of electricity by the blast furnaces, MWh;

$BSEEC_{BF}$ = specific consumption of electricity by the blast furnaces, MWh/t;

P_y = production of hot metal in year y, t;

$$BSEEC_{BF} = \frac{EC_{BF,hist}}{P_{hist}},$$

$BSEEC_{BF}$ = specific own consumption of electricity by the blast furnaces, MWh/t;

$EC_{BF,hist}$ = own consumption of electricity by the blast furnaces over historical period (3 years), MWh;

P_{hist} = aggregated production of hot metal over historical period (3 years), t.

Baseline scenario emissions from the consumption of electricity for oxygen and compressed air production:

$$BE_{El,y} = EC_{BL,O_2,y} EF_{BL,y} + EC_{BL,Air,y} EF_{BL,y},$$

where

$BE_{El,y}$ = baseline scenario emissions from electricity consumption for production of oxygen and compressed air, t CO_2e;
$EC_{BL,O2,y}$ = consumption of electricity for production of oxygen and compressed air in year y under the baseline scenario, MWh;

$EF_{BL,y}$ = emission factor for UES of Ukraine for energy efficiency projects, tCO_2e/MWh;

$EC_{BL,Air,y}$ = consumption of electricity for production of compressed air in year y under baseline scenario, MWh.

Under the baseline scenario, the consumption of electricity for production of oxygen and compressed air by the electric compressors is based on the specific consumption of electricity before the project activity start.

$$EC_{BL,O_2,y} = BSEEC_{O_2} \cdot P_y ,$$

where

$EC_{BL,O2,y}$ = consumption of electricity for oxygen production under baseline scenario in year y, MWh;

$BSEEC_{O2}$ = specific consumption of electricity for oxygen production, MWh/t;

P_y = hot metal production in year y, t;

$$BSEEC_{O_2} = \frac{EC_{hist,O_2}}{P_{hist}} ,$$

$BSEEC_{O2}$ = specific consumption of electricity for oxygen production, MWh/t;

$EC_{hist,O2}$ = historical data regarding the electricity consumption for oxygen production (3 years), MWh

P_{hist} = aggregated production of hot metal over historical period (3 years), t;

$$EC_{BL,Air,y} = BSEEC_{Air} \cdot P_y ,$$

where

$EC_{BL,Air,y}$ = consumption of electricity for production of compressed air in year y under baseline scenario, MWh;

$BSEEC_{Air}$ = specific consumption of electricity for production of oxygen, MWh/t;

P_y = production of hot metal in year y, t;

$$BSEEC_{Air} = \frac{EC_{hist,Air}}{P_{hist}} ,$$

$BSEEC_{Air}$ = specific consumption of electricity for production of compressed air, MWh/t ;

$EC_{hist,Air}$ = historical data regarding electricity consumption for production of compressed air (3 years), MWh

P_{hist} = aggregated production of hot metal over historical period (3 years), t.

Baseline scenario emissions from CHPP consists of emissions from natural gas consumption and own consumption of electricity by CHPP.

$$BE_{CHP,y} = FC_{BL,CHP,NG,y} EF_{CO_2,NG} + EC_{BL,Aux,y} \cdot EF_{BL,y} ,$$

where

$BE_{CHP,y}$ = baseline scenario emissions from CHPP, tCO_2e;

$FC_{BL,CHP,NG,y}$ = consumption of natural gas by CHPP in year *y* under the baseline scenario, TJ;

$EF_{CO2,NG}$ = carbon emission factor for natural gas, tCO_2/TJ;

$EF_{BL,y}$ = emission factor for UES of Ukraine for energy efficiency projects, tCO_2e/MWh;

$EC_{BL,Aux,y}$ = own consumption of electricity by CHPP in year *y* under baseline scenario, MWh.

Alike the calculation of electricity consumption for production of oxygen and compressed air, the calculations of the baseline scenario emissions by CHPP are based on specific consumption.

$$FC_{BL,CHP,NG,y} = BSEC_{NG,CHP} \cdot P_y ,$$

where

$FC_{BL,CHP,NG,y}$ = consumption of natural gas by CHPP to cover demand of BF Shop in year *y* under baseline scenario, TJ;

$BSEC_{NG,CHP}$ = specific consumption of natural gas by CHPP, TJ/t ;

P_y = production of hot metal in year *y*, t;

$$BSEC_{NG,CHP} = \frac{FC_{CHP,NG,hist}}{P_{hist}} ,$$

$BSEC_{NG,CHP}$ = specific consumption of natural gas by CHPP, TJ/t ;

$FC_{CHP,NG,hist}$ = consumption of natural gas by CHPP to cover demand of BF Shop over historical period, TJ;

P_{hist} = aggregated production of hot metal over historical period (3 years), t.

The consumption of natural gas to cover demand of BF Shop consists of demand for steam to generate compressed air as well as demand to cover technology needs.

$$FC_{CHP,NG,hist} = SNGC_{CHP,hist} \left(SC_{Air,hist} + SC_{Tech,hist} \right),$$

where

$FC_{CHP,NG,hist}$ = consumption of natural gas by CHPP to cover demand of BF Shop over historical period (3 years), TJ;

$SNGC_{CHP,hist}$ = specific consumption of natural gas over historical period, TJ/t;

$SC_{Air,hist}$ = consumption of steam to generate compressed air, t;

$SC_{Tech,hist}$ = consumption of steam to cover technology needs of the BF Shop, t;

$$SNGC_{CHP,hist} = \frac{FC_{CHPtotal,NG,hist}}{SC_{total,hist}},$$

$SNGC_{CHP,hist}$ = specific consumption of natural gas over historical period, TJ/t;

$FC_{CHPtotal,NG,hist}$ = total consumption of natural gas by CHPP over historical period (3 years), TJ;

$SC_{total,hist}$ = aggregated generation of steam by CHPP over historical period (3 years), t.

Own consumption of electricity.

$$EC_{BL,Aux,y} = BSEC_{Aux,CHP} \cdot P_y,$$

$EC_{BL,Aux,y}$ = own consumption of electricity by CHPP in year y under baseline scenario, MWh.

$BSEC_{Aux,CHP}$ = specific own consumption of electricity by CHPP, MWh/t;

P_y = production of hot metal in year y, t;

$$BSEC_{Aux,CHP} = \frac{EC_{Aux,CHP,hist}}{P_{hist}},$$

$BSEC_{Aux,CHP}$ = specific own consumption of electricity by CHPP, MWh/t;

P_{hist} = aggregated production of hot metal over historical period (3 years), t.

$EC_{Aux,CHP,hist}$ = own consumption of electricity by CHPP over historical period (3 years), MWh.

P_y = hot metal production in year y, t;

$$BSEC_{Aux,CHP} = \frac{EC_{Aux,CHP,hist}}{P_{hist}},$$

$BSEC_{Aux,CHP}$ = specific electricity consumption for the own needs of CHPP, MWh/t;

P_{hist} = aggregated hot metal production during the historical period (3 years), t;

$EC_{Aux,CHP,hist}$ = electricity consumption for the own needs of CHPP during the historical period (3 years), MWh.

$$BE_{CP,y} = EF_{CO_2,CP} M_{DCC,y}$$

$BE_{CP,y}$ = baseline emissions from coke production reduced due to blast furnace modernization, t CO_2e;
$M_{DCC,y}$ = Mass of reduced coke consumption at EMW, t;
EF_{CO2CP} = Emission factor[7] during coke production tCO_2/t;

Mass of reduced coke consumption calculated as difference between coke consumption in the baseline and project scenario

$$M_{DCC,y} = M_{BL,coke,y} - M_{P,coke,y}$$

$M_{DCC,y}$ = Mass of reduced coke consumption at EMW, t;
$M_{BL,coke,y}$ = Coke consumption at EMW in baseline scenario, t;
$M_{P,coke,y}$ = Coke consumption at EMW in project scenario, t;

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

Not applicable

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

[7] Emission factor taken in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 4, Table 4.1

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):

Not applicable

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

An increase in GHG emissions outside the project boundaries in result of the project implementation is not expected.

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

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

Leakages are not expected.

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):

Emission reductions are calculated in accordance with the following formulae:

$$ER_y = BE_y - PE_y - LE_y$$

where

ER_y = emission reductions in year *y*, tCO_2e;

BE_y = baseline GHG emissions in year *y*, tCO_2e;

PE_y = project GHG emissions in year *y*, tCO_2e;

LE_y = leakages in year *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:

Information on environmental impacts is presented in the Section F of this PDD.

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.
Table D.1.1.3. 1	low	Measurements are carried out by strain-gauge balance track scales of ErMak BB 200-2-50. The class of accuracy is average. Calibration is performed in accordance with GOST29329-92
Table D.1.1.1. 2,5	low	Measurements are carried out by weight hoppers. The class of accuracy is average.
Table D.1.1.1. 3, 23	low	Measurements are carried out by the track scales EVV40B and 115EVV40 for BF 1 and 4, as well as by the bunker scales for BF 5
Table D.1.1.1. 4	low	Measurements are carried out by the meter Metran 150, the class of accuracy is 0.25. Calibration is done in accordance with DSTU 2708-2006 "Methrology. Testing of measuring devices. Organization and procedures."

Table D.1.1.1. 6,7	low	Data are taken from the certificates provided by the suppliers. No plans for additional QA/QC procedures.
Table D.1.1.1. 8, 9, 10	low	No plans for additional QA/QC procedures.
Table D.1.1.1. 11	low	Measurements are carried out by the electronic meters. Calibration is done in accordance with DSTU 2708-2006 "Methrology. Testing of measuring devices. Organization and procedures."
Table D.1.1.1. 12,13	low	Measurements are carried out by the electronic meters Delta 8010, SAZU-I670M, SAZU-I673M ST-EA03. Calibration is done in accordance with DSTU 2708-2006 "Methrology. Testing of measuring devices. Organization and procedures."
Table D.1.1.1. 14	low	No plans for additional QA/QC procedures.
Table D.1.1.1. 15	low	Measurements are carried out by the meter Metran 100DD, the class of accuracy is 1.5%
Table D.1.1.1. 16	low	Measurements are carried out by the electronic meters TsE6805V, TsE6811, ST-EA03, SA4U-I672M, SAZU-I670M, LO-3T5-1M1. Calibration is done in accordance with DSTU 2708-2006 "Methrology. Testing of measuring devices. Organization and procedures."
Table D.1.1.1. 17,18,19	low	Measurements are carried out by the meter Metran 100DD, the class of accuracy is 2.5% and DM -3583 the class of accuracy is 2.5%
Table D.1.1.1. 20,21,22	low	No plans for additional QA/QC procedures.

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

The monitoring plan does not foresee any other additional measures, resulting in installation of new measuring equipment or collection of additional parameters in addition to those that are already implemented. A scheme of data collection is provided in Figure 5.

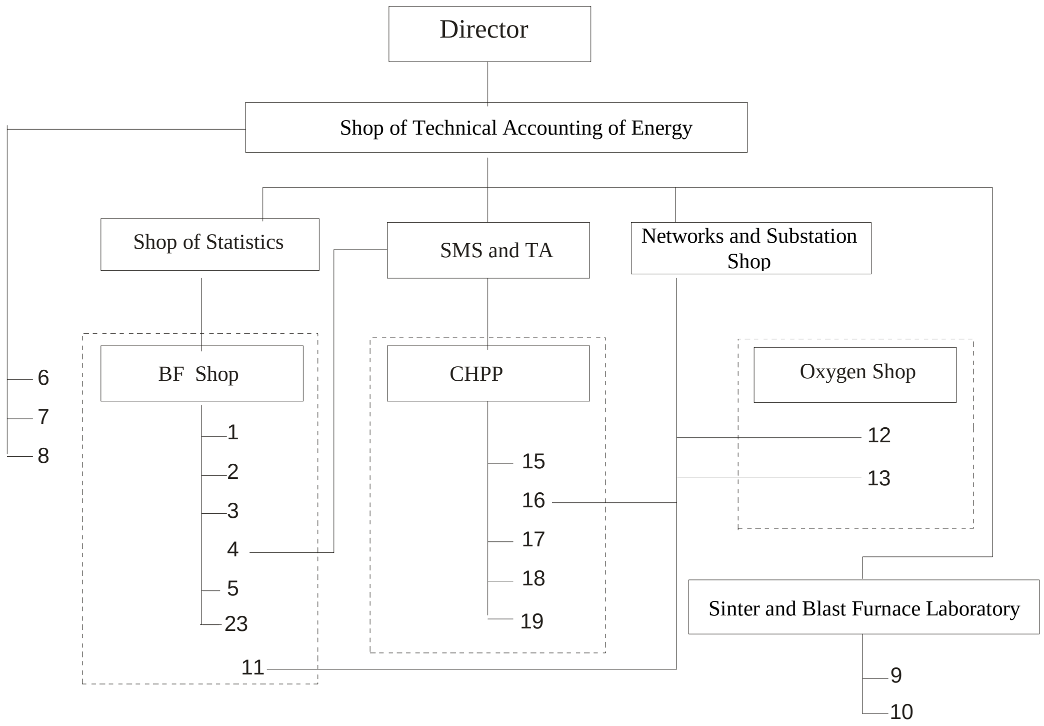

Figure 5 The scheme of data collection for the purposes of monitoring *(Numbers correspond to ID number of monitored data)*

The following shops and units are responsible for data collection and storage:

BF Shop

The shop collects data on the consumption of fuel and materials for hot metal production.

CHPP

The power plant is responsible for data collection on production of steam to generate compressed air and to cover the needs of BF Shop

Networks and Substation Shop

The shop is on charge of data collection regarding electricity consumption by the company shops

Shop of Measurement Systems and Thermal Automatic (SMS and TA)

is responsible for data collection on the consumption of natural gas.

Shop of statistics
stores primary information.
Sinter and Blast Furnace Laboratory
holds the express analysis of carbon content in limestone
Shop of Technical Accounting of Energy
provides data collection and processing
Oxygen Shop
does not participate in the data collection directly, but the equipment for generation of oxygen and compressed air is located on its territory

Initial data at EMW usually stored during 3 years. OJSC "EMW" issued special instruction # 711 to keep information during project lifetime plus two years.

Initial data is stored in the paper records at registers of Blast Furnace Shop, CHPP, SMS and TA, Networks and Substation Shop and Sinter and Blast Furnace Laboratory. Processed data in electronic form is also kept in Shop of Technical Accounting of Energy.

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

OJSC «Enakievo Metallurgical Works » (project participant)

GreenStream Network GmbH (project participant)

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The volumes of greenhouse gas emissions after the implementation of the project measures are presented in the Table 4 below. Table 5 presents the project scenario emissions after 2012.

Table 4. Project scenario emissions

			2007	2008	2009	2010	2011	2012
Emissions from the blast furnaces	$PE_{BF,y}$	tCO_2	4270662	4586320	3979796	4176130	4616532	4800505
Oxygen Shop emissions	$PE_{El,y}$	tCO_2	476953	449568	335068	389913	497218	497218
Emissions from CHPP	$PE_{CHP,y}$	tCO_2	88616	92739	76215	74305	94754	94754
Total emissions in the project scenario	$\boldsymbol{PE_y}$	$\mathbf{tCO_2}$	**4836232**	**5128627**	**4391080**	**4640348**	**5208504**	**5392477**

Table 5. Project scenario emissions after 2012

Year	Emissions from the blast furnaces, tCO_2	Oxygen Shop emissions, tCO_2	Emissions from CHPP, tCO_2	**Total project scenario emissions, tCO_2**
	$PE_{BF,y}$	$PE_{El,y}$	$PE_{CHP,y}$	$\boldsymbol{PE_y}$
2013	4 800 505	497 218	94 754	**5 392 477**
2014	4 800 505	497 218	94 754	**5 392 477**
2015	4 800 505	497 218	94 754	**5 392 477**
2016	4 800 505	497 218	94 754	**5 392 477**
2017	4 800 505	497 218	94 754	**5 392 477**
2018	4 800 505	497 218	94 754	**5 392 477**
2019	4 800 505	497 218	94 754	**5 392 477**
2020	4 800 505	497 218	94 754	**5 392 477**
2021	4 800 505	497 218	94 754	**5 392 477**

E.2. Estimated leakage:

No leakages are expected

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

Since the leakage emissions $LE_y = 0$, the sum of leakage emissions and project scenario emissions is in fact equal to the identified project scenario emissions. The resulting emissions volumes are presented below in the Table 6 and Table 7.

Table 6. The sum of leakages and project scenario emissions

			2007	2008	2009	2010	2011	2012
The sum of E.1. and E.2.	PE_y	tCO_2	**4836232**	**5128627**	**4391080**	**4640348**	**5208504**	**5392477**

Table 7. The sum of leakages and project scenario emissions after 2012

			2013	2014	2015	2016	2017	2018	2019	2020	2021
The sum of E.1. and E.2.	PE_y	tCO_2	**5392477**	**5392477**	**5392477**	**5392477**	**5392477**	**5392477**	**5392477**	**5392477**	**5392477**

E.4. Estimated baseline emissions:

The baseline scenario emissions are presented in the Table 8 and Table 9 below.

Table 8. Baseline scenario emissions

			2007	2008	2009	2010	2011	2012
Emissions from the blast furnaces	$BE_{BF,y}$	tCO_2	4486641	4836196	4156386	4426755	5159234	5159234
Oxygen Shop emissions	$BE_{El,y}$	tCO_2	489206	511964	420747	441503	563007	563007
Emissions from CHPP	$BE_{CHP,y}$	tCO_2	88616	92739	76215	79975	101985	101985
Emission from coke production	BE_{CP}	tCO_2	31 770	47 893	35 981	7 572	91 296	91 296
Total baseline scenario emissions	BE_y	tCO_2	**5096233**	**5488792**	**4689329**	**4955807**	**5915521**	**5915521**

Table 9. Baseline scenario emissions after 2012

Year	Emissions from the blast furnaces, tCO_2	Oxygen Shop emissions, tCO_2	Emissions from CHPP, tCO_2	Emissions from coke production, tCO_2	**Total baseline scenario emissions, tCO_2**
	$BE_{BF,y}$	$BE_{El,y}$	$BE_{CHP,y}$	BE_{CP}	$\boldsymbol{BE_y}$
2013	5 159 234	563 007	101 985	91 296	**5 828 481**
2014	5 159 234	563 007	101 985	91 296	**5 828 481**
2015	5 159 234	563 007	101 985	91 296	**5 828 481**
2016	5 159 234	563 007	101 985	91 296	**5 828 481**
2017	5 159 234	563 007	101 985	91 296	**5 828 481**
2018	5 159 234	563 007	101 985	91 296	**5 828 481**
2019	5 159 234	563 007	101 985	91 296	**5 828 481**
2020	5 159 234	563 007	101 985	91 296	**5 828 481**
2021	5 159 234	563 007	101 985	91 296	**5 828 481**

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

The emission reductions are presented below in the Table 10 and Table 11.

Table 10. Emission reductions

			2007	2008	2009	2010	2011	2012
Emission reductions	***ER***	**tCO_2**	260 001	360 165	298 249	315 459	707 017	523 044

Table 11. Emission reductions after 2012

			2013	2014	2015	2016	2017	2018	2019	2020	2021
Emission reductions	***ER***	**tCO_2**	523 044	523 044	523 044	523 044	523 044	523 044	523 044	523 044	523 044

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

The result of applying the formulae presented above is presented in the following tabular format				
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 emission reductions (tonnes of CO_2 equivalent)
2007	4 836 232	0	5 096 233	260 001
2008	5 128 627	0	5 488 792	360 165
2009	4 391 080	0	4 689 329	298 249
2010	4 640 348	0	4 955 807	315 459
2011	5 208 504	0	5 915 521	707 017
2012	5 392 477	0	5 915 521	523 044
Total (tonnes of CO_2 equivalent)	29 597 267	0	32 444 499	2 470 498

After 2012

The result of applying the formulae presented above is presented in the following tabular format				
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 emission reductions (tonnes of CO_2 equivalent)
2013	5 392 477	0	5 915 521	523 044
2014	5 392 477	0	5 915 521	523 044
2015	5 392 477	0	5 915 521	523 044
2016	5 392 477	0	5 915 521	523 044
2017	5 392 477	0	5 915 521	523 044
2018	5 392 477	0	5 915 521	523 044
2019	5 392 477	0	5 915 521	523 044
2020	5 392 477	0	5 915 521	523 044
2021	5 392 477	0	5 915 521	523 044
Total (tonnes of CO_2 equivalent)	48 532 289	0	53 239 687	4 707 398

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 proposed Introduction of energy efficiency measures at OJSC "Enakievo Metallurgical Works" includes measures that require Environmental Impact Assessment (EIA). EIA was performed and approved in frame of project design documentation. The following EIAs were performed:

'Construction of blast furnace #5 with payload volume 1513 m^3 with reconstruction of infrastructure objects. Environmental Impact Assessment Vol. 10.' Performed by OJSC "Ukrainian scientific centre of technical ecology"

'Feasibility study of blast furnace #3 reconstruction of Enakievo Metallurgical Works with increasing volume from 1033 m^3 up to 1513 m^3. Environmental Impact Assessment.' Performed b LLC "Ecotechnology".

'Energy department reconstruction. Stage 2. Feasibility study of first reconstructed object. Environmental Impact Assessment Vol. 4.'. Performed by CJSC "Lonas technology"

The EIA of the BF reconstruction project was performed in accordance with the following regulations:

- DBN A.2.2.1-2003 'Composition and content of the environmental impact assessment (EIA) documents for designing of the plants, buildings and structures'
- DBN A.2.2-3-2004 'Construction design composition and rules for its development, endorsement and approval'
- The Law of Ukraine 'On the environmental expertise'

The steel producing companies are listed in the Decree of the Cabinet of Ministers of Ukraine #554 dated 27.07.1995 'On the list of activities and objects which pose high environmental risk', therefore the full EIA procedure has to be undertaken in accordance with the DBN A.2.2.1-2003 standard.

Main conclusions

After the reconstruction of BF 5 and BF 3 the atmospheric emissions of hazardous substances will decrease by 1672 t annually compared to the existing emission level (6434 ton per year). The emissions of nitrogen oxides will be reduced by 31 t/year, sulfuric anhydride by 58 t/year, carbon monoxide by 1309 t/year and suspended matters by 274 t/year respectively.

The discharge of waste water into the river of Bulavyn will be reduced by 3154 t/year as a result of the reconstruction of BF 5 and BF 3.

The waste associated with the production processes (sludge, slag, top dust) and waste with iron content (top dust, gas cleaning sludge) are to be fully utilized in the sinter production and in the construction works for the housing and road construction, and engineering structures.

All the measures of reconstruction and construction activities are executed within the physical boundaries of the existing enterprise, therefore no additional land allocation is necessary.

The construction waste will partially be transported to the enterprise's warehouse and are to be sold to construction companies after the proper sorting; metal waste is used as scrap in the production process. Fifteen thousand cubic meters of the contaminated ground was utilized for covering the engineering communications during the construction of BF 5; the rest of ground was used for the restoration and conservation of the municipal solid waste landfill.

OJSC "EMW" has all necessary licences and permits for project activity

The permit to perform construction works of Linde oxygen unit dated 21.11.2003

The permit to perform construction works of blast furnace #5 dated 05.05.2004

The permit to perform construction works for reconstruction of blast furnace #3 dated 03.07.2009

The certificate of state inspection acceptance and allowing the operation of "Linde" oxygen unit dated 27.12.2006

The certificate of state inspection acceptance and allowing the operation the constructed blast furnace #5 dated 08.09.2008

Secondary complex expert's report on feasibility study of "Linde" oxygen unit dated 08.07.2004

Complex expert's report on feasibility study of blast furnace #3 reconstruction of Enakievo Metallurgical Works dated 15.05.2009

Special permission for water consumption # UKR DON 3516

Transboundary impacts

Ukraine has ratified three Protocols to the UN Convention on Long-range Transboundary Air Pollution. Two of these Protocols are directly related to the reduction and control over the hazardous substances emissions, namely:

- The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent, entered into force as of September 2nd, 1987.
- The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes, entered into force as of February 14th, 1991.

According to the EIA findings, the reconstruction of the blast furnaces will result in decreasing the emissions of nitrogen oxides by 31 t/year and sulfuric anhydride by 58 t/year. Therefore, the reduction of the abovementioned emissions is fully in accordance with the commitments of Ukraine under the UN Convention on Long-range Transboundary Air Pollution.

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 proposed project will have a positive overall impact on the environment compared to the existing state of affairs, since the planned reconstruction will improve energy efficiency and decrease the levels of pollutants discharge into the atmosphere and into the river of Bulavyn. Thus, the environmental impacts of the proposed project are insignificant.

SECTION G. Stakeholders' comments

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

The main stakeholder impacted by the proposed project is the population of the town of Yenakiyeve. The local population was duly informed about the project activities in the local newspaper 'Za Metall'. The December 1st, 2004 issue of the newspaper contains articles regarding the construction of the Linde unit and BF 5 reconstruction (‘V sotrudnichestve s nemetskimi spetsialistami’ / ‘Cooperation with the German experts’, ‘Vysota eschew vperedi’ / ‘The future achievements’). On November 10th 2007 an article regarding the reconstruction of BF 3 and introduction of the pulverized coal was published in the newspaper (‘Berem za osnovu luchshee’ / ‘Using the best practices’). As the proposed project envisages positive social and environmental impacts, only positive feedback regarding the project were received.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Project owner:

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Annex 2

BASELINE INFORMATION

Please refer to the Section B.

Annex 3

MONITORING PLAN

Please refer to the Section D.

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