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

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Revamping of sintering and blast-furnace production at OJSC «Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky»

Sectoral scope: 9 (metallurgy).

Project Design Document Version 6
10/05/2011

A.2. Description of the project:

Open Joint Stock Company Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky (DIISW) is one of the largest enterprises in the Ukrainian mining and steelmaking complex and a top six country's leading iron and steel works for production output and sales. The Plant is located in the city of Dniprodzerzhynsk, Dnipropetrovsk region, in the eastern part of Ukraine. DIISW is a part of Industrial Union of Donbass Corporation (IUD). IUD is one of the largest international steelmaking groups known to the world as a leader in the Central and Eastern European iron and steel sector. Apart from DIISW, IUD owns a number of enterprises in Ukraine and the EU, including such assets as OJSC Alchevsk Iron and Steel Works (Ukraine), ISD – Huta Częstochowa (Poland), CJSC ISD – Dunaferr (Hungary), and the coke plant OJSC Alchevskkoks (Ukraine).

DIISW is an enterprise with full metallurgical cycle. It includes the following production units as sintering, blast-furnace, converter with continuous casting, together with maintenance, energy, transport and supporting units.

Before project implementation DIISW used sinter plant (SP) and blast-furnaces (BF) which were installed in 1950-1970's and have not been changed technologically since their operation start. SP and BFs can be characterized as energy intensive, consuming large quantities of energy resources and causing significant emissions into atmosphere of greenhouse and harmful gases as well as dust. Sinter plant consisted of six sintering machines. BF shop consisted of the following BFs:#8, 9, 10[1] (further 1M), 11 and 12.

There were not and still do not exist any legal requirements to replace or reconstruct less effective blast furnaces or sinter plant in the country leaving a decision on their replacement at project owner's discretion. Also, the greater presence at the market could be achieved by use of old production technologies, virtually without additional investment. Therefore the baseline for the proposed JI project is preservation of the situation existing prior to the project: continuation of sinter plant and BFs operation without reconstruction and introduction of new technology.

In December 2003 both enterprise and IUD Corporation have decided to start development of the enterprise by technical revamping of sintering and BF production[2]. The main goal was not only to improve performance of the enterprise, but also to solve environmental problems of production process.

The proposed Joint Implementation project considers complex resource-saving effect related with implementation of new SP and BF#4, gradual reconstruction of the remaining BFs #8, 9, 12 and 1M with application of contemporary technologies and equipment such as:

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[1] After the radical reconstruction of the BF#10 it was renamed into BF#1M.
[2] The minutes of meeting regarding condition of basic production assets of DIISW and development of strategy for its reconstruction and revamping, dated December 26, 2003

- pulverized-coal injection system;
- oxygen unit;
- coal drying and grinding units;
- introduction of the automatic and control systems;
- aspiration and gas-purification facilities.

Also, project activity envisages technological improvements in the process of sintering and pig iron production.

The project measures and activities that have been and would be implemented at DIISW pig iron production lead to better productivity of SP and BFs, reduction of specific coke and other fuel and materials consumption and therefore, emission reductions of GHGs. Some of these measures involved improvements in preparation of raw materials at SP which mainly of technological character and also connected with introduction of a new SP that would replace the existing one.

A new SP would be a state of art metallurgical equipment comprising engineering and design achievements with automatic solutions[3] and would lead to lower fuel consumption and emission levels during sintering process. The same effect will be reached after introduction of new BF#4 and radical reconstruction of BF#1M, which would replace less efficient existing BF production.

The SP and BF shop require production of so-called secondary energy sources such as compressed air, steam, nitrogen, oxygen etc. These products are produced at the Steel Mill and a major part of them comes from the local power facilities. For a long time the modernization of the energy production has not been done because of absence of incentives into energy saving, uncertainty with market situation, difficulties with mobilizing the credit resources etc.

The implementation of JI project requires the total investment costs of US$ 1,1 billion as described further in this PDD (Section A.4.2., Table 1).

The possibility to use Kyoto mechanisms contributed to identification of ways to improve energy-efficiency and environment at the sintering and blast-furnace process. These mechanisms will allow DIISW to receive additional financing needed to expand the JI project boundaries and reduce the period of credit payment and thus enhance the attractiveness of the project.

[3] http://www.industry.siemens.com/industrysolutions/metals-mining/en/metals/ironmaking/sinter_plant/Pages/home.aspx

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 Party)	OJSC "Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky"	No
Japan	Sumitomo Corporation	No
Spain	Endesa Carbono, S.L.	No
The Netherlands	Stichting Carbon Finance (SCF) - *on behalf of the Netherlands*	No
Spain	Stichting Carbon Finance (SCF) - *on behalf of Spain*	No
The Netherlands	Deutsche Bank AG, *London branch*	No

A.4. Technical description of the project:

A.4.1. Location of the project:

The site of the DIISW is located in the northern part of the town of Dniprodzerzhynsk located on the right side of the Dnipro river, 12 km from Baglei station of Transdnipro Railways, serving deliveries of materials to the Plant and shipments of its finished products. The site is limited by the Dnipro river from the north, urban areas from the south, sites of Dniprodzerzhynsk HPP and cement factory from the west, and coke plant from the east.

A.4.1.1. Host Party(ies):

Ukraine

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

Dnipropetrovsk region

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

Dniprodzerzhynsk

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

Dniprodzerzhynsk is one of the Ukraine's largest industrial centres. Established in 1897, it covers both sides of the Dnipro river and its global position is 48°30′N – 34°37′E. The town has the area of approximately 138 square kilometres and the population of 251.4 thousand people. Location of the project on the Ukrainian map is shown on Fig. 1.

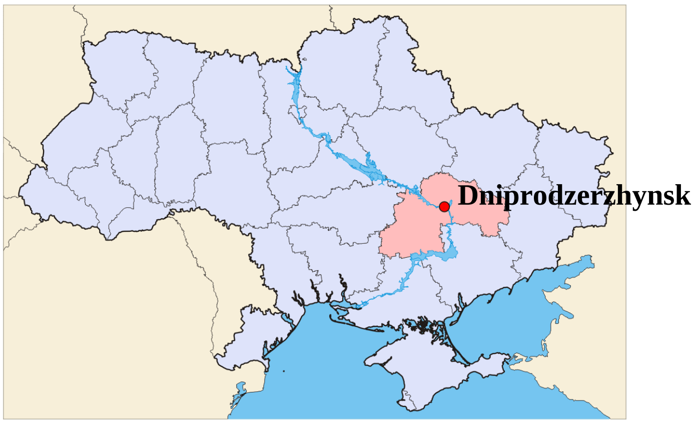

Figure 1. Map of Ukraine and Location of JI Project Site. Source: www.wikipedia.org.

Industrial estate of the town is comprised of 48 large productions representing 10 sectors of industry, predominantly steelmaking and chemical sector, but also heavy engineering, electric power, wood processing, food, light, printing and other economy sectors. The largest enterprises include Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky, DniproAzot, Dniprovagonmash, Bagliykoks, Dniprodzerzhynsk Coke Plant and Transdnipro Chemical Works.

Nearly 80% of the town's overall production output is on account of steelmaking and chemical industry. Articles produced include pig iron, steel, mill products, cement, coke, mineral fertilisers, electricity, mainline and industrial railway cars, and buses.

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

The proposed project activity consists of three main components as follows: 1) technological improvements of BFs operation; 2) reconstruction of BF shop with an introduction of the new blast furnace #4; 3) modernization of sintering process with an introduction of the new SP.

Table 1. Implementation schedule for revamping of sintering and pig iron production[4]

Phase	*Measures*	*Invest-ments, mio. USD*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
1	**Technological improvements of the BFs operation**														
	Installation of pulverized coal injection (PCI) system	143[5]													
2	**Reconstruction of the BF shop**														
	Renewal and reconstruction of BF#1M	42,5[6]													
	Reconstruction of BF # 8, 9,12	347,6[5]													
	Implementation of a new BF#4M	168,6[5]													
	Implementation of a new oxygen plant AKAp 40/53-4	135,6[6]													
3	**Modernization of the sintering process**														
	Implementation of a new sinter plant	266,4[5]													
	Total	**1 103,7**													

In order to understand the character of project activity that involves technological improvements, it is needed to give a brief explanation about principal technological scheme of sintering process and blast furnace operation.

Carbon dioxide emissions in the sintering production processes are mainly achieved during: the process of burning solid fuel, which is part of the sintering charge; the process of burning natural gas, which is fed into burners for ignition of sintering charge; reaction of limestone decomposition, which is part of sintering charge, to calcium oxide and carbon dioxide. The principal scheme of sinter plant operation is described below.

[4] Expected at the time of preparation of this document.
[5] Source: Feasibility study, available upon request to DIISW.
[6] Actual data, available at planned - economic department of DIISW

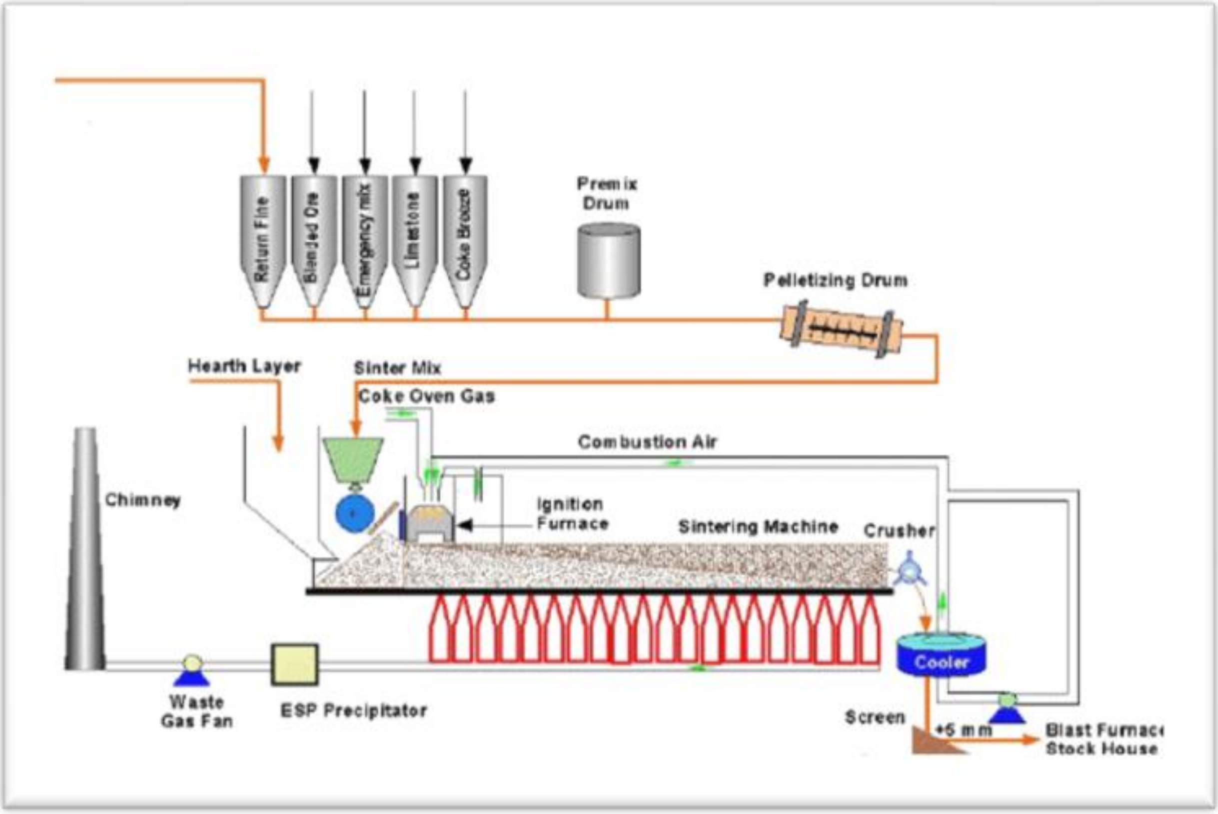

Figure 2. Principal process description of sintering production

By sintering, the pelletisation of fine-grained, smeltable ores, iron ore in particular, to compact lumps by heating nearly to the melting or softening point is understood. Melting tendencies at the grain boundaries lead to a caking of the material. Before the sintering, the various substances are first mixed and granulated. The iron ores are agglomerated on conveyor sinter installations, the conveyor belts consist of a large number of waggons. These waggons that have been linked up as an endless conveyor belt. The fine ore to be sintered is moistened and fed on to the circulating grid together with coke slack and additions such as limestone, quick lime, olivine or dolomite. Burners above a heat-resistant grate belt heat the material to the required temperature (1100-1200 °C). This causes the fuel in the mixture to be ignited. The carbon burns with the aid of the air sucked through the grid into the mixture, resulting in the flame front being moved through the sintering bed. The sintering processes are completed once the flame front has passed through the entire mixed layer and all fuel has been burnt.

Iron sintering plants are associated with the manufacture of pig iron. The sintering process is a pre-treatment step in the production of pig iron, where fine particles of iron ores and also secondary iron oxide wastes (collected dusts, mill scale), are agglomerated by combustion. Sintering involves the heating of fine iron ore with flux and coke fines or coal to produce a semi-molten mass that solidifies into porous pieces of sinter with the size and strength characteristics necessary for feeding into the blast furnace. Moistened feed is delivered as a layer onto a continuously moving grate or "strand." The surface is ignited with gas burners at the start of the strand, and air is drawn through the moving bed causing the fuel to burn. Strand velocity and gas flow are controlled to ensure that "burn through" (i.e. the point at which the burning fuel layer reaches the base of the strand) occurs just prior to the sinter being discharged. The solidified sinter is then broken into pieces in a crusher and is air-cooled. Product outside the required size range is screened out, oversize material is recrushed, and undersize material is recycled back to the process.

The flexibility of the sintering process permits conversion of a variety of materials, including iron ore fines, captured dusts, ore concentrates, and other iron-bearing materials of small particle size (e.g., mill scale) into a clinker-like agglomerate.

Agglomerate or ironstone is main feeding product of the blast furnaces.

The general scheme of blast furnace process is given below.

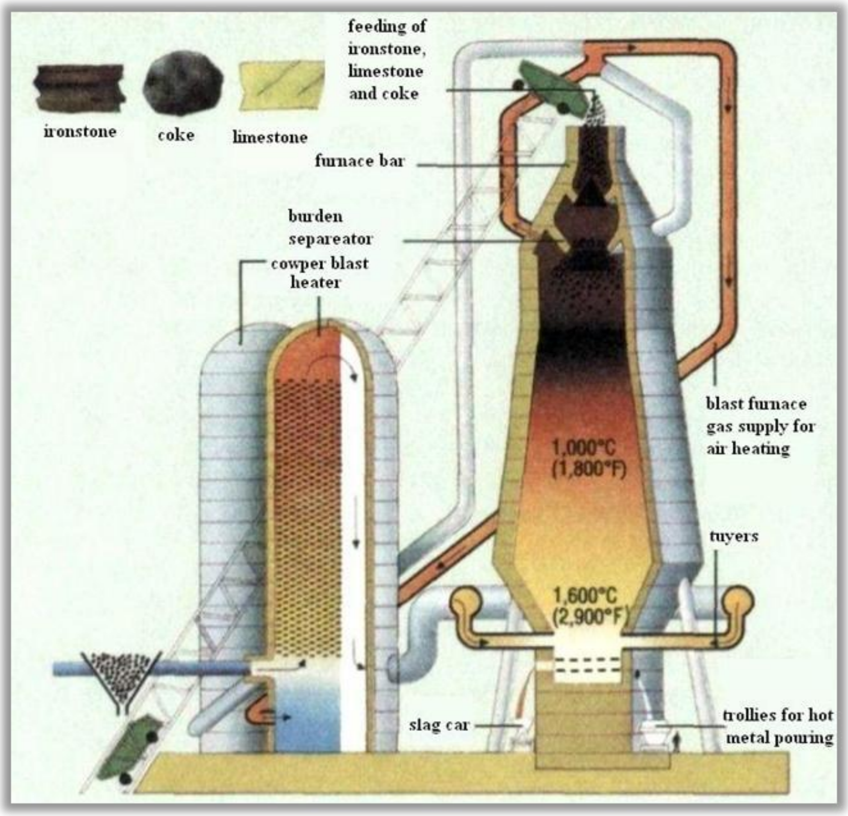

Figure 3. The general scheme of blast furnace process

The blast furnace is a counter flow kiln. A simplified schematic of the Blast Furnace is shown in Figure 3.

The iron making blast furnace itself is built in the form of a tall chimney-like structure lined with refractory brick. Coke, limestone flux, and iron ore (iron oxide) are charged into the top of the furnace in a precise filling order which helps control gas flow and the chemical reactions inside the furnace. Four "uptakes" allow the hot, dirty gas to exit the furnace dome, while "bleeder valves" protect the top of the furnace from sudden gas pressure surges. The "casthouse" at the bottom half of the furnace contains the bustle pipe, tuyeres and the equipment for casting the liquid iron and slag. Once a "taphole" is drilled through the refractory clay plug, liquid iron and slag flow down a trough through a "skimmer" opening, separating the iron and slag. Once the pig iron and slag has been tapped, the taphole is again plugged with refractory clay.

Pig iron is a product of the reduction of the iron bearing materials. The process of the iron reduction from pellets and agglomerate can be expressed by following chemical reactions:

1. $3Fe_2O_3 + CO = CO_2 + 2Fe_3O_4$ Begins at 450 ^oC;
2. $Fe_3O_4 + CO = CO_2 + 3FeO$ Begins at 600 ^oC;

3. $FeO + CO = Fe + CO_2$ or
4. $FeO + C = Fe + CO$ Begins at 700 °C.

Emissions that occur during the pig iron production mainly occur from coke combustion, natural gas combustion, limestone calcination as well as electricity consumption.

Below it is given a more detailed explanation of the project activity.

1. Technological improvements of the BFs operation

According to the Ukrainian standards and norms, regular *maintenance and overhauling* of the main equipment of the blast furnace shop at DIISW is planned to be performed within certain time periods (see Table 2).

Table 2. Maintenance timing. Source: "Maintenance and equipment repair"

Type of maintenance	Period between maintenances, years	Maintenance duration, days
First category maintenance of the BF	14 - 16	36-40
Second category maintenance of the BF	5 - 8	15-20
Third category maintenance of the BF	1 - 2	2-5

The purpose of maintenance is to maintain the performance of the furnace and to extend the technical lifetime. Some of the proposed project measures could not be implemented whilst maintaining the original technical characteristics of the furnaces' layout. That is why technical improvements of the blast furnaces were planned.

Technological improvements in the context of this project are defined as measures that exceed those that would be normally included during regular maintenance. Therefore the project activity cannot be mixed activities for maintenance of the blast furnaces.

Technological improvements in the blast furnace shop mainly include the following measures:

Improvement of blast furnace coke quality

The improvement of coke quality, in particular, of its fraction content, hardness, abrasion, ash content, sulphur content etc., influence directly on reduction of coke consumption and increase of productivity of BFs, as it can be seen from the table 3, Section A.4.3.

Measures on improvement of BF coke quality are implemented at the plant from the beginning of the year 2004. Starting from the year 2012 the DIISW is planning to consume coke of dry quenching. The experience of dry coke usage has showed its positive influence on energy intensity of pig iron process.

The improvement of BF coke quality is not monitored directly within the proposed project activity as utilization of coke of better quality leads to changes in specific rates of coke consumption and productivity of BFs, which are monitored according to the monitoring plan.

Increasing the iron content in the iron-bearing materials

BFs at DIISW are using iron ore as the main material needed for the steel process. The iron content in iron ore directly affects the effectiveness of the BFs operation in terms of coke consumption and blast furnace productivity. Usually in order to produce one tonne of pig iron almost two tonnes of iron-bearing materials (iron ore) needs to be charged into BFs and melted, using coke and natural gas as a fuel and as reducing agents. The objective of the project activity is to decrease this loaded volume by means of higher iron content in the iron ore. This measure allows the same amount of pig iron to be produced by using less of the raw material, hence, reducing the consumption of coke per tonne of iron. This measure is achievable by increasing the iron-bearing material content of the agglomerate. Before the project operation it was varied at the level around 50%, and during the project realization DIISW plans that it should reach in average 60%. The measure will be gradually implemented in the period from 2011 to 2012 at different blast furnaces.

The measure will not be monitored directly within the proposed project activity as the increase of iron content in iron-bearing materials leads to changes in specific rates of coke consumption and productivity of BFs, which are monitored according to the monitoring plan.

Decreasing the silicon content in the pig iron

The reduction of the silicon (Si) from the silica begins at 1450^0C and is processed as follows:
$SiO_2 + 2C = Si + 2CO - Q$
Therefore, a reduction of the Si content will reduce coke required.

In addition it needs to be stressed that a temperature of pig iron less than 1450^0C could be achieved using well maintained equipment, otherwise BF could be frozen up to the solidification of the pig iron.

The average silicon content in the pig iron before the project implementation was about 0,87%, but after project activities implementation it should be decreased to 0.75-0,77% (to 0,73 for BF#1M) and even lower level[7]. The decrease of silicon content in pig iron is caused by improvement of pig iron process and modernization of BFs.

This measure is gradually implemented in the period from 2004 to 2012.

Decrease of silicon content in pig iron is not monitored directly within the proposed project activity as it leads to changes in specific rates of coke consumption, other energy resources and BFs productivity, which are monitored according to the monitoring plan.

Decreasing the BFs idle times and downtime

Blast furnaces are in continuous operation, only interrupted for maintenance. Any idle time or downtime requires that the BFs are kept at a high temperature, which is achieved by burning coke. Therefore, any measures focused on decreasing idle times and downtime will reduce the coke consumption.

According to the plan, DIISW aimed to reduce idle times to as low as possible manageable level. However, this plan depends upon market conditions.

This measure is implemented since 2004.

The decrease of BFs idle times and downtime is not monitored directly within the proposed project activity as it leads to changes in specific rates of coke consumption and productivity of BFs, which are monitored according to the monitoring plan.

Partial substitution of the limestone by lime

Limestone that is charged into BFs is calcinated through the reaction: $CaCO_3 = CaO + CO_2$.
This reaction requires heat. The same reaction takes place in the special kilns for the lime production using regular coal as a fuel. Therefore, charging lime in the BFs will save coke that would be consumed

[7] The data can be provided additionally upon request to DIISW.

for the calcination. Emission factor for the lime production will be taken into account in the calculation of emission reductions.

The measure is gradually implemented in the period from 2004 to 2012.

The measure is not monitored directly within the proposed project activity as it leads to changes in specific rates of coke consumption and productivity of BFs, which are monitored according to the monitoring plan.

Improvement of the quality of agglomerate

From the beginning of the proposed project activity DIISW has started implementation of measures on improvement of agglomerate quality by improvement of its production technology.

The quality of agglomerate to be produced at local SP is generally leading to the same effects as other components in the list of technological improvements, however there is deficit of empirical justification of such an impact. Nevertheless the positive impact of better strength of agglomerate can be witnessed by the BFs operators. For example, the decrease of fine fraction content in agglomerate that is fed into blast furnaces by 8-10% leads to general improvement of blast furnace operation and lower consumption of coke per tonne of pig iron produced.

DIISW plans to increase the quality of agglomerate gradually during the project time.

Measures related to improvement of the quality of agglomerate are further described in component 3 of the project activity.

This measure is not monitored directly within the proposed project activity as it leads to changes in specific rates of coke consumption and productivity of BFs, which are monitored according to the monitoring plan.

Replacement of coke by natural gas and coal

Due to high consumption of coke in the BFs, DIISW planned to decrease its level gradually which included higher coal consumption for instance by PCI. This is considered to be more environmentally friendly measure that will lead to lower emissions with keeping C-balance at needed operational level.

Project activity envisages implementation of PCI system for BFs #1M, 8, 9, and 12. After implementation of BF#4 it will be also equipped with PCI. Technological scheme of the PCI implies injection of fine coal into blast furnaces instead of coke and natural gas.

The technology of injecting pulverized coal into a blast furnace as an auxiliary fuel allows to reduce the amount of coke consumed and therefore to reduce operating costs in the production of pig iron and then ultimately crude steel. The technology involves injecting very fine particles of coal at high rates into the chamber of the blast furnace as a fuel.

The overall efficiency of PCI system is 170-200 t/h of pulverized coal.

At the same time, even without PCI coke is replaced by coal and natural gas as it could be seen in calculations of emission reductions.

This measure is not monitored directly within the proposed project activity as it leads to changes in specific rates of fuel and energy resources consumption and productivity of BFs, which are monitored according to the monitoring plan.

Oxygen enrichment of BF blowing

Gradual oxygen enrichment of blast-furnace blowing is realised as part of project activity. This also has positive impact on coke consumption reduction and blast-furnace operation (see Section A.4.3, Table 3).

The enrichment of BF blowing is not monitored directly within the proposed project activity as it leads to changes in specific rates of fuel and energy resources consumption and productivity of BFs, which are monitored according to the monitoring plan.

Other measures

Improvement of technology of BF production is an endless process. If any additional measures would be implemented in order to improve technology of production this shall be indicated in the monitoring plan.

2. Reconstruction of the BF shop

Pig iron production at DIISW is one of the most energy intensive processes. Generally, based on world modern pig iron production experience, the specific coke consumption per 1 t of pig iron produced is at the level of 400 kg/t. However, the pig iron process at DIISW involves rather high coke consumption rate. Before the project activity this level could reach 580 kg/t[8]. Therefore DIISW considered seriously how to decrease specific coke consumption rate to much lower levels often below 500 kg/t during project activity. Within project activity DIISW has reached the average annual coke consumption 495 kg/t[9] during the years 2004 to 2009 and it is expected to further decrease.

Also, as it was mentioned above, pig iron production is a complex thermodynamic and chemical process where any changes in charging materials/fuels/layout of BF should be compensated or/and adjusted by other measures. So in order to decrease the risks associated with the proposed project implementation, an energy efficiency measures are implemented on a gradual basis.

The reconstruction of the BF Shop envisages such measures as:

a) introduction of the brickwork of the furnace's stack and hearth made from composite refractory body (Si-SiC-Al_2O_3). This measure directed to the decreasing of the heat losses from the hearth, adjustment of the heat balance of the furnace and coke savings as a consequence. In addition introduction of the new brickwork's materials will prolong lifetime of the furnace in compare with regular materials used in Ukraine;
b) construction of coal drying and grinding units with introduction of a distribution system and facilities for injection of dust and pulverized coal into blast furnace tuyeres;
c) implementation of aspiration (allows to capture 1470 t of dust annually) and gas-purification facilities;
d) implementation of the new charging equipment at all BFs;
e) introduction of auxiliary equipment related to oxygen, nitrogen and air blowing production, dust aspiration and gas cleaning etc.

   Within project activity the oxygen unit АКАр 40/53-4, by Giprokislorod[10] (Russia) together with Kriogenmash[11] (Russia) company, was introduced in 2007 with total output of gaseous:
   - oxygen – 284550 ths. m^3;
   - nitrogen – 325200 ths. m^3;
   - argon – 8113,7 ths. m^3.

[8] As per 1999 – 2003 years. The data can be provided additionally upon request to DIISW.
[9] The data can be provided additionally upon request to DIISW.
[10] http://giprokislorod.lgg.ru/
[11] http://www.cryogenmash.ru/en

Introduction of the new oxygen unit АКАр 40/53-4 allowed reducing energy consumption in the blast furnace shop and also increasing pig iron production productivity. DIISW plans to increase the rates of oxygen injection into the blast furnaces during the project activity.

e) introduction of the automatic and control systems in order to control and manage:
- tuyere failure;
- gas flow;
- temperature field on the charging materials;
- cooling system of the furnace's stack;
- heat load at heat exchangers at hearth;
- charging process.

f) application of desulfurization of pig iron in furnace ladles by Mg treatment with further deletion of slag by special scrub machine in order to increase pig iron quality.

Also within project activity envisaged introduction of new BF#4 with the following technical parameters:
- net volume – 1640 m^3;
- blast pressure – 0,35-0,37 MPa;
- top smoke pressure– 0,2-0,25 MPa;
- temperature of blowing - 1150-1200 C°;
- oxygen content in blast - 28%.

The BF#4 will be constructed by local contractors. BF#4 will be equipped with PCI, automatic and control systems, charging equipment, gas purification and aspiration facilities, shaft free hot-blast stoves, slag granulation facilities, etc. Supplier of major equipment (charging equipment, slag granulation facilities, gas purification, blower nozzles) for the new BF#4 will be the Paul Wurth company[12].

Introduction of BF#4 will lead to further reduction of coke consumption and also facilitate to injection of auxiliary fuels such as pulverized-coal as replacement of metallurgical coke. New BF#4 will satisfy even strictest environmental and safety requirements.

In 2008 DIISW has completed the feasibility study and received all necessary permits to implement the new BF#4[13].

The BF shop of DIISW currently consists of four BFs with net volume: BF#1M (modernized) - 1500 m^3, which was launched in May 2007 and has further substituted BF#11 (which was decommissioned in 2008) with net volume – 1386 m^3, BF #8 – 1754 m^3, BF#9 – 1386 m^3, BF#12 – 1386 m^3.

DIISW realized a radical reconstruction of BF#1M[14]. BF#1M is considered to be the most modern at DIISW. The furnace is equipped with secondary dust suppression, which appears in the works at the site where ore is stored, in closed and open conveyors, cargo bins. Moreover dust capture facility is applied at the furnace.

Reconstruction of BFs #8, 9 and 12 is also expected to be realized gradually. As a result the specific consumption rate for coke per tonne of pig iron will be reduced, as well as other carbon containing resources, and productivity of BFs will be increased, that would lead to GHG and other dangerous substances' emission reductions.

[12] www.paulwurth.com
[13] All documents are available at DIISW.
[14] It should be noted that before the project activity, in the chosen base period (1999-2003) for the proposed project activity, BF#1M was in reserve and didn't generate CO_{2e} emissions. Therefore baseline emissions do not include the data regarding BF1M.

Reconstruction of blast furnaces at the DIISW is planned in the way that was described above according to the schedule.

The impact of the reconstruction of the BF shop on specific rates of energy and fuel resources consumption, in particular coke, will be monitored by the parameters specifically determined in the monitoring plan.

3. Modernization of sintering process

Currently DIISW uses a sinter plant which was built in 1963 - 1964 and is consisting of six sintering machines with sintering area of 75 m², cooling zone of 50 m² and total area of 125 m² each, facilities for receiving materials, its preparation and transportation. Production capacity of sinter plant is 5600 ths. t/year of agglomerate. The sinter plant is the most environmentally dangerous process at the project site with the main portion of gross emissions of hazardous substances.

Carbon dioxide emissions in the sintering production processes are mainly achieved during: the process of burning solid fuel, which is part of the sintering charge; the process of burning natural gas, which is fed into burners for ignition of sintering charge; reaction of limestone decomposition, which is part of sintering charge, to calcium oxide and carbon dioxide.

The program of revamping of the plant envisages the introduction of new Siemens - VAI sinter plant with total output of 11 mio t/year of agglomerate, consisting of two sinter machines with the sintering area – 477 m^2. After introduction of the new SP the existing SP will be decommissioned, meaning that the main source of emissions will be removed.

With the introduction of new sinter plant of Siemens VAI the following benefits will be achieved[15]:

a. low electrical energy consumption even when the sinter machine is operated with high bed height;
b. low solid fuel and energy consumption because of the best fuel distribution;
c. stable high sinter quality;
d. lower coke consumption in blast furnaces because of better quality of agglomerate;
e. low quantity of off-gas and better utilization of cooling air etc.

In order to reduce carbon emissions during sintering production a number of technological measures and installations were and will be implemented during the project activity from the year 2004 to 2015:

- improvements of solid fuel burning process, which is part of the sintering charge;
- increase of the level of steel waste utilization in sintering process;
- implementation of the state-of-the-art dust suppression and gas purification facilities, which will ensure the required level of emissions by the World Bank and EU BAT standards (particulate matter - $\leq$50 mg/nm^3, $SO_2 \leq$500 mg/nm^3);
- optimization of limestone decomposition reaction by means of introduction of components with low content of Si (SiO2) in the sinter charge that would lead to lower limestone consumption;
- improvement of natural gas burning process, which is supplied to burners for the ignition of sintering charge;
- improvements of chemical composition of sinter charge by means of adding the better quality of iron ore;
- reduction of fine fraction content in agglomerate. To reduce consumption of coke and iron, one need to produce cooled and stabilized agglomerate with low fine fraction content as well as with better strength. Stabilization of agglomerate means its mechanical treatment, crushing, cooling and grating. Before project implementation the sinter plant produced a hot sintering mix (agglomerate),

[15] http://is.industry.siemens.com/broschueren/pdf/metals/siemens_vai/en/SinterSolutions_en.pdf

which contained 12-15% of fine fraction at the moment of feeding the mix into the blast furnace bin. The technology of production of agglomerate envisages that furnace charge raw mix is charged in the agglomeration machines (sintering machines) for fritting and breaking-in. The agglomerate was unloaded from the agglomeration machines and transported to the blast furnaces. During transportation the agglomerate naturally cooled and partly crushed, which increased the mass content of fine fraction (with diameter less than 5 mm). Further agglomerate together with coke and limestone were supplied to blast furnace shop. Before project implementation the specific coke consumption per tonne of pig iron was rather high and general efficiency of pig iron production was rather low.

JI project maintenance will be in accordance with national requirements and DIISW internal routines with technical support on the part of technology suppliers.

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 objective of the proposed project is to reduce energy and materials, mainly coke, consumption during pig iron production. Coke consumption is associated with two sources of emissions of GHGs:

1. During coke production. IPCC set the value of the emission factor for the coke production at the level 0.56 t CO_{2e}/t of coke, and

2. Coke processing in the BF. The emission factor for coke processing is 3.1 t CO_{2e}/t, assuming that default IPCC factor is used.

The following table shows the reduction in coke consumption by the measures proposed above:

Table 3. Dependence of coke consumption. Source: "Soviet Union standard "Influence of technological factors on the specific consumption of coke and blast furnace performance"

Factor/measure	Unit	Coke consumption	BF productivity
Increasing of the iron content in the iron-bearing materials on every 1% within the limits:			
up to 50%	%	-1,4	+2,4
from 50%-55%	%	-1,2	+2,0
from 55-60%	%	-1,0	+1,7
Silicon content decreasing in pig iron on every 0,1%	%	-1,2	+1,2
Decreasing of the idle time on every 1%	%	-0,5	+1,0
Decreasing of the downtime on every 1%	%	-0,5	+1,5
Consumption decreasing on every 10kg/t of the pig iron of limestone	%	-0,5	+0,5
Increase of coke hardness (M_{25}) on every 1%	%	-0,6	+0,6
Reduction of coke abrasion (M_{10}) on every 1%	%	-2,8	+2,8
Reduction of coke faction content over 80mm, (M_{80}) on every 1%	%	-0,2	+0,2
Oxygen enrichment of BF blowing on every 1%			
up to 25%	%	+0,20	+2,4
from 25%-30%	%	+0,30	+2,1
from 30%-35%	%	+0,40	+1,8
from 35%-40%	%	+0,50	+1,6
Ash content decreasing in coke on every 1%	%	-1,3	+1,3
Sulphur content decreasing in coke on every 0,1%	%	-0,3	+0,3

It should be noted that factors presented in the Table 3 are indicative and are of an empirical nature. Nevertheless, we can see that the proposed measures will lead to the reduction of coke consumption that would not have occurred in the absence of the project. The impact of the above mentioned factors on the coke consumption and blast furnace production is also supported by scientific publications[16].

Emissions that occur during pig iron production at DIISW are calculated based on the specific emission factor (EF) for pig iron production. The EF is a sum of emission components associated with different carbon-bearing material flows taking part in the BFs operations and preceding processes such as sintering and secondary energy production.

In the absence of the proposed project, the BF Shop and Sinter and Power Plants of DIISW will continue operations without implementing the set of measures described in Section A.4.2., so the structure of the EF for the pig iron production will be identical.

After the project's implementation the specific coke as well as other fuels and materials consumption per tonne of pig iron output will be reduced significantly.

Without project activity emission reductions of GHG would not be achieved as the plant would continue operation of old SP and BFs without reconstruction and introduction of new facilities and technologies, as:

a. this scenario represents the usual (business-as-usual) operation for DIISW;
b. Ukrainian legislation does not require obligatory reconstruction of the facilities of the plant;
c. continuation of operation within baseline scenario does not require large investments for revamping of sinter and blast furnace production process.

The reason why emission reductions would not be achieved without project activity is described in more detail in Section B.1.

A.4.3.1. Estimated amount of emission reductions over the crediting period:[17]

In the proposed project activity the crediting period starts from the 1st of April 2004, after Ukraine's ratification the Kyoto protocol to the United Nations Framework convention on climate change.

Duration of the crediting period	3 years and 9 months
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
01/04/2004 – 31/12/2004	870 080
2005	1 521 560
2006	1 754 446
2007	2 099 026
Total estimated emission reductions over the 2004-2007 crediting period (tonnes of CO_2 equivalent)	**6 245 112**
Annual average of estimated emission reductions over the 2004-2007 crediting period (tonnes of CO_2 equivalent)	1 665 363

[16] http://ukhin.org.ua/index.php?option=com_mtree&task=viewlink&link_id=456&Itemid=3
[17] Project emissions, baseline emissions together with emission reductions (which are provided in this section) are rounded to the whole figure (1t) and are based on calculations which are demonstrated in attached excel file. This file is provided to the verifier.

First commitment period of Kyoto Protocol

Duration of the crediting period	5 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	1 649 147
2009	1 349 863
2010	1 348 676
2011	1 654 868
2012	2 259 836
Total estimated emission reductions over the 2008-2012 crediting period (tonnes of CO_2 equivalent)	**8 262 389**
Annual average of estimated emission reductions over the 2008-2012 crediting period (tonnes of CO_2 equivalent)	1 652 478

Period following first commitment period of Kyoto Protocol[18]

Duration of the crediting period	8 years
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2013	2 272 491
2014	2 324 693
2015	2 337 348
2016	2 450 340
2017	2 450 340
2018	2 450 340
2019	2 450 340
2020	2 450 340
Total estimated emission reductions over the 2013-2020 crediting period (tonnes of CO_2 equivalent)	**19 186 230**
Annual average of estimated emission reductions over the 2013-2020 crediting period (tonnes of CO_2 equivalent)	2 398 279

A.5. Project approval by the Parties involved:

The project has already received Letter of Endorsement (LoE) from the Government of Ukraine #1807/23/7 of 09.11.2010 issued by the National Environmental Investment Agency of Ukraine. The final version of the Project Design Document shall be submitted to the State Environmental Investment Agency of Ukraine along with a positive determination report for the Letter of Approval (LoA), which is usually expected within 30 days. The LoA of a foreign government is usually provided within 30 days along with a positive determination report. It is expected that LoA of a foreign government will be provided either by the Government of Japan (The Liaison Committee for the Utilization of the Kyoto Mechanisms), by the Government of Spain (Ministerio de Medio Ambiente, Medio Rural y Marino Oficina Española de Cambio Climático) or by the Government of the Netherlands (Ministry of Economic Affairs).

[18] In case the period will be changed by UNFCCC or by the Government of Ukraine, it will be indicated in the monitoring reports.

SECTION B. Baseline

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

The baseline for the proposed project is identified and justified following the Annex B to the JI Guidelines[19] and the JISC "*Guidance on Criteria for Baseline Setting and Monitoring"*[20]. No applicable approved CDM methodologies are available for this project; however, JI Project "Energy Efficiency measures at the "Public Joint Stock Company Azovstal Iron and Steel Works"[21] has been submitted to the accredited independent entity (AIE) in 2010 and already passed a positive determination and received a letter of approval from the Government of Ukraine. It is assuming implementation of technological measures to improve the energy efficiency of blast furnace production as well as its modernisation. This may be treated as similar to the proposed project, therefore its approach can be fully applied to the project in question. Besides, in terms of methodological approach, the proposed project is fully identical to the relevant part of the project registered at UNFCCC with reference number UA1000022[22], as it covers basically the same assets as in the proposed JI project. It refers to blast furnace shop and sintering machines as well as secondary energy production. It takes into account all emissions of GHGs related to the process of pig iron and sintering production. Therefore the approach is fully applicable for the proposed project.

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

The baseline scenario was chosen based on project-specific approach in accordance with paragraph 9(a) of the JISC Guidance and refers to the DIISW project-specific conditions and parameters as they are described in this PDD. Everything related to the anthropogenic emission assessment is sufficiently described and justified. According to the Article 20 of the Guidance a baseline should be established based on scenario that reasonably represents the anthropogenic emissions by sources or net anthropogenic removals by sinks of such emissions that would occur in the absence of the project.

The following two-step approach was used to identify and choose the baseline scenario for the project:

a) Identifying and listing alternatives to the project activity on the basis of conservative assumptions and taking into account uncertainties.

b) Identifying the most plausible alternatives considering relevant sectoral policies and circumstances, such as economic situation in the steel sector in Ukraine and other key factors that may affect the baseline. The baseline is identified by screening of the alternatives based on the technological and economic considerations for the project developer, as well as on the prevailing technologies and practices in Ukrainian steel industry at the time of the investment decision.

All alternatives have been listed and analyzed below. The alternatives have been identified based on national practice and reasonable assumptions with regard to the sectoral legislation and reform, economic situation in the country, availability of raw materials and fuel as well as technologies and logistics etc.

Substep 1a) Identify alternatives to the project activity

All the Ukrainian Steel Mills continue to run so called old blast furnaces and sinter plants that have mostly been installed during Soviet time more than 20 years ago. The type of blast furnaces and sinter plants basically remain unchanged since 19th century.

[19] Decision 9/CMP.1 Conference of the Parties serving as the Meeting of the Parties of the Kyoto protocol 30th of March 2006
[20] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf
[21] http://ji.unfccc.int/JI_News/issues/issues/I_6O4WUKCQKHSADTWQV0BD8XZ3U0RLO6/viewnewsitem.html
[22] http://ji.unfccc.int/JIITLProject/DB/V75OZ8TQOFTB325LEDMXE2628ZD548/details

At the time of investment decision, i. e. in 2003, DIISW had three technically feasible alternatives for its planned development strategy assuming *inter alia* increase of market share and expansion of production output as there were no other intermediary solutions:

Alternative # 1: Preservation of the situation existing prior to the project: continuation of sinter plant and BFs operation without reconstruction and introduction of new technology
Alternative # 2: Revamping of sinter plant and all the blast furnaces without carbon financing;
Alternative # 3: Realisation of projects on the not blast-furnace iron-making plants at DIISW.

All alternatives would meet all relevant Ukrainian requirements as discussed in a detailed way below. These alternatives would also provide the same service level to the market.

Step 1b) Identify the most plausible alternative

The most plausible alternative scenarios among the possible ones were identified as followings:

The alternatives are explained and considered below with regard to estimate the baseline in relation to the Project.

Alternative # 1: Preservation of the situation existing prior to the project: continuation of sinter plant and BFs operation without reconstruction and introduction of new technology.

Ukrainian iron and steel production facilities have inherited process equipment installed during the Soviet era. Iron and steel industry is today in need of a sector-wide reform. However innovative development of the nation's iron and steel industry is practically minimal. The reason is that such practical decisions made bumped against lack of reliable financial and institutional support[23]. These reasons have also hampered DIISW to initiate and realise modernisation of the Plant.

Therefore, production of pig iron and steel and expansion of market share based on existing process lines, without introduction of new facilities, which envisaged insignificant investment due to maintenance and equipment repair which is within usual practice of the plant, would be business-as-usual (BAU) solution fully in line with international steelmaking practices at the time of investment decision, as well as with economy environment of IUD and Ukraine in general. The benefits for the project owner include (i) insignificant capital expenditures due to maintenance and equipment repair, (ii) profit in the short-term perspective amid crisis environment; (iii) no need to secure access to significant financing, mostly required to make up operating capital, due to absent investment requirements and known technology, (iv) no need for capital construction, (v) low technical risk due to historical experience, familiarity and confirmed capacity to build, operate the facilities, and to manage related risks, (vi) availability of trained staff, etc.

In fact, the planned pig iron output could have also been secured with existing older BFs, SP and secondary power generation facilities. At the moment of the investment decision, as well as currently, there were no regulatory or technical limitations for the operation of the older BFs and other steel facilities. Such limitations will continue to be absent at least until 2012 and even in longer term till 2022 – if there persist current Ukrainian economy conditions and intentions for its reform encouraging to hold back administrative barriers before commercial production activity carried out by private entities. However, in order to ensure conservativeness of the assumptions used for the identification of the baseline alternatives, five previous consecutive years before reconstruction start were have been chosen for establishing the baseline. The average data for the 5-year period should be enough to equal the impact of regular maintenance and working renewal of the steel facilities. Therefore the considered alternative does not face any barriers.

[23] http://www.nbuv.gov.ua/portal/Natural/VDU/Ekon/2008_1/VDU1-2008/181.pdf

Alternative # 2: Revamping of sinter plant and all the blast furnaces without carbon financing.

The project activity includes reconstruction of all the BFs, SP and secondary power generation facilities at the DIISW as well as introduction of the new SP and BFs.

In 2003, when decision was made, there were, and there still are, no legal or regulatory requirements in Ukraine for the adoption of obligatory reconstruction or modernisation activities in steel making sector. The proposed project is in line with non-mandatory, general government policies, such as the Restructuring Program of the Iron and Steel Sector and with the long-term Energy Strategy for Ukraine (adopted in 2006)[24].

The project activity is itself an integrated energy efficient programme aimed at reduction of energy consumption per tonne of pig iron produced. This cannot be done without reconstruction and modernisation of equipment in the Blast Furnace Shop as well in the Sinter Plant and Power Plant that includes other secondary production facilities and therefore without a massive investment programme.

Against the backdrop of the poor economic situation of the DIISW at the beginning of the project implementation and moreover the global crisis whose effects were particularly acute for the whole Ukrainian iron and steel sector, a project requiring the total investment of US$ 1,1 billion would be hard to accomplish, given its current status (see Section B.2.).

Therefore, considering financial, technical and other barriers, project scenario without the JI component was not the most attractive one, which prevented its further implementation.

Alternative # 3: Realisation of projects on the not blast-furnace iron-making plants at DIISW.

In general there is an option to replace blast furnace production and therefore also influence on sintering production.

This option is related to the construction of industrial plants for production of reduced iron by Midrex or similar technology. However this option is not fully realistic for the DIISW because the Steel Mill does not have its own access to iron ore resources and fully relies on market condition. The recent problems with iron ore supply have shown the extreme volatility of such a decision upon market conditions. Additionally such a decision could require a significant portion of investments estimated at around more than US$3 billion. In Ukraine so far no company has been able to overcome such investment barriers. The declared project activity by OJSC “Vorskla Steel” in a construction of Midrex-based furnaces has been suspended for an indefinite time. Moreover new technological decisions like not blast-furnace iron making require a replacement of the established logistical scheme which is additional risk for DIISW. Therefore the switch to the new steelmaking technology based on Midrex technology can not be considered as baseline scenario due to a number of mentioned obstacles.

The Alternative #1 is the most likely baseline scenario for a number of reasons, for instance the required quantity and quality of pig iron can be produced without costly and large-scale reconstruction as well as change of historical manufacturing practice and logistics. The above suggests that the Alternative # 1 would be the most plausible and credible alternative and it represents the baseline scenario for the proposed project activity. For the baseline scenario, the full amount of CO_2 emissions related to this scenario is accounted for; its monitoring is performed as part of detailed monitoring of steelworks processes required for the DIISW technical purposes (please see more detail in Section D).

[24] OECD Special Meeting at High-level on Steel Issues, The Ukrainian Steel Industry, Paris, 11 January, 2005.

Step 2. Application of the approach chosen

The detailed analysis of the alternatives was given above. Alternative #3 was the least feasible among all 3 alternatives because it required huge investments and complete change of logistical scheme. Alternative #2 presents the project scenario and in comparison with Alternative #1 that is the baseline required significantly more investments. Therefore continuation of existing practice with gradual planned maintenance and repair does not require additional massive investments as well as change of used process technology and is the most plausible and realistic one.

Consistency with mandatory applicable laws and regulations.

As it was also mentioned above the year 2003 was selected as the year when the investment decision was made. All the listed alternatives in the year 2003 were considered to be feasible and did not face any legislative barriers. Moreover even at the date of PDD preparation situation is still identical. Ukrainian legislation does not regulate CO_{2e} emissions and does not demand reductions of such emissions.

Therefore, the most plausible scenario for the baseline is the Altenative #1. All the information concerning approach for calculation of emission reductions are given below.

Conservative assumptions used for baseline emission calculations have been applied:

a) 5 year base period from 1999 to 2003 has been chosen in order to nullify the impact of annual or periodic repair and maintenance of the equipment;

b) timing of baseline period coincides with gradual improvements at the global steel market. At the same time project line faces negative impact of world financial and economic crisis that makes specific energy consumption rate per tonne of pig iron to be more intensive than under normal operation;

c) in the baseline period natural gas was historically cheaper than in the project line that could cause its replacement on coal and coke with higher emission factor during the project activity. This impact was ignored that makes approach a very conservative;

d) DIISW faced no difficulties with supply of raw materials such as ore and coal (as is the project period, especially from 2008).

In order to calculate the project emission reduction units the total pig iron production is accepted as equal to the project production.

Key parameters

No national policies and circumstances can significantly influence the baseline. Therefore, only some technical parameters have to be described.

As key parameters that can significantly influence emission reduction amount, the following parameters have to be considered:

Key Information and Data Used for Baseline Identification

Data/Parameter	$TPII_b$
Data unit	Tonnes
Description	Total pig iron output
Time of determination/monitoring	Measured on regular basis (monthly)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is equal to the total pig iron output during the project activity
QA/QC procedures (to be) applied	See Section D.2.
Any comment	

Data/Parameter	$Q_{fpi,b}$
Data unit	1000 m^3
Description	Quantity of each fuel (fpi) used in making pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Data/Parameter	$EF_{f,b}$[25] (B-6, B-13, B-26)
Data unit	Tonnes CO_{2e}/1000 m^3
Description	Emission factor for fuel consumption
Time of determination/monitoring	Fixed value based on DIISW average data
Source of data (to be) used	DIISW average data IPCC 1996 Potentially measured by DIISW laboratory or local fuel distributor
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Emission factor for natural gas consumption is calculated based on estimated net calorific value which is in accordance with DIISW average data and based on carbon content stated in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.[26] Net calorific value is anticipated at nearly 33,913 TJ/ 1 000 000 Nm^3. Therefore the carbon emission factor for Natural Gas combustion is anticipated at nearly 1,893 tonnes of CO_{2e}/1000 Nm^3 and is calculated based on mentioned above net calorific value.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	

Data/Parameter	$ECPI_b$
Data unit	MWh
Description	Electricity consumed in producing pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on amount of electricity consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	Accounts for all sources of electricity consumption for primary and secondary production needs.

[25] For more detailed information please see Annex 2.
[26] In case if the data regarding net calorific value for mentioned above fuels will be available at DIISW for each of the specific monitoring periods, the carbon emission factors will be accordingly modified at the stage of monitoring report development.

Key Variables/Parameters	$EF_{e,b}$ (B-9, B-16, B-29)
Measuring unit	Tonnes CO_{2e}/MWh
Description	Emission factor for electricity consumption
Identification/monitoring frequency	Regular tabulation (on monthly basis)
Source of data	Carbon emission factors verified by TÜV SÜD and carbon emission factors based on the Orders of the National environmental investment agency of Ukraine #43 dated 28th of March 2011, #62 dated 15th of April 2011 and #63 dated 15th of April 2011.
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[27]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[28]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[29]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[30]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
Quality assurance and control procedures	See Section D.2.
Note	

[27] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[28] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[29] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[30] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

Data/Parameter	$Q_{fio,b}$
Data unit	1000 m^3
Description	Quantity of each fuel (fio) used in sintering process
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Data/Parameter	$ECIO_b$
Data unit	MWh
Description	Electricity consumed in sintering process
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on amount of electricity consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	Accounts for sources of electricity consumption for primary and secondary production needs.

Key Variables/Parameters	$Q_{rapi,b}$
Measuring unit	Tonnes
Description	Quantity of each reducing agent (rapi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of reducing agents consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{ra,b}$[31]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each reducing agent
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006 Potentially measured by DIISW laboratory
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf) and Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf). For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	This PDD uses default factors: For coke it is anticipated at 3.66 tonnes CO_{2e}/tonne; For anthracite the anticipated factor is 2.62 tonnes CO_{2e}/tonne. However in the monitoring reports these factors will be calculated based on carbon content in coke and net calorific value of anthracite. If information on actual carbon content or net calorific value is available, it would prevail over default factors.

[31] For more detailed information please see Annex 2.

Key Variables/Parameters	$Q_{oipi,b}$
Measuring unit	Tonnes
Description	Quantity of each other input (oipi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of other inputs consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{oi,b}$[32]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each other input
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf). For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	For pellets it is anticipated at 0.03 tonnes CO_{2e}/tonne of pellets produced. For limestone it is anticipated at 0.44 tonnes CO_{2e}/tonne of limestone. For dolomite it is anticipated at 0.477 tonnes CO_{2e}/tonne of dolomite.

[32] For more detailed information please see Annex 2.

Data/Parameter	$Q_{fbpn,b}$
Data unit	1000 m^3
Description	Quantity of each fuel (fbpn) used for balance of process needs
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Data/Parameter	$ECBPN_b$
Data unit	MWh
Description	Electricity consumed for balance of process needs
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Table 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on amount of electricity consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	Accounts for sources of electricity consumption for primary and secondary production needs.

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

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

Step 1. Indication and description of the approach applied

A JI specific approach is used, therefore one of the approaches, defined in paragraph 2 of the annex I to the "Guidance on criteria for baseline setting and monitoring"[33], to demonstrate additionality of the project shall be used. As suggested by paragraph 2 (c) of the annex I to the "Guidance on criteria for baseline setting and monitoring" the most recent version of the Tool for the Demonstration and

[33] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

Assessment of Additionality approved by CDM Executive Board (version 05.2[34]) is used to demonstrate the additionality of the project.

Step 2. Application of the approach chosen

This section includes analysis of project additionality and is intended to demonstrate that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of GHG emissions in comparison to the baseline. The analysis below is performed following steps of the latest version (version 05.2) of the Tool for the Demonstration and Assessment of Additionality[35] approved by CDM Executive Board, which accordingly may be fully applied to Joint Implementation Projects.

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

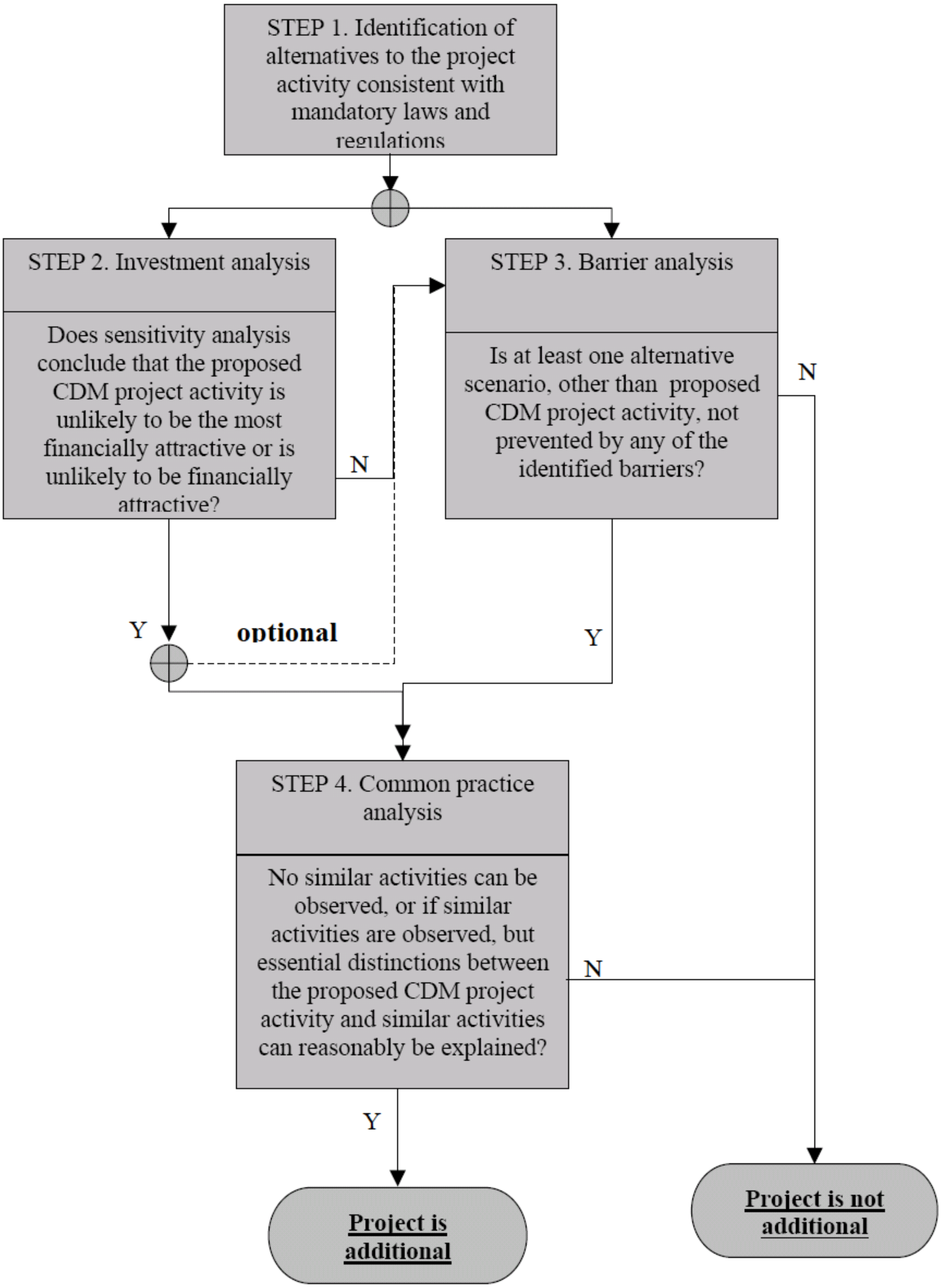

Figure 4. JI Project Additionality Scheme Defined in the Tool for the Demonstration and Assessment of Additionality (version 05.2)

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations
Sub-step 1a. Define alternatives to the project activity:

In Section B.1 the following scenarios to the project activity were chosen:

Alternative #1: Preservation of the situation existing prior to the project: continuation of sinter plant and BFs operation without reconstruction and introduction of new technology;
Alternative #2: Revamping of sinter plant and all the blast furnaces without carbon financing;
Alternative #3: Realisation of projects on the not blast-furnace iron-making plants at DIISW.

As it was mentioned in Section B.1 the alternative #3 is not fully realistic for the DIISW due to high capital expenditures and logistical risks, also the plant does not have its own access to iron ore resources, which makes this alternative the least credible one. Therefore, only alternatives #1 and #2 shall be selected to demonstrate additionality of the project.

Outcome of Step 1a: Realistic and credible alternative scenarios to the project activity were identified.

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

All the alternatives above comply with mandatory laws and regulations. Under the current national and/or sectoral policies and circumstances and regulations of the proposed project site, both alternatives above can be selected as credible and realistic alternatives.

National policy of Ukraine regarding the emissions of pollutants into atmosphere is determined by the Law of Ukraine *On Protection of Atmospheric Air* of 21 June 2001 No. 2556-III[36]. The Order of the Ministry for Environment of Ukraine dated 27.06.2006, No. 309 approves admissible level of emissions of polluting substances from stationary sources, both active and those being designed, developed, or retrofitted. Regulatory allowances for admissible level of emissions of polluting agents and their aggregates set limits on mass concentration of pollutants in point source emissions from stationary sources (in mg/m^3) and do not provide any specific requirements as to new technologies. Nonetheless, as specified above, most Ukrainian steel and pig iron making enterprises continue successfully to operate equipment installed back during the Soviet era.

The above Order of the Ministry for Environment of Ukraine does not ration GHG emissions from stationary sources. Such rationing will be introduced provided approval of a National GHG Emission Allowance Distribution Plan and a National GHG Emission Allowance Trading Scheme by the Ukrainian government, which seems unlikely either today or during the time horizon until 2020.

The above, as well as the current practice of pig iron productions operation in Ukraine uphold the consistency of the baseline scenario of the proposed Joint Implementation Project with the national requirements and practice.

The Tool for the Demonstration and Assessment of Additionality requires that the next step in the project additionality assessment process be Step 2, Investment Analysis, or Step 3, Barrier Analysis. Most appropriate way to prove additionality of the project was considered barrier analysis due to the presence of clearly defined barriers to the project implementation.

Outcome of Step 1b: The identified alternatives are realistic and credible alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region and Ukraine.

[36] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2707-12

Step 3. Barrier analysis

The step-by-step approach in this case means sequential description of existing barriers and explanation of the way in which they hamper the project activity, as well as of how application of the JI mechanism helps remove these barriers. Based on the requirements of the document referenced above, the process should culminate in the common practice analysis intended to confirm barrier analysis conclusions.

Sub-step 3a. Identify barriers that would prevent the implementation of the proposed JI project activity:

<u>Specific Barriers</u>

The project has faced certain barriers of different nature. In accordance with paragraph 6 of the Annex 13 of Guidelines for objective demonstration and assessment of barriers[37] (Version 01), even in case if it is difficult to evaluate concretely whether a barrier actually prevents the investment from being done, the evidence of presence of the barrier can be based on barrier experience of other projects under similar circumstances, in particular taking into account the barriers for already determined and verified JI project at AISW «Revamping of sintering and blast-furnace production at OJSC «Alchevsk Iron and Steel Works». The mentioned project is technologically the same with the proposed project activity.

However the “Guidelines for objective demonstration and assessment of barriers” (Annex 13, version 01, page 2/5, Guideline 3) does not require that other JI projects should be the same technologically. For demonstrating additionality it is enough to show, based on reputed source, that already registered JI project is similar to the proposed one, in other words it realized in similar circumstances (in similar industries/sectors, in companies of similar size and ownership structure, in similar projects).

Both project activities are realised under similar circumstances, within the same industry and under the framework of ISD Corporation. Moreover, despite the fact that majority of Ukrainian steel plants required modernisation of their steel capacities with involvement of state of the art technologies, at the time of investment decision no positive experience was demonstrated by other steel mills due to the existing market barriers.

These two JI projects are more than similar, they are technologically the same due to the fact that project lines for both projects are identical despite the natural initial differences of production processes. The only difference between these two JI projects is that AISW project envisages introduction of two new oxygen units while the proposed project activity – one, also the project at AISW envisages introduction of new lime kilns which is not implemented at DIISW.

The reference to the project at AISW was made by taking into account that it was already positively determined by Bureau Veritas company, which is considered to be the **reputed source**. This fact is in accordance with the “Guidelines for objective demonstration and assessment of barriers” (Annex 13, version 01, page 2/5, Guideline 3) which envisages demonstration of additionality in case if similar projects were approved by using **reputed sources** (IAE – Bureau Veritas): “Most investment projects face some type of barriers, but it is very difficult to evaluate whether a barrier actually prevents the investment from being done. The evidence of presence of the barrier for other project(s) under similar circumstances, using **reputed sources**, makes them much more objective and therefore **makes a strong argument that a project is additional**”.

Another JI project which is similar to the proposed project activity is the registered project at PJSC “Azovstal Iron & Steel Works”, UA1000223[38]. The project is realized in similar industry/sector and envisages activities (modernization and reconstruction of BF shop and technological improvements of

[37] http://cdm.unfccc.int/EB/050/eb50_repan13.pdf
[38] http://ji.unfccc.int/JIITLProject/DB/SH8R5WAZQ92CWBIXEZPJMSGCVXT2KS/details

BF's operation) which are also envisaged by the proposed project activity. Accordingly, the registered JI project at PJSC "Azovstal Iron & Steel Works" additionally proves the presence of barriers for the proposed project activity.

Together with this, in accordance with the "Guidelines for objective demonstration and assessment of barriers" (Annex 13, version 01, page 2/5, Guideline 3) the technological barrier may be confirmed by showing evidence that the use of this technology in the considered sector is marginal (below 10%).

All mentioned above information proves that the project is additional.

Investment barriers

The following investment barriers could be pointed out:

1. Adverse financial situation of DIISW

In 2003, when the investment decision was taken, the project could not receive any financial grant support from any financial institution or national financing programs due to a number of reasons. Firstly, the capitalization of DIISW was very low and general economic situation in Ukraine remained to be poor. Also DIISW was in a difficult situation as it had substantial debts to local budget[39]. This means that a high priority for the enterprise was offsetting of debt of the enterprise.

Moreover, at the time the investment decision was made, IUD conducted a large-scale program on modernization of its other enterprises, including OJSC "Alchevsk Iron and Steel Works".

As of 2003, Ukraine's domestic financial market was too weak to support a project of this level of magnitude. No Ukrainian bank was able to fund a like project on its own. The similar situation is typical for Ukraine even today. Therefore, investment partnerships were used as the common approach to investment projects financing at industrial ventures.

At the beginning of the project activity, in the year 2004, the investment required for the project was estimated at the level of US$ 1 billion[40], which was difficult to attract under the existing circumstances at DIISW, which were described above. By the year 2004 there were no similar projects in Ukraine implemented of such scale and requiring such amount of investment. Also, at the beginning of project activity one of the most significant barriers for DIISW was of technological character – lack of prevailing practice (as further described in the technological barriers of the project), mainly related with reduction of coke consumption in steel production which has never been implemented in Ukraine before.

The main revenues of the plant result from sales of slabs. Slab prices prognosis for the years 2004 to 2007 were above of long-term estimated prices[41], which made the project unattractive to invest as the slab prices have the most important impact on the project attractiveness highlighting the financial risks of such a large scale investment in a context of the increased volatility of steel products and semi-products.

[39] http://www.isd.com.ua/press/news/article.html?id=299
[40] See chapter A.4.2., Table 1
[41] Verified PDD of the JI project "Revamping and Modernization of the Alchevsk Steel Mill", Box1.Prices of steel products and semi-products (slabs) in 2001-2007, p.15

2. Backwardness of the Ukrainian Domestic Financial Market

As of 2003[42] and until now Ukraine is considered to be a high risk country for doing business and investing in. Almost no private capital is available from domestic or international capital markets for mid to long term investments, and any capital that is available has high cost.
Ukraine has relatively high price of credit resources which was[43] and is much higher than in other countries with full metallurgical cycle. At the time the investment decision was made interest rates were over 17,89% in hryvna-denominated loans[44] in part because of credit risk, and in part because of banks high operating costs[45], while in Europe interest rates were 2,21% in euro-denominated loans[46].

In general in 2003 the enterprise sector of Ukraine was weak. Inadequate accounting standards in enterprises hindered the evaluation of creditworthiness. Corporate governance was acknowledged to be non-transparent and open to abuse. The overall framework for creditors' rights and insolvency in Ukraine has improved in recent years, but continues to be weak.

The current legal basis is not only inadequate, but to a large extent it sabotages the development of market economy in Ukraine. Frequent and unpredictable changes in the legal system along with conflicting and inconsistent Civil and Commercial Codes do not allow for a transparent and stable enforced legal business environment, especially when it comes to VAT returned etc. This is perceived as a great source of uncertainty by international companies, which make future predictions of business goals and strategy risky.

Furthermore, the impact of global economic crisis influenced significantly on possibility of DIISW to continue and accomplish the project. Investment environment that developed by 2010 was and continue to be unstable and hampered the improvement of the Ukraine's investment ratings and the country's ability to attract enough direct foreign investments in its economy to be able to borrow from International Financial Institutions. DIISW, as part of IUD, was unable to take new loans amid financial and economy hurdles, neither in the form of project finance nor as a way to make up its operating capital requirements. Furthermore, global crisis prevented IUD from achieving access to international capital markets (by way of Eurobonds issue). The situation caused inability of IUD to complete several initiated JI projects at other sites.

Barriers due to Prevailing Practice and Technological Barriers

At the moment of the project decision was taken, other enterprises of Ukraine had never introduced such a wide-scale program of modernization. Actually IUD Corporation became the first in Ukraine to establish a program of modernization of this scale.

For the first time in Ukraine project envisaged the introduction of new sintering machines, fully modernized blast furnace etc.

Due to the complexity of this project (modernizations, different mixture of raw materials, introduction of new facilities etc.) this project faces a barrier due to prevailing practice. In particular, for the first time in Ukraine such measures were initiated as control and improvement of cast iron production technology, full reconstruction of blast furnaces, including equipping them with modern means of treatment and control of hazardous emissions into the atmosphere. DIISW has widely introduced such measures.

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[42] "The Investment Climate for Climate Investment: Joint Implementation in Transition Countries", Jan. 2003. This report ranks 13 European transition countries as to their investment climate and associated business risk of doing business in the countries. In this report, Ukraine is ranked as the last country in regards to investment climate and business risk.
[43] http://www.imf.org/external/pubs/ft/scr/2003/cr03340.pdf
[44] http://www.tradingeconomics.com/ukraine/lending-interest-rate-percent-wb-data.html
[45] http://www.imf.org/external/pubs/ft/scr/2003/cr03340.pdf
[46] http://www.euribor-rates.eu/euribor-2003.asp

It should be noted that the attractiveness of the project is crucially dependent on its ability to deliver the expected savings from fuel and material consumption. However at the same time quality of products should be secured and supplies of raw materials should not be undermined. This represents a very high risk in the project activity due to its innovate character and uncertainty regarding potential results and product quality.

There is a risk related to reduction of specific coke consumption. In relation to this a risk of discrepancy between actual and projected consumption of coke may occur. Even though reduction of coke can be observed, it occurred gradually over time. Coke consumption in BF is affected by numerous technological and economic factors, which are closely related to each other. Thus, there is a considerable probability that the projected activities may not bring about the expected reductions in coke consumption, or it may take a long time to achieve the estimated reductions. This raises uncertainty in project results, and may be interpreted as a barrier to project implementation.

Modernization of BFs and sinter plant could cause lower output and additional loses to DIISW. However, it is difficult to estimate this. On top of this, new automatic and control systems that would be accessible after modernizations require adjusting of the technological process and could lead to the additional underperformance of the BFs and sinter plant.

The improvement of BFs operation is planned to be achieved by introduction of the list of activities described in Section A4.2. Some of the listed activities have never been realized before at the project site and some of them are first of its kind in Ukraine. This fact leads to the high risk of control systems' malfunctions, resulting in the underperformance of the BFs.

Know-how of technology and facilities providers under the project, to some extent, could have guaranteed that stuff of the enterprise would receive the appropriate qualification to work with the new iron and agglomerate production process, but at that time there weren't fully trained professionals.
In spite of the fact that DIISW personnel are experienced in the maintenance, it would be challenge for them to introduce modernizations and use technologies never used before. The planned modernizations which would be implemented during the regular maintenance require extra time and labor.

In such event technological barriers would have additionally prevented implementation of Alternative 2.

This also proves that project is additional.

Outcome of Sub-step 3a: The identified barriers may prevent the Alternative #2 from implementation.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except for the proposed project activity):

Barrier Analysis Conclusions:

All mentioned barriers to some extent hamper the realisation of proposed project activity.

The above barriers would hinder project scenario implementation without additional revenue from Kyoto benefits and would in fact prevent any alternative scenario except baseline. There are also no alternative technologies to the existing situation that are affordable in the local situation. The down turned economy and very poor investment climate are very significant barrier to the implementation of more energy efficient technologies.

Thus the barriers identified above would hamper implementation of Alternative #2. At the same time these barriers would not constrain Alternative #1 (baseline) that could be realised based on the existing production cycle with practically no additional investments and on the basis of a well-known conventional technology.

Alleviation of barriers:

Despite the fact that Guidelines does not specifically require to prove alleviation of barriers by means of project registration if additionality is already proven, it is well understood that contribution of the potential carbon incomes to "enhance the credit profile of the project and mitigate some of its risks, including of technological character" was taken into consideration before ISD made an official decision to start the project activity.

Registration of the proposed project under JI mechanism will allow to overcome barriers connected with financing (investment barriers) as well as to cope with barriers of technological character. The additional benefit obtained from emission reductions sale will help to overcome barriers connected with the existing practice.

As the result of the JI project activity implementation all the barriers will be alleviated and project activity corresponds to the requirements of additionality.

Step 4. Common Practice Analysis

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

The proposed joint implementation project is not common practice. To-date, a similar project but to incomparable lower scale has been implemented only at Azovstal (some measures related to technological improvements of BFs operation and reconstruction of BF shop components of the proposed JI project) within the framework of one of the mechanisms provided by the Kyoto protocol to UNFCCC. Also, the same project is currently implemented at another IUD enetrprise: "Revamping of sintering and blast-furnace production at OJSC Alchevsk Iron and Steel Works". Pursuant to the Tool for the Demonstration and Assessment of Additionality, a project registered under Kyoto mechanism is excluded from common practice analysis, which makes the proposed project the only one of its kind for Ukraine.

So, the program of revamping of sintering and blast-furnace production planned to be implemented at DIISW is an integrated program that has no predecessors in Ukraine and could not be considered as a common practice.

Therefore, the overall conclusion is that the project activity meets all additionality criteria, which is best seen within Step 3.

Sub-steps 4a and 4b are satisfied. The project activity is additional.

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

The project boundary is determined in the way to cover all emissions of GHGs related to the project, as it is required by the paragraph 14 of the Guidance on criteria for baseline setting and monitoring (version 02)[47]. With respect to organizational structure of DIISW, project boundary includes directly sinter plant and blast-furnace shop together with all auxiliary power facilities of the plant. Power grid, natural gas supply network and material supplies such as coke are included to extended boundary of the project, as the proposed project activity is related with emissions which are caused by its manufacture and transportation. These emissions were taken into account in the project emission calculations with

[47] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

consideration of the default factors per tonne of output based on national sources or IPCC data of 1996 and 2006. Thus all CO_2 emissions related to project and baseline cases have been taken into account.

N_2O emissions from steelmaking process are unlikely to be significant; IPCC does not provide a methodology to calculate N_2O emissions[48]. They will not typically change from baseline to project case. CH_4 emissions are related to sinter and coke production in this type of project and are very minor in comparison with CO_{2e} emissions. Both types of emissions are excluded from the quantification of baseline and project emissions. The exclusion of CH_4 represents a conservative approach as more sinter and coke is consumed in absolute terms in the baseline in comparison with the project.

Table 4. Sources of Emissions

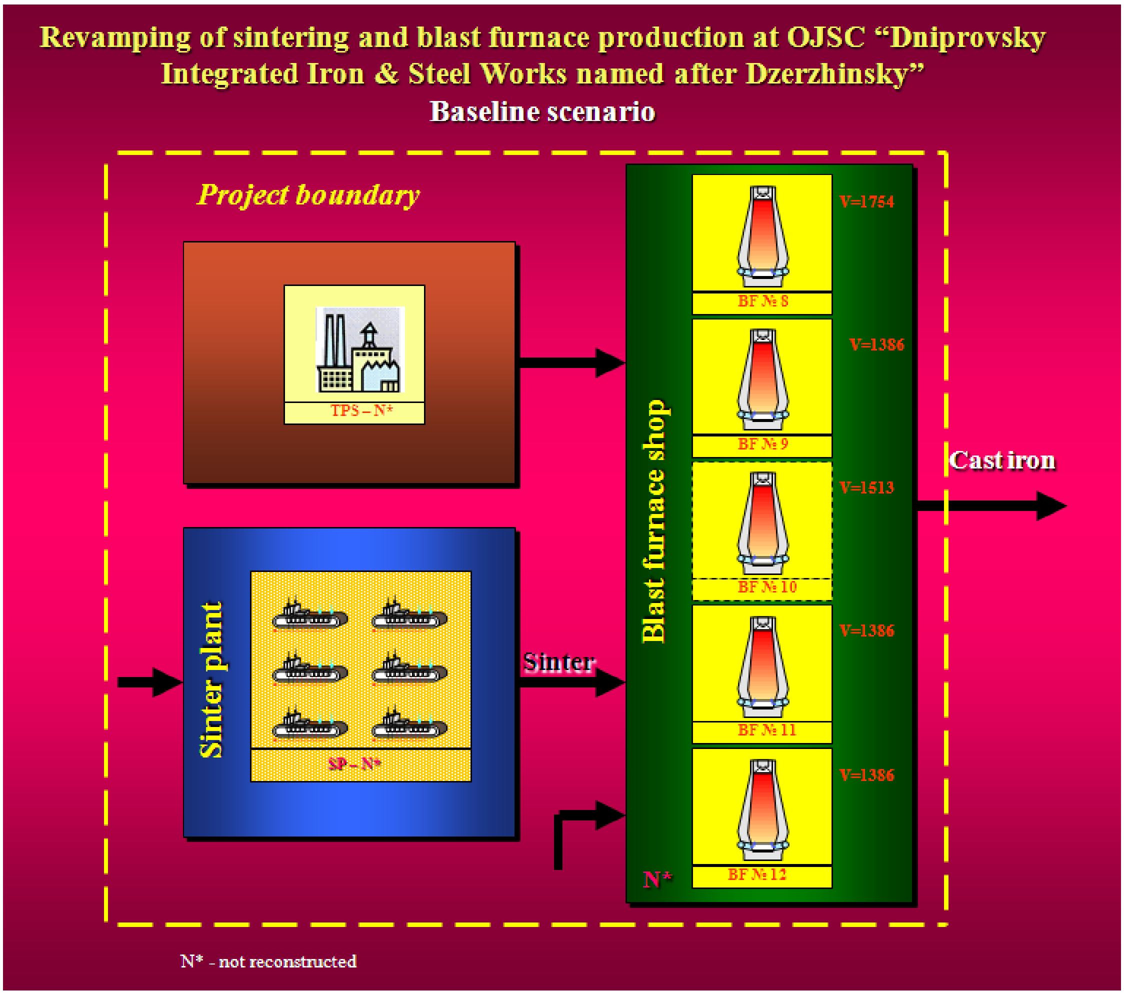
	Source	Gas	Inclusion/Exclusion	Justification / Explanation
Baseline Scenario	Fuel used	CO_2	Yes	Will be source of CO_2 emissions.
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
	Electricity used	CO_2	Yes	Will be source of CO_2 emissions.
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
	Material flow as part of production process	CO_2	Yes	Will be the main source of CO_2 emissions.
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.

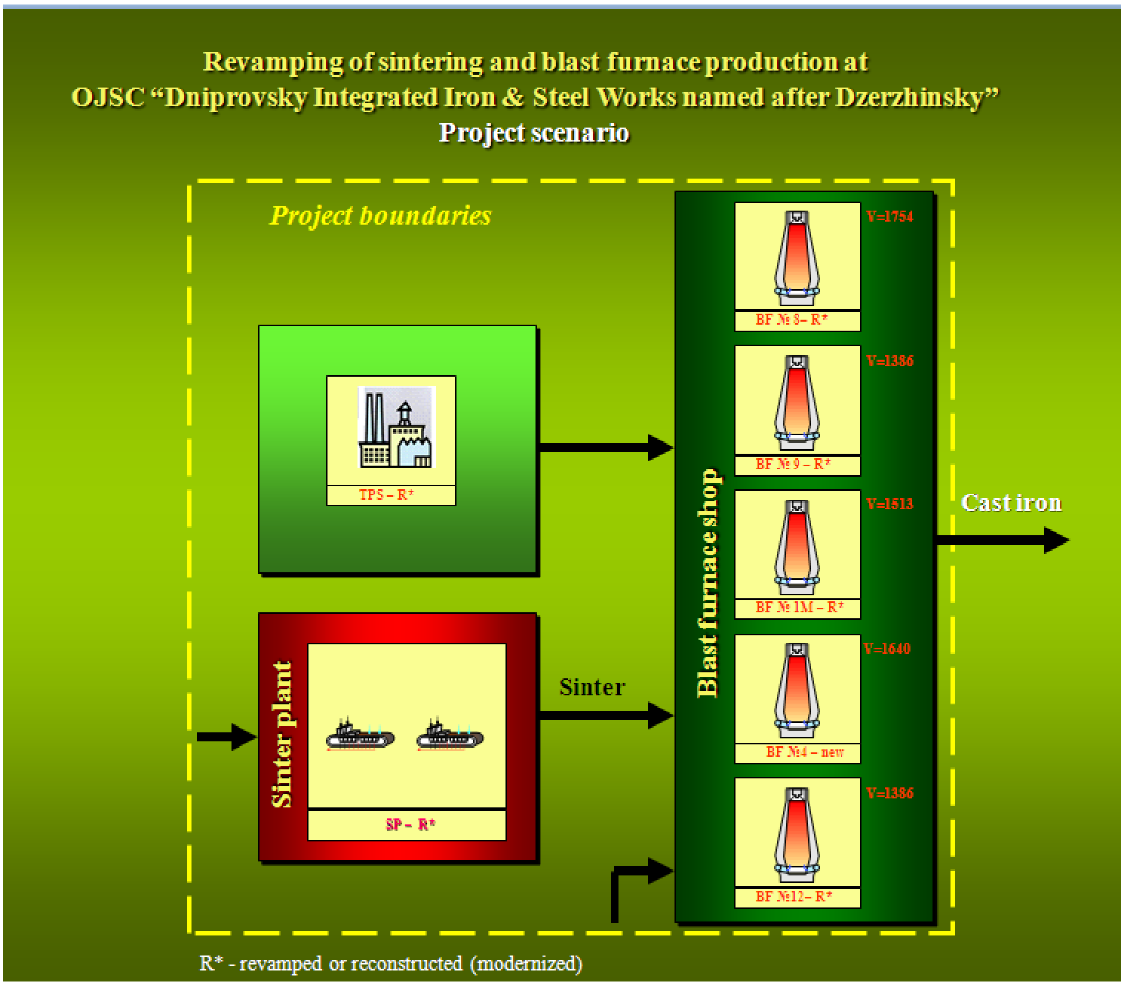
	Source	Gas	Inclusion/Exclusion	Justification / Explanation
Project Scenario	Fuels used	CO_2	Yes	CO_2 emissions will be reduced due to reduced use of fossil fuels (mainly coke).
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
	Electricity used	CO_2	Yes	No major change for total CO_2 emissions.
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.

[48] IPCC, 2006, Guidelines for National Greenhouse Gas Inventories, Volume 3, Industrial Processes and Product Use.

	Material flow as part of production process	CO_2	Yes	CO_2 emissions will be reduced due to decreased use of coke
		CH_4	No	This amount is likely to be insignificant and will not typically change from baseline to project case.
		N_2O	No	This amount is likely to be insignificant and will not typically change from baseline to project case.

The following schematics provide a very simple overview of the project and the baseline and the main elements associated with emission reductions.





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

<u>Date of Completion of Baseline Identification and Monitoring Methodology Application</u>

The implementation of the above baseline identification and monitoring plan is completed on 30/10/2010.

<u>Name of person/entity responsible for baseline identification and monitoring methodology application to the project</u>

Mr. Vasyl Vovchak
Director
Institute for Environment and Energy Conservation, Limited
11 Kotovskogo street, Kiev 04060, Ukraine
Tel./fax: + 380 44 206 4940
vovchak@ipee.org.ua

Institute for Environment and Energy Conservation Company, Limited is a consultancy company with experience in application of the Emission Trading and Joint Implementation Mechanisms. The company is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

1st of January 2004[49].

C.2. Expected operational lifetime of the project:

The operational lifetime of the project is at least 20 years (240 months) for all installed equipment and according to the schedule of the project.

C.3. Length of the crediting period:

Crediting period: 1st April 2004 – 31 December 2020.

Length of the crediting period: 16 years and 9 months or 201 months.

For the period from 1st April 2004 and up to 31 December 2007 Early Credits (AAU's) will be claimed to be transferred through Article 17 of the Kyoto Protocol.

Period before first commitment period: 1st April 2004 – 31st December 2007.

Length of period before first commitment period: 3 years and 9 months or 45 months.

First commitment period: 1st January 2008 – 31st December 2012.

Length of first commitment period: 5 years or 60 months.

Period following first commitment period: 1st January 2013 – 31st December 2020.

Length of period following first commitment period: 8 years or 96 months.

Emission reductions generated after the crediting period may be used in accordance with an appropriate mechanism under the UNFCCC. Also, In the event an agreement to prolong the Kyoto Protocol is achieved the crediting period may also be extended provided relevant approval.

[49] DIISW Order # 1792 of 29.12.2003 to the The minutes of meeting regarding condition of basic production assets of DIISW and development of strategy for its reconstruction and revamping, dated December 26, 2003

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

This Monitoring Plan is identical to the relevant part of Monitoring Plan used for the "Revamping and Modernisation of the Alchevsk Steel Mill" Joint Implementation Project, Project Registration Number UA 1000022[50]. This means the complete correlation between project and baseline scenarios of the proposed project and the said JI Project in Alchevsk.

The monitoring approach developed for this specific project is consistent with the assumptions and procedures adopted in the baseline approach (please see Section B.1). This monitoring approach requires monitoring and measurement of variables and parameters necessary to quantify the baseline emissions and project emissions in a conservative and transparent way.

1. The baseline technology with old blast furnaces and sinter plant reflects the common practice and has been successfully operated at DIISW for an extended time period. This allows the project developer to use historical data on the production and materials efficiency and compare with actual data in order to calculate emission reductions of GHG's. Specifically, all facilities are having identical technological characters under the baseline scenario and the project scenario with only difference in their efficiency.

2. The historical period has been chosen with regard to cover project previous statistically and technologically reliable period of 5 years from 1999 to 2003. 5-year baseline period should neutralize the potential impact of facilities' maintenance and repair as a part of normal routine operation of the Steel Mill.

3. This Plant is an integrated modern steel mill. It has the project specific oversight and control and respects the high-level metering requirements, in accordance with national norms and regulations and based on DIISW's *Metrological Support of Measuring Equipment* corporate standard and *Guideline on Plant Metrology Department* internal document. In fact, monitoring under baseline and project cases is a routine activity whose quality was checked by certification companies on numerous occasions. This will ensure accurate data on both energy and material flows into the project boundary, but also the data required to determine the CO_{2e} impact of the materials in accordance with the Monitoring Plan.

4. In the baseline and project line, Blast Furnace Gas is used as a fuel. Blast Furnace Gas is a by-product of the Blast Furnace process. Its main embedded energy and carbon reside in CH_4 and CO which typically make up about 50% of blast furnace gas. The carbon content of the blast furnace gas comes from the coke and to a lesser extent natural gas used in the process. All carbon entering the Blast Furnace, mostly as combusted coke or natural gas, is calculated already

[50] http://ji.unfccc.int/JIITLProject/DB/V75OZ8TQOFTB325LEDMXE2628ZD548/details

as CO_{2e} emissions within the boundary including the carbon that ends up in blast furnace gas. Therefore, blast furnace gas is treated as a carbon free fuel for blast furnaces, sinter plant and auxiliary power facilities[51].

5. Carbon content of pig iron will not be taken into account in order to avoid double counting of emissions due to the fact that carbon will be counted as a sum of all carbon containing elements during pig iron production. It is assumed that carbon in pig iron will end up into atmosphere at later stages of its usage.

6. All parameters will be measured/monitored *ex-post* based on specific Monitoring Plan developed for this project. In case if data will not be available, IPCC default factors will be used. This monitoring approach reduces the risk of overestimation of the emission reductions given that no key parameters/factors of quantification would be based on uncertain assumptions.

7. Carbon emission factor for natural gas consumption is calculated based on fixed net calorific value (based on average data regarding net calorific value), default emission factor which is in accordance with IPCC 1996. To follow the conservative approach in this document, net calorific value is rather lower than actual net calorific value during next periods. However if AIE requests to use actual calorific value of natural gas, the relevant calculations will be done in monitoring reports based on DIISW laboratory data.

8. This monitoring plan assumes accounting of all primary and secondary energy resources[52] consumed and to be consumed under the project and baseline cases. Since in the project and baseline scenario secondary energy will be consumed not only by major equipment but also for process support purposes, DIISW will separately monitor such additional[53] secondary energy resources as blast-furnace blowing, chemically treated water and heat production, as well as compressed air, steam, oxygen, nitrogen, argon, water, air-free water and treated gas together with its transportation.

9. Emission reductions in 2010 have been calculated based on conservative estimations on the pig iron output, general efficiency etc. which were observed in 2009. However, by taking into account that at the moment of PDD development it is complicated to provide precise emission reduction estimations based on extreme volatile market situation, any changes will be reflected in the relevant monitoring report after receiving all production data for the year 2010 which is expected in early 2011. The emission reductions in 2011 and 2012 have been calculated based on assumption of gradual market recovery. For conservativeness it is estimated that emission reductions in the year 2011 and 2012 would reach actual emission reductions in 2007 and 2008.

10. Emission reductions for the period 2013-2020 are based on production data during year 2007. Together with this it is assumed that due to continuous technological improvements of the blast furnaces (such as introduction of PCI system), continuous reconstruction of blast furnace shop (reconstruction of BF's #8, #9, #12 and implementation of a new BF#4M) and also by continuous modernization of the sintering process together with implementation of a new sinter

[51] If an emission factor is applied to BFG, these emissions would be double counted.
[52] Secondary energy is mainly derived from electricity to be measured directly using relevant meters.
[53] For avoidance of double counting additional energy resource consumption will be accounted net of consumption by major equipment.

plant the the amount of emission reductions will be continuously increased from 0,56% in 2013 and till 8,43% in 2016. Actual data of fuel and energy resources consumption for the specific monitoring period will be reflected in periodic monitoring reports.

11. Step 2 "Balance of process needs" of chosen JI specific approach in PDD implies CO_{2e} emissions from such facilities as: CHP (that produces blast-furnace blowing, chemically treated water and heat), as well as facilities that produce compressed air, oxygen, nitrogen, argon, water, air-free water and treated gas. These facilities consume fuel-and energy resources to ensure supply of all secondary energy resources to the technological process. Double counting is avoided.

12. Data monitored and required for determination will be stored at DISW during the whole crediting period and also during two years after the last transfer of ERU's.

Data/Parameter	Data Sources
Electricity & Fuels Used	Measured
Emission Factors for Fuels and Electricity	Carbon emission factors for fuel consumption will be based on average data regarding net calorific value of fuel (Natural Gas) taking into account the calorific value remains practically stable with very low level of fluctuations. Such decision ensures applicability of JI specific approach. In case if it is required by verifier the actual calorific values of different fuels can be monitored and reflected in relevant monitoring reports. Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[54]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[55].

[54] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[55] http://www.neia.gov.ua/nature/doccatalog/document?id=127171

	During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[56]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[57]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
Pig iron Produced	Measured
Quantities of Materials Used	Measured.
Emission Factors of Materials Used	Factors will be calculated based on actual net calorific value and carbon content in accordance with governing principles for the National Greenhouse Gas Register (IPCC 1996)[58].

All material and energy flows within the project boundary are measured and will be quantified as per their CO_{2e} impact using equations (1) – (25).

The monitoring plan meters, encompasses and monitors the energy and material flows into the project boundary and calculations are made as to the associated CO_{2e} emissions from those flows using the same formulae as the baseline approach:

1. Quantification of all CO_{2e} contributions of all the material flows in the project scenario
2. Quantification of CO_{2e} contributions of all energy flows in the project/baseline scenarios
3. Quantification of the total annual production output in the project/baseline cases

[56] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[57] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.
[58] http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

The material flows will include raw inputs of agglomerate, iron pellets as well as process inputs such as oxygen and compressed air (produced using electricity). Each material flow will be measured for impact on the tonnes of CO_{2e} emissions per tonne of pig iron production. Electricity consumed will be measured and converted to CO_{2e} emissions using grid data. This will provide a comprehensive picture of the emissions of CO_{2e} from the project and from the baseline.

As the project is configured, part of Blast Furnace Gas is used as a fuel in the existing combined heat and power plant to generate secondary energy sources. The CO_{2e} emissions from Blast Furnace Gas are already counted in the context of the total emissions of the pig iron production process so the Blast Furnace Gas is a zero emission fuel. Blast Furnace Gas is created as a by-product of the pig iron production process. The carbon content in the Blast Furnace Gas comes from the coke, coal and to a lesser extent natural gas used in the process and so is already counted as an emission in the calculation of the CO_{2e} impact of pig iron.

As described in section B.3., to ensure that double counting does not occur and that emission reductions are accurately calculated, agglomerate will be considered as material input into the pig iron making process. The total emissions from the sinter plant/blast furnace process will be calculated by using two basic steps: pig iron production and balance of process needs. The total pig iron output from the Blast Furnace will also be monitored allowing the project developer to calculate the tonnes of CO_{2e} emissions per tonne of pig iron produced. The baseline calculations will include the CO_{2e} emissions per tonne of pig iron in the project year multiplied by the baseline production of pig iron calculated for the project year as CO_{2e} emissions from project production.

It should be noted that baseline and monitoring approach allows changes of fuels and materials used in baseline and project scenarios. Therefore not all parameters listed are currently used in baseline and project cases for this specific project, e.g. oxygen is produced utilizing electricity, but Monitoring Plan takes into account the possible use of other fuels for oxygen production, depending on the market situation. Monitoring Plan therefore takes into account possible changes in the project design. Several parameters are the same in baseline and project cases as indicated in table D.2.

Data Quality Management

Given the complexity of the data requirements for the project monitoring the project developer will take the following steps to ensure data quality.

- Each new meter installed will be calibrated according to manufacturer’s specifications and frequency, national requirements, and the corporate standard STP 230-35-07, *Metrological Support of Measuring Equipment*.
- All new meters will be installed and calibrated before flows requiring monitoring commence.
- All existing meters that are used in new functions or are subject to some physical disruption in their use due to construction will be recalibrated according to STP 230-35-07, *Metrological Support of Measuring Equipment* and manufacturer’s specifications before measuring any flow.

It is critical to note, that while there are numerous data flows to be collected, the data collected is rigorously monitored as part of normal operation process of DIISW to ensure the proper proportions of material flows are added to the pig iron production process at the correct time. Data required for the Monitoring Plan for the project will be closely tracked as integral part of the steel plant’s core business. In addition, the project developer meticulously maintains records of energy consumption in relation to each part of the process and each material production shop which is under the project activity. All the production facilities are equipped with metering facilities that have consistently been used, are well understood by operators and constantly calibrated. Control over consumption of energy resources, input material and production is further monitored by a separate unit of the steel mill (Unit for Control and Automation) with a help of different meters all operating in accordance to the national standards of Ukraine and documented in Guiding Metrological Instructions of DIISW. Responsibilities for monitoring are defined in Table 5.

The project developer has additional documentation to support Monitoring Plan, e.g.:

- the Monitoring Database (including also *ex-ante* estimates of materials and fuels used) that will be regularly updated with actual data to compile and calculate the emission reductions monthly and annually;
- the Investment Plan giving a schedule of construction activities, and
- detailed guidelines regulating the monitoring procedures and responsibilities (DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*)

Generally quality assurance procedures will be based on the Plant's ISO 9001:2001 quality management system (QMS) implemented in 2001. This QMS covers the whole of the Plant's production process. In 2010, the system was upgraded to the more recent ISO 9001:2008[59] version. Certificates were issued by UkrSEPRO (no. 2.008.04188 dd. 29/01/2010) and TÜV SÜD (no. 12 100 37982 dd. 22/03/2010).

Furthermore, an OHSAS 18000 industrial safety management system and an ISO 14000 environmental management system were implemented in 2009. Relevant certificates were issued by TÜV Thuringen (nos. TIC 1511610202 dd. 02/03/2010 and TIC 1510410697 dd. 02/03/2010, respectively).

Compliance audits for the above standards are performed on an annual basis. In addition, the Plant has a number of other certificates (relevant information may be provided upon request), which could be seen as another proof of project monitoring quality assurance.

59 http://www.dmkd.dp.ua/sites/new.dmkd.dp.ua/files/sertif01.jpg

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

Key Information and Data Used for Project Case Identification

Data/Parameter	$TPII_p$
Data unit	Tonnes
Description	Total pig iron output
Time of determination/monitoring	Measured on regular basis (monthly)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 26-27
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is equal to the total pig iron output during the project activity
QA/QC procedures (to be) applied	See Section D.2.
Any comment	

Data/Parameter	$Q_{fpi,p}$
Data unit	1000 m^3
Description	Quantity of each fuel (fpi) used in making pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 26-27
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the project scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$EF_{f,p}$[60] (P-6, P-13, P-26)
Measuring unit	Tonnes CO_{2e}/1000 m^3
Description	Emission factor for fuel consumption
Identification/monitoring frequency	Fixed value based on DIISW average data
Source of data	DIISW average data IPCC 1996 Potentially measured by DIISW laboratory or local fuel distributor
Parameter value (for indicative calculations/identification)	See Table 26-27
Justification of parameter choice or description of measurement methods and procedure	Emission factor for natural gas consumption is calculated based on estimated net calorific value which is in accordance with DIISW average data and based on carbon content stated in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.[61] Net calorific value is anticipated at nearly 33,913 TJ/ 1 000 000 Nm^3. Therefore the carbon emission factor for Natural Gas combustion is anticipated at nearly 1,893 tonnes of CO_{2e}/1000 Nm^3 and is calculated based on mentioned above net calorific value.
Quality assurance and control procedures	See Section D.2.
Note	

[60] For more detailed information please see Annex 2.
[61] In case if the data regarding net calorific value for mentioned above fuels will be available at DIISW for each of the specific monitoring periods, the carbon emission factors will be accordingly modified at the stage of monitoring report development.

Data/Parameter	$ECPI_p$
Data unit	MWh
Description	Electricity consumed in producing pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 26-27
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on amount of electricity consumption in the project scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	Accounts for all sources of electricity consumption for primary and secondary production needs.

Key Variables/Parameters	$EF_{e,p}$ (P-9, P-16, P-29)
Measuring unit	Tonnes CO_{2e}/MWh
Description	Emission factor for electricity consumption
Identification/monitoring frequency	Regular tabulation (on monthly basis)
Source of data	Carbon emission factors verified by TÜV SÜD and carbon emission factors based on the Orders of the National environmental investment agency of Ukraine #43 dated 28th of March 2011, #62 dated 15th of April 2011 and #63 dated 15th of April 2011.
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[62]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[63]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[64]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[65]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
Quality assurance and control procedures	See Section D.2.
Note	

[62] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[63] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[64] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[65] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

Data/Parameter	$Q_{fio,p}$
Data unit	1000 m^3
Description	Quantity of each fuel (fio) used in sintering process
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 26-27
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the project scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$ECIO_p$
Measuring unit	MWh
Description	Electricity consumed in sintering process
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on amount of electricity consumption in the project scenario.
Quality assurance and control procedures	See Section D.2.
Note	Accounts for sources of electricity consumption for primary and secondary production needs.

Key Variables/Parameters	$Q_{rapi,p}$
Measuring unit	Tonnes
Description	Quantity of each reducing agent (rapi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 26-27
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of reducing agents consumption in the project scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{ra,p}$[66]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each reducing agent
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006 Potentially measured by DIISW laboratory
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf) and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf). For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	This PDD uses default factors: For coke it is anticipated at 3.66 tonnes CO_{2e}/tonne; For anthracite the anticipated factor is 2.62 tonnes CO_{2e}/tonne. However in the monitoring reports these factors will be calculated based on carbon content in coke and net calorific value of anthracite. If information on actual carbon content or net calorific value is available, it would prevail over default factors.

[66] For more detailed information please see Annex 2.

Key Variables/Parameters	$Q_{oipi,p}$
Measuring unit	Tonnes
Description	Quantity of each other input (oipi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of other inputs consumption in the project scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{oi,p}$[67]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each other input
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf). For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	For pellets it is anticipated at 0.03 tonnes CO_{2e}/tonne of pellets produced. For limestone it is anticipated at 0.44 tonnes CO_{2e}/tonne of limestone. For dolomite it is anticipated at 0.477 tonnes CO_{2e}/tonne of dolomite.

[67] For more detailed information please see Annex 2.

Key Variables/Parameters	$Q_{fbpn,p}$
Measuring unit	1000 m^3
Description	Quantity of fuel (fbpn) used for balance of process needs
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on quantity of fuel consumption in the project scenario.
Quality assurance and control procedures	See Section D.2.
Note	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$ECBPN_p$
Measuring unit	MWh
Description	Electricity consumed for balance of process needs
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Tables 26-27
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on amount of electricity consumption in the project scenario.
Quality assurance and control procedures	See Section D.2.
Note	Accounts for sources of electricity consumption for primary and secondary production needs.

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

Project emissions will equal the total tonnes of CO_{2e} from the Pig Iron Process and Sintering (Sinter production) added to the total tonnes of CO_{2e} from the energy consumed for the balance of process needs. The data will be measured regularly. Equations capture the entire CO_{2e} impact from all material and energy flows into the project. Therefore the approach is both transparent and justifiable. Monitoring approach captures also potential changes in project design.

$PE_i = TCPI_{p,i} + TCBPN_{p,i}$ (1),

where:
$TCPI_{p,i}$ = total embodied CO_{2e} from Pig Iron production, t CO_{2e} (project case)
$TCBPN_{p,i}$ = total CO_{2e} in the balance of production processes, t CO_{2e} (project case)

$_i$ = regular data registration interval

To calculate project emissions, equations 1-12 are applied.

The approach includes 2 clear steps determining the CO_{2e} emissions from Pig Iron production (Step 1) and emissions from balance of process needs (Step 2) required estimate total CO_{2e} emissions per 1 tonne of pig iron produced in the project scenario.

The equations capture the entire CO_{2e} impacts of all material and energy flows into the projectline. Therefore the approach is both transparent and justifiable. All the changes, e.g. the potential energy efficiency measures will be directly reflected in the projectline emissions further supporting the conservativeness of the projectline approach.

STEP 1. PIG IRON PRODUCTION

CO_{2e} due to the production of Pig Iron ($TCPI_{p,i}$) comes from three sources: fuel (natural gas), electricity and material inputs, such as coke, anthracite, limestone, dolomite, pellets, etc.

$TCPI_{p,i} = (TCFCPI_{p,i} + TCEPI_{p,i} + TCIPI_{p,i})$ (2),

where:

$TCFCPI_{p,i}$ = total CO_{2e} from fuel consumption in producing Pig Iron, t CO_{2e}
$TCEPI_{p,i}$ = total CO_{2e} from electricity consumption in producing Pig Iron, t CO_{2e}
$TCIPI_{p,i}$ = total CO_{2e} from Inputs into Pig Iron, t CO_{2e}

Total CO_{2e} from fuel consumption in producing Pig Iron ($TCFCPI_{p,i}$) is the quantity of fuel multiplied by the emission factor of the fuel:

$$TCFCPI_{p,i} = \sum_{1}^{fpi} \left(Q_{fpi,p,i} \times EF_{f,p} \right) \quad (3),$$

where:
$fpi_{p,i}$ = fuel used in making pig iron
$Q_{p,i}$ = quantity of fuel fpi used (1000 m^3)
$EF_{f,p}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

Total CO_{2e} from electricity consumption in producing Pig Iron ($TCEPI_{p,i}$) is the quantity of electricity multiplied by the emission factor of electricity:

$$TCEPI_{p,i} = ECPI_{p,i} \text{ x } EF_{e,p} \quad (4),$$

where:
$ECPI_{p,i}$ = electricity consumed in producing pig iron, MWh
$EF_{e,p}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

$TCIPI_{p,i}$ – the total CO_{2e} emissions from the material inputs into pig iron – include the CO_{2e} from fuel and electricity used to prepare iron ore, the total CO_{2e} from the reducing agents (coke, anthracite etc.) and the total CO_{2e} from limestone, dolomite, pellets etc.

$$TCIPI_{p,i} = TCFIO_{p,i} + TCEIO_{p,i} + TCRAPI_{p,i} + TCOIPI_{p,i} \quad (5),$$

where:
$TCFIO_{p,i}$ = total CO_{2e} from fuel used to prepare iron ore, t CO_{2e}

$TCEIO_{p,i}$ = total CO_{2e} from electricity consumption in preparing iron ore, t CO_{2e}
$TCRAPI_{p,i}$ = total CO_{2e} from reducing agents, t CO_{2e}[68]
$TCOIPI_{p,i}$ = total CO_{2e} from the other consumed inputs, t CO_{2e}[69]

Total CO_{2e} from fuel used for Sinter production ($TCFIO_{p,i}$) is the quantity of fuel multiplied by the emission factor of this fuel:

$$TCFIO_{p,i} = \sum_{1}^{fio} \left(Q_{fio,p,i} \times EF_{f,p} \right) \quad (6),$$

where:
$fio_{p,i}$ = fuel used for Sinter production
$Q_{p,i}$ = quantity of fuel fio used (1000 m^3)
$EF_{f,p}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

Total CO_{2e} from electricity consumption for Sinter production ($TCEIO_{p,i}$) is the quantity of electricity multiplied by the emission factor of electricity:

$$TCEIO_{p,i} = ECIO_{p,i} * EF_{e,p} \quad (7),$$

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[68] For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf) and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf). For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf).
[69] For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for* CO_2, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf). For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf).

where:
$ECIO_{p,i}$ = electricity consumed for Sinter production, MWh
$EF_{e,p}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

Total CO_{2e} from reducing agents in pig iron production $TCRAPI_{p,i}$ is the quantity of each reducing agent multiplied by the emission factor for the reducing agent:

$$TCRAPI_{p,i} = \sum_{1}^{rapi} \left(Q_{rapi,p,i} \times EF_{ra,p} \right) \qquad (8),$$

where:
$rapi_{p,i}$ = number of reducing agents in pig iron production
$Q_{p,i}$ = quantity of each reducing agent rapi used (tonnes)
$EF_{ra,p}$ = emission factor for reducing agent, t CO_{2e}/tonne in the relevant period

The PDD is using default factors for coke (emission factor 3.66 t CO_{2e}/tonne, which includes the default factor for coke burning (3.1 t CO_{2e}/tonne) and the default factor for coke production (0.56 t CO_{2e}/tonne)), anthracite (default emission factor 2.62 t CO_{2e}/tonne). If other reducing agents are to be used, their default emission factors will be applied. In case if actual data on carbon content and the net calorific value of coke and coal are available, the emission factor for these parameters will be recalculated and these data would prevail over PDD estimations.

Total CO_{2e} from the other inputs such as limestone, dolomite, pellets etc. in pig iron production $TCOIPI_{p,i}$ is the quantity of each other input multiplied by the emission factor for that input:

$$TCOIPI_{p,i} = \sum_{1}^{oipi} \left(Q_{oipi,p,i} \times EF_{oi,p} \right) \qquad (9),$$

where:
$oipi_{p,i}$ = number of the other inputs in pig iron production
$Q_{p,i}$ = quantity of each other input oipi used (tonnes)
$EF_{oi,,p}$ = emission factor for the other inputs, t CO_{2e}/tonne in the relevant period

STEP 2. BALANCE OF PROCESS NEEDS

Total tonnes of CO_2 related to the balance of process needs of the project, namely production of secondary energy at the CHP (that produces blast-furnace blowing, chemically treated water and heat), as well as processes to produce compressed air, steam, oxygen, nitrogen, argon[70], water, air-free water and treated gas together with its transportation. The relevant parameters are calculated based on the amounts of fuel and electricity consumed by the said processes:

$TCBPN_{p,i}$ = total tonnes of CO_2 related to the balance of process needs, which is the sum of CO_2 emissions from fuel and electricity consumed:

$$TCBPN_{p,i} = TCFCBPN_{p,i} + TCEBPN_{p,i} \quad (10),$$

where:
$TCFCBPN_{p,i}$ = total CO_{2e} from fuel consumption for balance of process needs, t CO_{2e}:

$$TCFCBPN_{p,i} = \sum_{1}^{fbpn} Q_{fbpn,p,i} \times EF_{f,p} \quad (11),$$

where:
$fbpn_{p,i}$ = fuel used in producing secondary energy used for balance of process needs
$Q_{p,i}$ = quantity of fuel fbpn used (1000 m^3)
$EF_{f,p}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

$TCEBPN_{p,i}$ = total CO_{2e} from electricity consumption for balance of process needs, t CO_{2e}:

$$TCEBPN_{p,i} = ECBPN_{p,i} * EF_{e,p} \quad (12),$$

where:
$ECBPN_{p,i}$ = electricity used for production of secondary energy used for the balance of process needs (MWh)
$EF_{e,p}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

[70] Argon is a by-product of Oxygen production therefore will not be double counted.

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

Key Information and Data Used for Baseline Identification

Data/Parameter	$TPII_b$
Data unit	Tonnes
Description	Total pig iron output
Time of determination/monitoring	Measured on regular basis (monthly)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is equal to the total pig iron output during the project activity
QA/QC procedures (to be) applied	See Section D.2.
Any comment	

Data/Parameter	$Q_{fpi,b}$
Data unit	1000 m^3
Description	Quantity of each fuel (fpi) used in making pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$EF_{f,b}$[71] (B-6, B-13, B-26)
Measuring unit	Tonnes CO_{2e}/1000 m^3
Description	Emission factor for fuel consumption
Identification/monitoring frequency	Fixed value based on DIISW average data
Source of data	DIISW average data IPCC 1996 Potentially measured by DIISW laboratory or local fuel distributor
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	Emission factor for natural gas consumption is calculated based on estimated net calorific value which is in accordance with DIISW average data and based on carbon content stated in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.[72] Net calorific value is anticipated at nearly 33,913 TJ/ 1 000 000 Nm^3. Therefore the carbon emission factor for Natural Gas combustion is anticipated at nearly 1,893 tonnes of CO_{2e}/1000 Nm^3 and is calculated based on mentioned above net calorific value.
Quality assurance and control procedures	See Section D.2.
Note	

[71] For more detailed information please see Annex 2.
[72] In case if the data regarding net calorific value for mentioned above fuels will be available at DIISW for each of the specific monitoring periods, the carbon emission factors will be accordingly modified at the stage of monitoring report development.

Data/Parameter	$ECPI_b$
Data unit	MWh
Description	Electricity consumed in producing pig iron
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on amount of electricity consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	Accounts for all sources of electricity consumption for primary and secondary production needs.

Key Variables/Parameters	$EF_{e,b}$ (B-9, B-16, B-29)
Measuring unit	Tonnes CO_{2e}/MWh
Description	Emission factor for electricity consumption
Identification/monitoring frequency	Regular tabulation (on monthly basis)
Source of data	Carbon emission factors verified by TÜV SÜD and carbon emission factors based on the Orders of the National environmental investment agency of Ukraine #43 dated 28th of March 2011, #62 dated 15th of April 2011 and #63 dated 15th of April 2011.
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[73]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[74]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[75]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[76]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
Quality assurance and control procedures	See Section D.2.
Note	

[73] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[74] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[75] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[76] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

Data/Parameter	$Q_{fio,b}$
Data unit	1000 m^3
Description	Quantity of each fuel (fio) used in sintering process
Time of determination/monitoring	Continuous with regular tabulation (monthly basis)
Source of data (to be) used	Recorded by DIISW
Value of data applied (for ex ante calculations/determinations)	See Tables 28-30
Justification of the choice of data or description of measurement methods and procedures (to be) applied	This parameter is based on quantity of fuel consumption in the baseline scenario.
QA/QC procedures (to be) applied	See Section D.2.
Any comment	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$ECIO_b$
Measuring unit	MWh
Description	Electricity consumed in sintering process
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on amount of electricity consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	Accounts for sources of electricity consumption for primary and secondary production needs.

Key Variables/Parameters	$Q_{rapi,b}$
Measuring unit	Tonnes
Description	Quantity of each reducing agent (rapi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of reducing agents consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{ra,b}$[77]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each reducing agent
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006 Potentially measured by DIISW laboratory
Parameter value (for indicative calculations/identification)	See Tables 28-30
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf) and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf). For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	This PDD uses default factors: For coke it is anticipated at 3.66 tonnes CO_{2e}/tonne; For anthracite the anticipated factor is 2.62 tonnes CO_{2e}/tonne. However in the monitoring reports these factors will be calculated based on carbon content in coke and net calorific value of anthracite. If information on actual carbon content or net calorific value is available, it would prevail over default factors.

[77] For more detailed information please see Annex 2.

Key Variables/Parameters	$Q_{oipi,b}$
Measuring unit	Tonnes
Description	Quantity of each other input (oipi) in Pig Iron Production
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on volume of other inputs consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	

Key Variables/Parameters	$EF_{oi,b}$[78]
Measuring unit	Tonnes CO_{2e}/Tonnes
Description	Emission factor of each other input
Identification/monitoring frequency	Fixed and monitored values
Source of data	IPCC 1996 IPCC 2006
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf). For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). Also see Annex 3
Quality assurance and control procedures	See Section D.2.
Note	For pellets it is anticipated at 0.03 tonnes CO_{2e}/tonne of pellets produced. For limestone it is anticipated at 0.44 tonnes CO_{2e}/tonne of limestone. For dolomite it is anticipated at 0.477 tonnes CO_{2e}/tonne of dolomite.

[78] For more detailed information please see Annex 2.

Key Variables/Parameters	$Q_{fbpn,b}$
Measuring unit	1000 m^3
Description	Quantity of fuel (fbpn) used for balance of process needs
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on quantity of fuel consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	For this project natural gas is considered to be a fuel measured in 1000 m^3.

Key Variables/Parameters	$ECBPN_b$
Measuring unit	MWh
Description	Electricity consumed for balance of process needs
Identification/monitoring frequency	Continuous with regular tabulation (monthly basis)
Source of data	Recorded by DIISW
Parameter value (for indicative calculations/identification)	See Table 28-30
Justification of parameter choice or description of measurement methods and procedure	This parameter is based on amount of electricity consumption in the baseline scenario.
Quality assurance and control procedures	See Section D.2.
Note	Accounts for sources of electricity consumption for primary and secondary production needs.

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

$BE_i = TCPTPIP_b \times TPII_{p,i}$ (13),

where:
$TCPTPIP_b$ – total CO_{2e} emissions per 1 tonne of pig iron produced, t CO_{2e}
$TPII_{p,i}$ = total pig iron production during the particular project period, tonnes

$_i$ = regular data registration interval
$_p$ = project case
$_b$ = baseline

$TCPTPIP_b$ – total CO_{2e} emissions per 1 tonne of pig iron produced in the baseline scenario (historical data of DIISW operation regarding pig iron production during the period of 1999 – 2003) – includes total embodied CO_{2e} from Pig Iron production and total CO_{2e} in the balance of production processes, which are divided by total volume of pig iron production in the baseline scenario (historical pig iron production at DIISW during the period of 1999-2003).

$TCPTPIP_b = (TCPI_b + TCBPN_b) / TPII_b$ (14),

where:
$TCPI_b$ = total embodied CO_{2e} from Pig Iron production, t CO_{2e}
$TCBPN_b$ = total CO_{2e} in the balance of production processes, t CO_{2e}
$TPII_b$ = total pig iron production during the baseline period, tonnes

The approach includes 2 clear steps determining the CO_{2e} emissions from Pig Iron production (Step 1) and emissions from balance of process needs (Step 2) required estimate total CO_{2e} emissions per 1 tonne of pig iron produced in the baseline scenario.

The equations capture the entire CO_{2e} impacts of all material and energy flows into the baseline. Therefore the approach is both transparent and justifiable. All the changes, e.g. the potential energy efficiency measures will be directly reflected in the baseline emissions further supporting the conservativeness of the baseline approach.

To calculate baseline emissions, equations 13-25 are applied.

STEP 1. PIG IRON PRODUCTION

CO_{2e} due to the production of Pig Iron ($TCPI_{b,i}$) comes from three sources: fuel (natural gas), electricity, and material inputs, such as coke, anthracite, limestone, dolomite, pellets, etc.

$$TCPI_{b,i} = (TCFCPI_{b,i} + TCEPI_{b,i} + TCIPI_{b,i}) \quad (15),$$

where:

$TCFCPI_{b,i}$ = total CO_{2e} from fuel consumption in producing Pig Iron, t CO_{2e}
$TCEPI_{b,i}$ = total CO_{2e} from electricity consumption in producing Pig Iron, t CO_{2e}
$TCIPI_{b,i}$ = total CO_{2e} from Inputs into Pig Iron, t CO_{2e}

Total CO_{2e} from fuel consumption in producing Pig Iron ($TCFCPI_{b,i}$) is the quantity of fuel multiplied by the emission factor of the fuel:

$$TCFCPI_{b,i} = \sum_{1}^{fpi} \left(Q_{fpi,b,i} \times EF_{f,b} \right) \quad (16),$$

where:
$fpi_{b,i}$ = fuel used in making pig iron
$Q_{b,i}$ = quantity of fuel fpi used (1000 m^3)
$EF_{f,b}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

Total CO_{2e} from electricity consumption in producing Pig Iron ($TCEPI_{b,i}$) is the quantity of electricity multiplied by the emission factor of electricity:

$$TCEPI_{b,i} = ECPI_{b,i} \times EF_{e,b} \quad (17),$$

where:
$ECPI_{b,i}$ = electricity consumed in producing pig iron, MWh

$EF_{e,b}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

$TCIPI_{b,i}$ – the total CO_{2e} emissions from the material inputs into pig iron – include the CO_{2e} from fuel and electricity used to prepare iron ore, the total CO_{2e} from the reducing agents (coke, anthracite etc.) and the total CO_{2e} from limestone, dolomite, pellets etc.

$$TCIPI_{b,i} = TCFIO_{b,i} + TCEIO_{b,i} + TCRAPI_{b,i} + TCOIPI_{b,i} \quad (18),$$

where:
$TCFIO_{b,i}$ = total CO_{2e} from fuel used to prepare iron ore, t CO_{2e}
$TCEIO_{b,i}$ = total CO_{2e} from electricity consumption in preparing iron ore, t CO_{2e}
$TCRAPI_{b,i}$ = total CO_{2e} from reducing agents, t CO_{2e}[79]
$TCOIPI_{b,i}$ = total CO_{2e} from the other consumed inputs, t CO_{2e}[80]

Total CO_{2e} from fuel used for Sinter production ($TCFIO_{b,i}$) is the quantity of fuel multiplied by the emission factor of this fuel:

$$TCFIO_{b,i} = \sum_{1}^{fio} \left(Q_{fio,b,i} \times EF_{f,b} \right) \quad (19),$$

where:
$fio_{b,i}$ = fuel used for Sinter production
$Q_{b,i}$ = quantity of fuel fio used (1000 m^3)
$EF_{f,b}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

[79] For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf) and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf). For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf). NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf).

[80] For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10 (http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf). For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf).

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

Total CO_{2e} from electricity consumption for Sinter production ($TCEIO_{b,i}$) is the quantity of electricity multiplied by the emission factor of electricity:

$$TCEIO_{b,i} = ECIO_{b,i} * EF_{e,b} \quad (20),$$

where:
$ECIO_{b,i}$ = electricity consumed for Sinter production, MWh
$EF_{e,b}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

Total CO_{2e} from reducing agents in pig iron production $TCRAPI_{b,i}$ is the quantity of each reducing agent multiplied by the emission factor for the reducing agent:

$$TCRAPI_{b,i} = \sum_{1}^{rapi} \left(Q_{rapi,b,i} \times EF_{ra,b} \right) \quad (21),$$

where:
$rapi_{b,i}$ = number of reducing agents in pig iron production
$Q_{b,i}$ = quantity of each reducing agent rapi used (tonnes)
$EF_{ra,b}$ = emission factor for reducing agent, t CO_{2e}/tonne in the relevant period

The PDD is using default factors for coke (emission factor 3.66 t CO_{2e}/tonne, which includes the default factor for coke burning (3.1 t CO_{2e}/tonne) and the default factor for coke production (0.56 t CO_{2e}/tonne)), anthracite (default emission factor 2.62 t CO_{2e}/tonne). If other reducing agents are to be used, their default emission factors will be applied. In case if actual data on carbon content and the net calorific value of coke and anthracite are available, the emission factor for these parameters will be recalculated and these data would prevail over PDD estimations.

Total CO_{2e} from the other inputs such as limestone, dolomite, pellets etc. in pig iron production $TCOIPI_{b,i}$ is the quantity of each other input multiplied by the emission factor for that input:

$$TCOIPI_{b,i} = \sum_{1}^{oipi} \left(Q_{oipi,b,i} \times EF_{oi,b} \right) \quad (22),$$

where:
$oipi_{b,i}$ = number of the other inputs in pig iron production
$Q_{b,i}$ = quantity of each other input oipi used (tonnes)
$EF_{oi,,b}$ = emission factor for the other inputs, t CO_{2e}/tonne in the relevant period

STEP 2. BALANCE OF PROCESS NEEDS

Total tonnes of CO_2 related to the balance of process needs of the project, namely production of secondary energy at the CHP (that produces blast-furnace blowing, chemically treated water and heat), as well as processes to produce compressed air, steam, oxygen, nitrogen, argon[81], water, air-free water and treated gas together with its transportation. The relevant parameters are calculated based on the amounts of fuel and electricity consumed by the said processes:

$TCBPN_{b,i}$ = total tonnes of CO_2 related to the balance of process needs, which is the sum of CO_2 emissions from fuel and electricity consumed:

$$TCBPN_{b,i} = TCFCBPN_{b,i} + TCEBPN_{b,i} \quad (23),$$

where:
$TCFCBPN_{b,i}$ = total CO_{2e} from fuel consumption for balance of process needs, t CO_{2e}:

$$TCFCBPN_{b,i} = \sum_{1}^{fbpn} Q_{fbpn,b,i} \times EF_{f,b} \quad (24),$$

where:
$fbpn_{b,i}$ = fuel used in producing secondary energy used for balance of process needs
$Q_{b,i}$ = quantity of fuel fbpn used (1000 m^3)
$EF_{f,b}$ = tonnes of CO_{2e} per 1000 m^3 of fuel

[81] Argon is a by-product of Oxygen production therefore will not be double counted.

Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.

$TCEBPN_{b,i}$ = total CO_{2e} from electricity consumption for balance of process needs, t CO_{2e}:

$$TCEBPN_{b,i} = ECBPN_{b,i} * EF_{e,p} \quad (25),$$

where:
$ECBPN_{b,i}$ = electricity used for production of secondary energy used for the balance of process needs (MWh)
$EF_{e,p}$ = emission factor for electricity, t CO_{2e}/MWh in the relevant period

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

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

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

Not applicable.

D.1.2.2. 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:

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

Not applicable.

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

Not applicable. The emissions from installing the new equipment will not be significant. The emissions from transport of materials will not be significantly higher for the baseline; however this will not be taken into account to secure conservativeness of the analysis.

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):

$$ER_i = BE_i - (PE_i + LE_i) \quad (26),$$

where:
ER_i = Emission Reductions
BE_i = Baseline Emissions
PE_i = Project Emissions
LE_i = Leakages of GHG's
$_i$ = regular data registration interval

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:

DIISW has historical experience in dealing with environmental impacts by different steelmaking processes. Environmental activity is one of the core activities of the plant due to location of the plant in the quite populated city Dniprodzerzhynsk.

Within DIISW's structure there is a special environmental department (SED) which is in charge of the monitoring for various kinds of environmental impacts within the plant activity, data collection, analysis and archiving, which is a routine activity of DIISW. It shall be noted that the project activity does not lead to aggravation of environmental situation, but rather opposite - reduces load on environment.

In its operation SED is regulated by the national and local documents. Overall environmental influence is under manageable control and fully in compliance with national and local regulations.

The environmental management standard ISO 14001[82] is implemented and certified at DIISW.

The monitoring frequency is in accordance with approved graphs of analytical and departmental control.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:			
Data *(Indicate table and ID number)*	Data variable	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P-3	Total Pig Iron Output ($TPII_p$)	Low, ±50-150kg	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
P-5	Quantity of each fuel (fpi_p) used in making Pig Iron ($Q_{fpi,p}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
P-6, 13, 26	Emission factor for fuel consumption $EF_{f,p}$	Low	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13. Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.
P-8	Electricity Consumed in producing Pig Iron ($ECPI_p$)	Low, ±0.5-2%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.

[82] http://www.dmkd.dp.ua/node/237

P-9, 16, 29	Emission factor for electricity consumption $EF_{e,p}$	Low	Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[83]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[84]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[85]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[86]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
P-12	Quantity of each fuel (fio_p) used in Sintering ($Q_{fio,p}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
P-15	Electricity Consumed in Sintering ($ECIO_p$)	Low, ±0.5-2.5%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.
P-18	Quantity of each reducing agent ($rapi_p$) in Pig Iron Production ($Q_{rapi,p,i}$)	Low, 0.1-1.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.

[83] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[84] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[85] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[86] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

P-19	Emission factor of each reducing agent, $EF_{ra,p}$	Low	For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13. For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25. NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors*, Table 1.2, page 18. The PDD is using default factors for coke (emission factor 3.66 t CO_{2e}/tonne, which includes the default factor for coke burning (3.1 t CO_{2e}/tonne) and the default factor for coke production (0.56 t CO_{2e}/tonne)), anthracite (default emission factor 2.62 t CO_{2e}/tonne). If other reducing agents are to be used, their default emission factors will be applied. In case if actual data on carbon content and the net calorific value of coke and anthracite are available, the emission factor for these parameters will be recalculated and these data would prevail over PDD estimations.
P-21	Quantity of each other input ($oipi_p$) in Pig Iron Production ($Q_{oipi,p,i}$)	Low, ±50-150kg	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
P-22	Emission factor of each other input, $EF_{oi,p}$	Low	For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10. For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25.
P-25	Quantity of each fuel ($fbpn_p$) used for balance of process needs ($Q_{fbpn,p}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
P-28	Electricity Consumed for balance of process needs ($ECBPN_p$)	Low, 2%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.

B-3	Total Pig Iron Output ($TPII_b$)	Low, ±50-150kg	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
B-5	Quantity of each fuel (fpi_b) used in making Pig Iron ($Q_{fpi,b}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
B-6, 13, 26	Emission factor for fuel consumption $EF_{f,pb}$	Low	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13. Emission factor for fuel in this case is based on fixed net calorific value. During the monitoring report development emission factor will be modified by taking into account actual net calorific value of fuel.
B-8	Electricity Consumed in producing Pig Iron ($ECPI_b$)	Low, ±0.5-2%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.
B-9, 16, 29	Emission factor for electricity consumption $EF_{e,b}$	Low	Up to 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[87]. During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[88]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[89]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[90]. If any other emission factors will be officially approved, the project developer will make an appropriate modification at the stage of monitoring report development. For more detailed information please also see Annex 2.
B-12	Quantity of each fuel (fio_b) used in Sintering ($Q_{fio,b}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.

87 http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
88 http://www.neia.gov.ua/nature/doccatalog/document?id=127171
89 http://www.neia.gov.ua/nature/doccatalog/document?id=127172
90 http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

B-15	Electricity Consumed in Sintering ($ECIO_b$)	Low, ±0.5-2.5%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.
B-18	Quantity of each reducing agent ($rapi_b$) in Pig Iron Production ($Q_{rapi,b,i}$)	Low, 0.1-1.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
B-19	Emission factor of each reducing agent, $EF_{ra,b}$	Low	For default carbon emission factors of various reducing agents consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26 and Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13. For default carbon emission factors of various reducing agents production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25. NCV for anthracite is based on default value in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors,* Table 1.2, page 18. The PDD is using default factors for coke (emission factor 3.66 t CO_{2e}/tonne, which includes the default factor for coke burning (3.1 t CO_{2e}/tonne) and the default factor for coke production (0.56 t CO_{2e}/tonne)), anthracite (default emission factor 2.62 t CO_{2e}/tonne). If other reducing agents are to be used, their default emission factors will be applied. In case if actual data on carbon content and the net calorific value of coke and anthracite are available, the emission factor for these parameters will be recalculated and these data would prevail over PDD estimations.
B-21	Quantity of each other input ($oipi_b$) in Pig Iron Production ($Q_{oipi,b,i}$)	Low, ±50-150kg	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.

B-22	Emission factor of each other input, $EF_{oi,b}$	Low	For default carbon emission factors of various other inputs consumption please see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10. For default carbon emission factors of various other inputs production please see 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25.
B-25	Quantity of each fuel ($fbpn_b$) used for balance of process needs ($Q_{fbpn,b}$)	Low, 0.25%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards.
B-28	Electricity Consumed for balance of process needs ($ECBPN_b$)	Low, 2%	Metering and measuring devices will be calibrated as per manufacturer's instructions and in line with DIISW's *Metrological Support of Measuring Equipment* and *Guideline on Plant Metrology Department*, as well as national standards. Detailed monitoring device listing is available.

Uncertainties of measurement results are limited in chosen approach. Monitoring/measuring methodologies and QA/QC procedures are basically the same for the baseline and project scenarios leading to similar uncertainties (pls. see the Section D.2 for details). In fact, the main source of emission reductions is reduced use of materials. The monitoring/measurement procedures are exactly the same both for the baseline and project production line as far the use of pig iron is concerned and errors have similar implications in both cases.

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

The data required to monitor the ERs is routinely collected within the normal operations of the DIISW therefore monitoring is integral part of routine monitoring. All data will be stored in paper format and, partly, collected into electronic database of DIISW. Data is compiled in (i) day-to-day records, (ii) monthly records, (iii) quarterly records, and (iv) annual records. All records are finally stored in Planning Department. The appropriate data for GHG monitoring will be fed into the Monitoring Database.

The Monitoring Plan will be implemented by different specialists of the DIISW under supervision of Head of Technical Directorate's Technical Department and managed by top management of the Plant. Chief Engineer has overall project responsibility. All the main production shops and specialists of the plant will be involved into the preparation of monitoring report under coordination of Head of Technical Directorate's Technical Department. The Institute for Environment and Energy Conservation will also supervise the implementation of the Monitoring Plan for the project at regular intervals. See also Annex 3 for additional information.

Table 5. Specialists Responsible for Monitoring

Responsibility	Specialist Responsible	Data Variable	
		Baseline	Project
Overall project responsibility	Chief Engineer		
Overall responsibility for Monitoring Report	Technical Department Head	B-6, B-9, B-13, B-16, B-19, B-22, B-26, B-29	P-6, P-9, P-13, P-16, P-19, P-22, P-26, P-29
Data for Blast Furnaces	Blast Furnace Shop Manager	B-3, B-5, B-8, B-18, B-21	P-3, P-5, P-8, P-18, P-21
Data for Sinter Plant	Sinter Plant Manager	B-12, B-15, B-18, B-21	P-12, P-15, P-18, P-21
Data for balance of process needs	Head of CHP, Deputy Chief Energy Specialist	B-25, B-28	P-25, P-28

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

Mr Vasyl Vovchak, Director, Institute for Environment and Energy Conservation
11 Kotovskogo street, Kiev, 04060 Ukraine
+ 380 44 206 49 40
vovchak@ipee.org.ua

Institute for Environment and Energy Conservation Company Limited is not a project Participant.

SECTION E. Estimation of greenhouse gas emission reductions[91]

E.1. Estimated project emissions:

Detailed calculation is provided in Tables 26 and 27.

Table 6. Estimated project emissions (before the start of Kyoto protocol crediting period)

Project emissions (PE)		01/04/2004 – 31/12/2004	2005	2006	2007
Pig Iron	t CO_{2e}/a	5 917 652	7 095 446	7 901 185	8 168 533
Balance of process needs	t CO_{2e}/a	439 156	505 035	520 373	666 294
Totally	t CO_{2e}/a	6 356 809	7 600 481	8 421 557	8 834 827
Totally, 01/04/2004 – 31/12/2007	t CO_{2e}	31 213 674			

Table 7. Estimated project emissions (during Kyoto protocol crediting period)

Project emissions (PE)		2008	2009	2010	2011	2012
Pig Iron	t CO_{2e}/a	7 535 087	8 129 742	8 128 650	7 538 843	8 221 391
Balance of process needs	t CO_{2e}/a	785 595	951 359	949 083	792 115	775 584
Totally	t CO_{2e}/a	8 320 682	9 081 101	9 077 733	8 330 958	8 996 974
Totally, 2008-2012	t CO_{2e}	43 807 449				

Table 8. Estimated project emissions (during post-Kyoto period)

Project emissions (PE)		2013	2014	2015	2016	2017
Pig Iron	t CO_{2e}/a	8 221 391	8 221 391	8 221 391	8 221 391	8 221 391
Balance of process needs	t CO_{2e}/a	775 584	775 584	775 584	775 584	775 584
Totally	t CO_{2e}/a	8 996 974	8 996 974	8 996 974	8 996 974	8 996 974
Totally, 2013-2017	t CO_{2e}	44 984 872				

Project emissions (PE)		2018	2019	2020
Pig Iron	t CO_{2e}/a	8 221 391	8 221 391	8 221 391
Balance of process needs	t CO_{2e}/a	775 584	775 584	775 584
Totally	t CO_{2e}/a	8 996 974	8 996 974	8 996 974
Totally, 2018-2020	t CO_{2e}	26 990 923		
Totally, 2013-2020	t CO_{2e}	71 975 796		

E.2. Estimated leakage:

Not applicable.

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

Project emissions (PE)		01/04/2004 – 31/12/2004	2005	2006	2007
Totally	t CO_{2e}/a	6 356 809	7 600 481	8 421 557	8 834 827
Totally, 01/04/2004 – 31/12/2007	t CO_{2e}	31 213 674			

Project emissions (PE)		2008	2009	2010	2011	2012
Totally	t CO_{2e}/a	8 320 682	9 081 101	9 077 733	8 330 958	8 996 974
Totally, 2008-2012	t CO_{2e}	43 807 449				

Project emissions (PE)	2013	2014	2015	2016	2017

[91] Project emissions, baseline emissions together with emission reductions (which are provided in this section) are rounded to the whole figure (1t) and are based on calculations which are demonstrated in attached excel file. This file is provided to the verifier.

Totally	**t CO_{2e}/a**	**8 996 974**	**8 996 974**	**8 996 974**	**8 996 974**	**8 996 974**
Totally, 2013-2017	**t CO_{2e}**	**44 984 872**				

Project emissions (PE)		**2018**	**2019**	**2020**
Totally	**t CO_{2e}/a**	**8 996 974**	**8 996 974**	**8 996 974**
Totally, 2018-2020	**t CO_{2e}**	**26 990 923**		
Totally, 2013-2020	**t CO_{2e}**	**71 975 796**		

E.4. Estimated baseline emissions:

Detailed calculation is provided in Tables 28 - 30.

Table 9. Estimated baseline emissions (before the start of Kyoto protocol crediting period)

Baseline emissions (BE)		**01/04/2004 – 31/12/2004**	**2005**	**2006**	**2007**
Pig Iron	**t CO_{2e}/a**	**6 286 231**	**7 934 709**	**8 851 488**	**9 510 695**
Balance of process needs	**t CO_{2e}/a**	**940 657**	**1 187 331**	**1 324 516**	**1 423 158**
Totally	**t CO_{2e}/a**	**7 226 889**	**9 122 041**	**10 176 004**	**10 933 853**
Totally, 01/04/2004 – 31/12/2007	**t CO_{2e}**	**37 458 786**			

Table 10. Estimated baseline emissions (during Kyoto protocol crediting period)

Baseline emissions (BE)		**2008**	**2009**	**2010**	**2011**	**2012**
Pig Iron	**t CO_{2e}/a**	**8 508 409**	**8 889 430**	**8 888 225**	**8 512 641**	**9 596 119**
Balance of process needs	**t CO_{2e}/a**	**1 461 420**	**1 541 534**	**1 538 184**	**1 473 185**	**1 660 691**
Totally	**t CO_{2e}/a**	**9 969 829**	**10 430 964**	**10 426 409**	**9 985 826**	**11 256 810**
Totally, 2008-2012	**t CO_{2e}**	**52 069 838**				

Table 11. Estimated baseline emissions (during post-Kyoto period)

Baseline emissions (BE)		**2013**	**2014**	**2015**	**2016**	**2017**
Pig Iron	**t CO_{2e}/a**	**9 596 119**	**9 596 119**	**9 596 119**	**9 596 119**	**9 596 119**
Balance of process needs	**t CO_{2e}/a**	**1 660 691**	**1 660 691**	**1 660 691**	**1 660 691**	**1 660 691**
Totally	**t CO_{2e}/a**	**11 256 810**	**11 256 810**	**11 256 810**	**11 256 810**	**11 256 810**
Totally, 2013-2017	**t CO_{2e}**	**56 284 050**				

Baseline emissions (BE)		**2018**	**2019**	**2020**
Pig Iron	**t CO_{2e}/a**	**9 596 119**	**9 596 119**	**9 596 119**
Balance of process needs	**t CO_{2e}/a**	**1 660 691**	**1 660 691**	**1 660 691**
Totally	**t CO_{2e}/a**	**11 256 810**	**11 256 810**	**11 256 810**
Totally, 2018-2020	**t CO_{2e}**	**33 770 430**		
Totally, 2013-2020	**t CO_{2e}**	**90 054 481**		

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

Table 12. Emission reductions estimations (before the start of Kyoto protocol crediting period)

Emission reductions (ER)		**01/04/2004 – 31/12/2004**	**2005**	**2006**	**2007**
Totally	**t CO_{2e}/a**	**870 080**	**1 521 560**	**1 754 446**	**2 099 026**
Totally, 01/04/2004 – 31/12/2007	**t CO_{2e}**	**6 245 112**			

Table 13. Emission reductions estimations (during Kyoto protocol crediting period)

Emission reductions (ER)		**2008**	**2009**	**2010**	**2011**	**2012**
Totally	**t CO_{2e}/a**	**1 649 147**	**1 349 863**	**1 348 676**	**1 654 868**	**2 259 836**
Totally, 2008-2012	**t CO_{2e}**	**8 262 389**				

Table 14. Emission reductions estimations (during post-Kyoto period)

Emission reductions (ER)		2013	2014	2015	2016	2017
Totally	t CO_{2e}/a	2 272 491	2 324 693	2 337 348	2 450 340	2 450 340
Totally, 2013-2017	t CO_{2e}	11 835 211				

Emission reductions (ER)		2018	2019	2020
Totally	t CO_{2e}/a	2 450 340	2 450 340	2 450 340
Totally, 2018-2020	t CO_{2e}	7 351 019		
Totally, 2013-2020	t CO_{2e}	19 186 230		

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

Year	Estimated project emissions (Tonnes CO_{2e})	Estimated leakage (Tonnes CO_{2e})	Estimated baseline emissions (Tonnes CO_{2e})	Estimated emission reductions (Tonnes CO_{2e})
Before the start of Kyoto protocol crediting period				
01/04/2004 – 31/12/2004	6 356 809	0	7 226 889	870 080
2005	7 600 481	0	9 122 041	1 521 560
2006	8 421 557	0	10 176 004	1 754 446
2007	8 834 827	0	10 933 853	2 099 026
Average annual amount, Tonnes of CO_{2e} per year	8 323 646	0	9 989 010	1 665 363
Totally (Tonnes CO_{2e})	31 213 674	0	37 458 786	6 245 112
During Kyoto protocol crediting period				
2008	8 320 682	0	9 969 829	1 649 147
2009	9 081 101	0	10 430 964	1 349 863
2010	9 077 733	0	10 426 409	1 348 676
2011	8 330 958	0	9 985 826	1 654 868
2012	8 996 974	0	11 256 810	2 259 836
Average annual amount, Tonnes of CO_{2e} per year	8 761 490	0	10 413 968	1 652 478
Totally (Tonnes CO_{2e})	43 807 449	0	52 069 838	8 262 389
During post-Kyoto period				
2013	8 996 974	0	11 256 810	2 272 491
2014	8 996 974	0	11 256 810	2 324 693
2015	8 996 974	0	11 256 810	2 337 348
2016	8 996 974	0	11 256 810	2 450 340
2017	8 996 974	0	11 256 810	2 450 340
2018	8 996 974	0	11 256 810	2 450 340
2019	8 996 974	0	11 256 810	2 450 340
2020	8 996 974	0	11 256 810	2 450 340
Average annual amount, Tonnes of	8 996 974	0	11 256 810	2 398 279

CO_{2e} per year				
Totally (Tonnes CO_{2e})	**71 975 796**	**0**	**90 054 481**	**19 186 230**

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:

As it was mentioned in the chapter A.4.2 project activity contains three main components such as: 1) technological improvements of the BFs operation; 2) reconstruction of the BF shop; 3) modernization of the sintering process.

In terms of potential environmental impact, the project activities can be divided into two further groups. The first one does not require a preparation of an environmental impact assessment (EIA). The activities of the first group are of technological character that involves specific improvements in pig iron and sintering processes. The second group requires EIAs and contains activities related to introduction of new steel facilities or the reconstructions of old ones. According to the Ukrainian legislation EIAs are developed as a part of mandatory feasibility studies (FSs).

The project is realized in accordance with the project implementation schedule which is presented above at the page 6 of this document.

FSs for this project have been completed together with EIAs for such activities as: reconstruction of sintering and blast-furnace production; reconstruction of blast-furnace shop with the introduction of BF # 4M, renewal with the reconstruction of BF # 10; reconstruction of oxygen plant.

Table 15. Developed EIAs together with FSs for the project

№	Project activities	Developer	Independent approvals
1	2	4	5
1	FS "Reconstruction of blast-furnace shop with the introduction of BF # 4M" 70057 (2008) EIA 70057-ZA (2008)	Ukrainian State Scientific and Engineering Center for technology and equipment, metals working, environmental protection and secondary resources utilization for metallurgy and machine-building "Energostal"	It is expected.
2	FS "Reconstruction of sintering and blast-furnace production" 70003 (2007) EIA 70003-ZA (2007)	Ukrainian State Scientific and Engineering Center for technology and equipment, metals working, environmental protection and secondary resources utilization for metallurgy and machine-building "Energostal"	It is expected.
3	FS "Reconstruction of oxygen plant" DT 341395 (2006)	Ukrainian State Scientific and Engineering Center for technology and equipment, metals working, environmental protection and secondary	Positive conclusions of state-owned enterprise "CS Ukrinvestekspertyza" # 84-2 dated from 20.06.2007, State environmental appraisal #

	EIA DT 341395 (2006)	resources utilization for metallurgy and machine-building "Energostal"	502 dated from 08.06.2007, Ministry of health # 05.03.02-07/28352 dated from 07.06.2007, state-owned enterprise "Kryvorizkyi ETC" # 12.2t 01-05-0558.07 dated from 01.06.2007, territorial administration of State inspectorate of energy conservation # 07.V.18-05.01024.
4	FS "Renewal with the reconstruction of BF # 10" DT 336459 (2004) EIA DT 339590a (2007)	Ukrainian State Scientific and Engineering Center for technology and equipment, metals working, environmental protection and secondary resources utilization for metallurgy and machine-building "Energostal".	Positive conclusions of state-owned enterprise "CS Ukrinvestekspertyza" # 129 dated from 20.10.2006, State environmental appraisal # 367 dated from 26.06.2006, Ministry of health # 05.03.02-07/22962 dated from 19.05.2006, state-owned enterprise "Prydniprovskyi ETC" # 12.1-01-OV-0936.06 dated from 10.09.2006, headquarters of Ministry of Ukraine of Emergencies and Affairs in Dnipropetrovsk region # 37 dated from 23.08.2006, territorial administration of State inspectorate of energy conservation in Dnipropetrovsk region # 06.V.18.05.01024.75.11.3-216 dated from 20.10.2006.

Note: All mentioned documents can be submitted to the verifier upon its request.

All formal EIAs were undertaken in accordance with the applicable legislation and regulations of Ukraine. These include: the Laws of Ukraine "*On Protection of Environmen"t*, "*On Environmental Due Diligence"*, "*On Protection of Atmospheric Air"*, "*On Wastes"*, "*On Ensuring Sanitary and Epidemic Welfare of the Population"*, "*On Local Councils of People's Deputies"* and "*On Local Governance in Ukraine"*, as well as in line with effective versions of Water Code, Land Code, Forest Code, and Ukraine's State Code of Civil Practice DBN A.2.2-1-2003 etc.

EIAs were developed by Ukrainian State Scientific and Engineering Center for technology and equipment, metals working, environmental protection and secondary resources utilization for metallurgy and machine-building "Energostal". The document provides assessment of impact of the project activity on various components of natural, social, and man-made environment.

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:

As mentioned in section F1, EIAs were prepared and completed according to the legislation of the host party by authorized governmental organization and provides opinion on positive or neutral environmental impact of the project activity.

Hard copies of the said documents in Russian and Ukrainian could be available upon relevant request from DIISW.

It should be noted also that, as provided by the Ukrainian law, EIAs environmental impact of any planned project activity could be issued unless comments of the public (if any) are taken into account.

Below it is given a brief summary of major environmental impacts of different parts of project activity.

Reconstruction of blast-furnace shop with the introduction of BF # 4M

The following main environmental benefits are expected to be achieved after introduction of the new BF #4M:

- better energy efficiency of pig iron production;
- excellent emission control;
- low CO, SO and NOx emissions by using high efficiency burners;
- highly efficient gas cleaning with an introduction of state of art gas cleaning system allowing fulfillment of strictest environmental emission limitations such as dust content of 30 mg/m³;
- higher level of waste utilisation by better quality of waste that can be used in other industries;
- lower water consumption and better options for cleaning of recirculated water;
- secured reliability of blast furnace operation controlled by innovated automatic system;
- efficient dust separation and high dust recycling;
- emission reduction of sulfurous compound;
- excluding the possibility of harmful effects of dynamic loads on the stability of the foundations;
- retirement from service of less efficient other BFs;
- dust emissions after the cleaning by electric air filters should be less than 30 mg/m³ etc[92].

Reconstruction of BF production

The reconstruction of BF shop leads to the next benefits:

- improvement of environment by reduction of harmful emissions into the atmosphere;
- reduction of coke consumption;
- air cleaning by electric air filters;
- decreasing of the concentration of carbon monoxide by new air heater to 20 mg/m³;
- reduction of water consumption over 33 %;
- purification efficiency will be more than 95 % at the expense of efficient control system.

Installation of PCI facilities at BFs effects on the environment as follows:

- leads to better productivity of blast furnace operation;
- improves stability of blast furnace operation;
- avoids expensive and energy intensive coking production and leads to potential shut down of old environmentally unsound coke plants;
- reduces the output of an existing coke batteries, which could improve the quality of the coke produced by using extra process room due to lower production rates;
- has high reliability of operation;
- exception of blast furnace gas injection into blast furnaces;

[92] More detailed information can be obtained from relevant EIAs.

- enables higher blast temperatures and lower moisture additions that effect in lower total fuel consumption etc.

Reconstruction of sintering production

The reconstruction of sintering production leads to:

- stable high sinter quality;
- low quantity of off-gas;
- increased productivity;
- high productivity with difficult charge materials;
- low coke consumption;
- less wear;
- lower energy consumption;
- less space requirement compared to conventional sinter plants;
- reduction of the off gas quantity up to 50 %. This significantly lowers not only environmental pollution but power consumption as well;
- possibility to recycle more than 50 t/h of contaminated ferrous materials to the sinter plant;
- up to 70 % reduction of noxious components and organics in the waste gas;
- significant savings in environmental costs for post-treatment and disposal with conventional solutions;
- conforming to all environmental guidelines, even stricter in the future;
- hydrodedusting of limestone during frost-free season;
- reduction of water consumption from the river;
- reduction of the initial concentration of harmful substances in sintering gases;
- low hazardous emissions such as:
  - dust: <10 mg/Nm^3;
  - sox: <50 ppm/Nm^3;
  - dioxin: <0.1 ng/Nm^3;
  - NOx: <50 ppm/Nm^3;
  - NOx content can be reduced to <50 ppm/Nm^3;
  - significant decrease of emissions from current 300-400 mg particulate/Nm^3 to at least 50 mg participate/Nm^3.

Reconstruction of oxygen plant

The modernization of BF production requires the reconstruction of oxygen plant. The reconstruction of oxygen plant leads to the next benefits:

- expanding the use of clean technologies to minimize the pollutants emissions;
- developing new oxy-combustion solutions to drastically reduce CO_{2e} and pollutant emissions;
- improving of the thermal yield and heat transfer, reducing of fuel consumption;
- significant greenhouse gases (GHG) emissions reduction as carbon dioxide (CO_{2e}), C_nH_m and volatile organic compounds (VOC);
- minimizing of emergency situations;
- safeguarding of lands and plantations;
- absence of emissions reduction sources;
- absence of such harmful factors as electromagnetic emission, ultrasound and others;
- normal level of noise;
- considerable oxygen surplus;

- no filtration leakage of soiled waters etc.

Renewal with the reconstruction of BF # 1M

Reconstruction of BF # 1M leads to:

- emissions reduction of harmful substance into the atmosphere upon 4233,093 t/year;
- reduction of discharge intensity of coke upon 40-45 kg/t of pig iron;
- improvement of desulfurizing ability of slag;
- air cleaning by electric air filters with a capacity of 850 ths. m^3/h;
- reduction of water consumption;
- increasing of coefficient of efficiency of air heater unit upon 5 %;
- economy of 9-12 mio m^3 per year of natural gas;
- decreasing of pig iron losses with a slag and scrap upon 25 ths. t per year;
- safeguarding of all plantations and lands;
- reduction of carbon monoxide content up to 20 mg/m^3 etc.

Generally the project activity would also lead to:

- lower water consumption and wastewater discharge;
- better waste utilization and management;
- preservation of current land foot print;
- decrease impact on ground and surface water capacity;
- lower numbers of potential accidences;
- general improvement of health and safety management system;
- better manageable options regarding operational aspects.

Revamping of sintering and blast-furnace production at DIISW will generally have a positive environmental impact. The general environmental impact opinion via the procedure endorsed by the Ukrainian government is that the project will have a positive environmental impact and its foreseeable emergency negative impacts will be insignificant and easily repaired.

It may generally be stated that the project activity is in line with the EU best available technology principle. Project activity will cause no harmful transboundary impacts.

SECTION G. Stakeholders' comments

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

Law of Ukraine on environmental expertise defines the procedure of participation of citizens and public organizations in the public environmental expertise.

Public has been informed about the planned economic activities with the goal to identify public attitudes and take opinion in account during environmental impact assessment process.

Public has been informed about the project, especially about the following information:
- project name, goals and site;
- legal name and address of project owner and its representative;
- approximate dates of EIAs procedures;
- deadline and formats of submission of public comments;
- when and where EIA documents can be retrieved.

No negative comments from the public were received within the deadlines. Public hearings have not been organized, because the project site lies within the DIISW territory and public did not express any interest in the planned activities.

All information on stakeholders' comments is included in the EIAs as a part of FSs completed in accordance with Ukrainian statutory requirements.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	OJSC Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky
Street/P.O.Box:	Kirov street
Building:	18-B
City:	Dniprodzerzhynsk
State/Region:	Dnipropetrovsk region
Postal code:	51902
Country:	Ukraine
Phone:	+38-056923 26 71
Fax:	+38-0569 53 16 36
E-mail:	dmkd@dmkd.dp.ua
URL:	www.dmkd.dp.ua
Represented by:	Mr Illya Buga
Title:	Director General
Salutation:	Mr
Last name:	Buga
Middle name:	Dmytrovych
First name:	Illya
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	
Personal e-mail:	

Organisation:	Sumitomo Corporation
Street/P.O.Box:	1-8-12 Harumi,
Building:	Harumi Triton Square Office Tower Y
City:	Chuo-ku
State/Region:	Tokyo
Postal code:	104-8610
Country:	Japan
Phone:	
Fax:	
E-mail:	
URL:	http://www.sumitomocorp.co.jp/english/
Represented by:	Ruiko Kato
Title:	Manager
Salutation:	Ms.
Last name:	Kato
Middle name:	
First name:	Ruiko
Department:	
Phone (direct):	+81 3 5166 3160
Fax (direct):	+81 3 5166 8753
Mobile:	
Personal e-mail:	ruiko.kato@sumitomocorp.co.jp

Organisation:	Endesa Carbono, S.L.
Street/P.O.Box:	Ribera del Loira
Building:	60
City:	Madrid
State/Region:	
Postal code:	28042
Country:	Spain
Phone:	+34 91 213 1000
Fax:	+34 91 213 1000
E-mail:	pablo.fernandez@endesa.es
URL:	www.carbonfinance.org
Represented by:	
Title:	Manager
Salutation:	Mr.
Last name:	Fernandez Guillen
Middle name:	
First name:	Pablo
Department:	
Phone (direct):	
Fax (direct):	+34 912 134 154
Mobile:	+34 912 131 052
Personal e-mail:	pablo.fernandez@endesa.es

Organisation:	Stichting Carbon Finance (SCF) - *on behalf of the Netherlands*
Street/P.O.Box:	Prins Bernhardplein
Building:	200
City:	Amsterdam
State/Region:	--
Postal code:	1097 JB
Country:	The Netherlands
Phone:	+31 (0) 20 521 47 77
Fax:	+31 (0) 20 521 48 88
E-mail:	carbonsolutions@intertrustgroup.com
URL:	www.intertrustgroup.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Veerman
Middle name:	Cornelis Maria
First name:	Jaap
Department:	Carbon Solutions
Phone (direct):	+ 31 (0) 651 327 151
Fax (direct):	
Mobile:	+ 31 (0) 20 521 4795
Personal e-mail:	jaap.veerman@intertrustgroup.com

Organisation:	Stichting Carbon Finance (SCF) - *on behalf of Spain*
Street/P.O.Box:	Prins Bernhardplein
Building:	200
City:	Amsterdam
State/Region:	--
Postal code:	1097 JB
Country:	The Netherlands
Phone:	+31 (0) 20 521 47 77
Fax:	+31 (0) 20 521 48 88
E-mail:	carbonsolutions@intertrustgroup.com
URL:	www.intertrustgroup.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Veerman
Middle name:	Cornelis Maria
First name:	Jaap
Department:	Carbon Solutions
Phone (direct):	+ 31 (0) 651 327 151
Fax (direct):	
Mobile:	+ 31 (0) 20 521 4795
Personal e-mail:	jaap.veerman@intertrustgroup.com

Organisation:	Deutsche Bank AG, *London branch*
Street/P.O.Box:	1 Great Winchester Street
Building:	Winchester House
City:	London
State/Region:	--
Postal code:	EC2N 2DB
Country:	The United Kingdom of Great Britain and Northern Ireland
Phone:	
Fax:	
E-mail:	
URL:	www.db.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Orlando
Middle name:	
First name:	Brett
Department:	Environmental Financial Products
Phone (direct):	+44 20 7547 3347
Fax (direct):	+44 20 7547 3713
Mobile:	
Personal e-mail:	brett.orlando@db.com

Annex 2

BASELINE INFORMATION

The baseline will be calculated for each project year using specific energy and materials consumption per tonne of pig iron production during historical period and the actual production in the given project year to determine the baseline emissions.

In this case, the most plausible baseline technology for pig iron production is represented by major steelmaking equipment such as old blast furnaces and sinter plant. These allow most of baseline parameters to be measured by the same approaches as the projectline.

The baseline tonnes CO_{2e} emissions per tonne of pig iron output will be measured using the historical efficiency parameters, as well as calculated based on the historical and estimated values. These will be used to calculate the baseline for each project year to adjust to the amount of pig iron actually produced by the project line. In order to develop data in the baseline case that is comparable to the emissions data derived in the project case, the baseline CO_{2e} emissions per output figure will include both the material flows and energy flows into project. The material flows will include major raw inputs of coke, anthracite, limestone, dolomite etc. as well as process inputs such as steam, oxygen and compressed air etc. Each material flow will be measured for its per unit impact on the tonnes of CO_{2e} emissions per tonne of pig iron output.

Table 16. Emission Factors for Inputs and Reducing Agents (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13[93], Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Table 2-12, page 2.26[94], Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 3), Chapter 2 (Industrial Processes), Section 2.5.2 *Emissions estimation methodology for CO_2*, page 2.10[95] and 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 1 Introduction, Section 1.4.2 *Emission Factors,* Table 1.2, page 18[96])

Table 16
Emission Factors for CO_2 from Inputs and Reducing Agents Consumption (tonnes CO_2 / tonne of material or reducing agent)

Reducing Agent	Emission Factor
Coal Coke	3.1
Anthracite	2.62
Limestone	0.44
Dolomite	0.477

Table 17. Emission Factors for Inputs and Reducing Agents Production (2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 Industrial Processes and Product Use, Chapter 4 Metal Industries Emissions, Section 4.2.2.3 *Choice of Emission Factors*, Table 4.1, page 4.25[97])

Table 17
CO_2 Emission Factors for Inputs and Reducing Agents Production and Transportation (tonnes CO_2 / tonne of material or reducing agent)

[93] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf
[94] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref2.pdf
[95] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch2ref1.pdf
[96] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
[97] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_4_Ch4_Metal_Industry.pdf

Reducing Agent	Emission Factor
Coal Coke	0.56
Pellets	0.03

Table 18. Emission Factors for Fuels (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual (Volume 2), Chapter 1 (Energy), Table 1-1 (continued), page 1.13[98])

	TJ/ 1,000,000 m^3	t CO_{2e}/TJ	Oxidising Factor	t CO_{2e}/m^3	t CO_{2e}/1 000 m^3
NG	33.91308	56.1	0.995	0.00189301	1.89301

Baseline Emission Factor for Ukrainian Electricity Grid

As soon as any other developed baseline emission factor of the Ukrainian electricity system will be approved, the project developer will make appropriate modifications of emission reduction calculations at the stage of monitoring repot development.

Before year 2008 the carbon emission factor for electricity consumption is based on Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007[99].

The baseline emission factor of the Ukrainian electricity system can be summarized as indicated in Table 19 for both components of power delivery to the grid and conservation of power consumption in DIISW. The approach and assumptions employed are broadly similar to those stipulated in the approved consolidated CDM methodology, ACM0002, taking account of *Guidance on criteria for baseline setting and monitoring for JI projects* issued by JISC, *Operational Guidelines for the Project Design Document, ERUPT* issued by the Ministry of Economic Affairs of the Netherlands, and also country specific circumstances of Ukraine. The estimation of baseline emission factor is assessed by TÜV SÜD for its validity. The scheme of the estimation is represented below.

Table 19. Baseline carbon emission factors for JI projects for Ukrainian grid. Source: Standardized emission factors for the Ukrainian electricity grid, Annex 2 of Ukraine – Assessment of new calculation of CEF, assessed by TÜV SÜD, 2007

Baseline carbon emission factor for generation	[tCO_{2e}/MWh]	0.807
Baseline carbon emission factor electricity consumption	[tCO_{2e}/MWh]	0.896

Consolidated baseline methodology, ACM0002, takes combination of the Operating Margin, OM, and the Build Margin, BM, to estimate the emission in absence of the CDM project activity. OM accounts for the reduction in power generation plants that provide the electricity to the grid while BM accounts the potential delay in construction of future addition of power plants in the grid.

For OM calculation, it is therefore necessary to identify the group of power plants operating "on margin" that could most likely reduce their output when additional power is delivered to the grid. On the other hand, strict application of BM calculation specified in ACM0002 is not realistic and lead to distorted picture of the Ukrainian grid since most recent capacity addition to be identified is nuclear plants. Therefore, the Operating Margin only will be used to develop the baseline emission factor.

[98] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref1.pdf
[99] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

Following assumptions to calculate emission factor of Ukrainian grid are employed,
1) the grid must be constituted of all power plants servicing the grid,
2) there is no significant electricity import to the grid,
3) electricity export is not accounted and not excluding from the calculations.

All of above are in compliance with ACM0002.

The following four options are provided for calculation of OM in ACM0002,
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Though "Dispatch Data Analysis" (c) is the first methodological choice as per ACM0002, this option is not applicable because of the data availability.[100] "Simple adjusted OM" (b) is not applicable either for the same reason. The "Average OM" (d) would not present a realistic picture since nuclear power plants always work as the base load and constitute up to 48% of overall electricity generation during past five years as indicated in Tables 20 and 21, respectively.

Table 20. Electricity demand and generation in Ukraine as of March 2005[101]

		Minimum demand (03:00)	Peak demand (19:00)
Consumption (MW)		21,287	27,126
Generation (MW)		22,464	28,354
	Thermal power plants	10,049	13,506
	Hydro power plants	527	3,971
	Nuclear power plants	11,888	10,877
Balance import/export (MW)		-1,177	-1,228

Table 21. Share of power generation by source in the annual power generation[102]

Year	2001	2002	2003	2004	2005
Nuclear plant generation	44.23	45.08	45.32	47.99	47.92
Thermal power generation	38.81	38.32	37.24	32.50	33.22
Combined heat and power	9.92	11.02	12.28	13.04	12.21
Hydro power generation	7.04	5.58	5.15	6.47	6.65

In Ukraine the low-cost must-run power plants are nuclear power plants and their contribution to the total electricity generation is below 59%. Therefore, the "Simple OM" is only applicable option for the Ukrainian grid.

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j,y}}{\sum_{j} GEN_{j,y}} \qquad \text{(A.1)},$$

where:

[100] Source: State Committee of Statistics of Ukraine. *Fuel and Energy resources of Ukraine 2001-2003*, Kiev, 2004.
[101] *Ukraine – Assessment of new calculation of CEF*, 2007 – http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514
[102] *Overview of data on electric power plants in Ukraine 2001-2005*, Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by power plant source *j* in year(s) *y* (2001-2005),
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must run power plants, and including imports to the grid;
$COEF_{i,j\,y}$ is the CO_{2e} emission coefficient of fuel *i* (tCO_{2e} /mass or volume unit of the fuel), taking into account the carbon content of the fuels used by power sources *j* and the oxidation percent of the fuel in year(s) '*y'*, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* in year(s) '*y'*.

$$COEF_i = NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \qquad \text{(A.2)},$$

where:
NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;
$OXID_i$ is the oxidation factor of the fuel;
$EF_{CO2e,i}$ is the CO_{2e} emission factor per unit of energy of the fuel *i* (tCO_{2e} /TJ).

Individual data for power generation and fuel properties was obtained from the individual power plants.[103]

The local NCV values of individual power plants for natural gas and coal were used. For heavy oil, the IPCC[104] default NCV was used. Local CO_2 emission factors for all types of fuels were taken for the purpose of the calculations and Ukrainian oxidation factors were used.

The Simple OM is applicable to the JI project that delivers additional amount of electricity to the grid, "generation JI project". However, the project that reduces on-site consumption of electricity, referred to as "reducing project", reduces losses in the grid. Losses in the Ukrainian grid are classified as technical losses and non-technical losses that include no-payment and other losses of unknown reasons. For the purpose to determine emission factor of the Ukrainian grid for "reducing project", only technical losses were considered. Statistical data on the losses are indicated in Table 22.

Table 22. Grid losses in Ukraine

Year	Technical losses (%)	Non-technical losses (%)	Total (%)
2001	14.2	7	21.2
2002	14.6	6.5	21.1
2003	14.2	5.4	19.6
2004	13.4	3.2	16.6
2005	13.1	1.6	14.7

Though technical losses decrease over years and are expected to reach 22% in 2012, technical losses of ten (10) percent are applied for the period during 2006 through 2012 as a conservative assumption.

As conclusions, emission factors for "generation JI projects" and "reducing JI projects" in Ukraine are summarized as follows,

$$EF_{grid,produced,y} = EF_{OM,y} \qquad \text{(A.3)}$$

and

[103] *Overview of data on electric power plants in Ukraine 2001-2005*, Ministry of Fuel and Energy of Ukraine, 31 October 2006 and 16 November 2006.
[104] Revised 1996 IPCC guidelines for national greenhouse gas inventories.

$$EF_{grid,reduced,y} = \frac{EF_{gid,produced,y}}{1 - loss_{grid}} \quad (A.4),$$

where:
$EF_{grid,produced,y}$ is the emission factor for JI projects supplying additional electricity to the grid (tCO_{2e} /MWh);
$EF_{grid,reduced,y}$ is the emission factor for JI projects reducing electricity consumption from the grid (tCO_{2e} /MWh);
$EF_{OM,y}$ is the simple OM of the Ukrainian grid (tCO_{2e}/MWh);
$Loss_{grid}$ is the technical losses in the grid (%).

Basic data employed for the assessment of carbon emission factor of the Ukrainian grid are summarized in Table 23.

Table 23. Key data for OM factor calculation of the Ukrainian grid.

	Generation (MWh)	CO_{2e} emissions (tCO_{2e})	Technical losses (%)	for producing project, $EF_{grid,produced}$ (tCO_{2e}/MWh)	for reducing project, $EF_{grid,reduced}$ (tCO_{2e}/MWh)
2003	98,214,112	80,846	14.2		
2004	94,330,765	74,518	13.4		
2005	96,526,887	78,203	13.1		
total	**289,071,764**	**233,567**	**10**	**0.807**	**0.896**

The results of the calculation are summarized as indicated in Table 24.

Table 24. Emission factors for the Ukrainian grid for 2006-2012

Type of JI project	parameter	EF (tCO_{2e}/MWh)
Producing projects	$EF_{grid,produced,y}$	0.807
Reducing projects	$EF_{grid,reduced,y}$	0.896

During 2008 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #62 dated 15th of April 2011[105]. During 2009 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #63 dated 15th of April 2011[106]. Starting from year 2010 the carbon emission factor for electricity consumption is based on the Order of the National environmental investment agency of Ukraine #43 dated 28th of March 2011[107].

In accordance with mentioned above decrees issued by NEIA for the 1st – class electricity consumers the carbon emission factor for electricity consumption is equal to:

- 1,082 $kgCO_2$/kWh in 2008;
- 1,096 $kgCO_2$/kWh in 2009;
- 1,093 $kgCO_2$/kWh starting from 2010.

[105] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[106] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[107] http://www.neia.gov.ua/nature/doccatalog/document?id=126006.

The use of the emission factor for the 1st-class electricity consumers is justified by the resolution of National Electricity Regulatory Commission of Ukraine № 1052 of 13 August 1998[108], according to the resolution the 1st – class electricity consumers are the consumers, who:

1) receive electricity from electricity supplier at the point of sale of electricity with the degree of voltage 27.5 kV and above;
2) connected to the power rails of power plants (except hydroelectric, which produce electricity periodically), as well as to power rails of substations of the electricity grid with voltage of 220 kV and above, regardless voltage level at the point of sale of electricity by the power supplier to consumer;
3) is the industrial enterprise with average monthly rate of electricity consumption - 150 million kWh and above for the technological needs of production, regardless of the voltage level at the point of sale of electricity by the power supplier to consumer.

Based on the information stated above, DIISW refers to the 1st – class electricity consumers, which can be proven by additional documents that can be provided to the verifier upon request.

[108] http://energetik.org.ua/node/90

Annex 3

MONITORING PLAN

The monitoring procedures for the most part are straightforward in terms of what DIISW already does to collect energy consumption data and measure inputs and outputs. See Chapter D for details. The monitoring procedure will center on the collection of baseline data from blast furnaces, sinter plant and other auxiliary facilities and annual project year data from the JI project boundary including:

- The types and amounts of different fuels used at various stages of the process.
- The amount and source of electricity consumed at various points of the process.
- Carbon emission factors for electricity consumption in Ukraine, approved by AIE or national authorized body.
- The quantities of material inputs entering into the project in order to produce pig iron.
- The electricity and fuels used to produce the material inputs into the process.
- CO_{2e} emissions released during the preparation of inputs.
- Other carbon emission factors.
- Quantity of output.

The approach accounts emission reductions due to decrease of specific fuel and energy resources consumption as the result of the project activity.

The approach envisages monitoring of the total pig iron production, a fuel and energy resource consumption at the plant during the project activity.

Specifically, the project developer gathers information on fuel consumption, electricity consumption and the CO_{2e} impact of the material inputs into the project boundary pig iron making process. This data will be used to determine in the baseline emissions for each year using historical data of measured the CO_{2e} emissions per tonne of pig iron output. This is then multiplied by the actual pig iron product output each project year in the JI project steel making line to get the baseline CO_{2e} emissions. This is then compared to the total CO_{2e} produced in the actual project year. The difference is the emission reductions for that year.

It is expected that in the baseline case electricity comes exclusively from the grid and natural gas is received from the national gas transportation system.

Such parameters as carbon emission factors for coke, anthracite, natural gas consumption are identified as default values in the PDD. In case if the data regarding carbon content or/and the net calorific value for each of the mentioned above fuel and energy resources will be available at DIISW for each of the specific monitoring periods, the carbon emission factors will be accordingly modified.

Data Quality Management

Quality assurance for data collection process is a part of Plant’s routine activity whose compliance is regularly audited as specified in Section D above.

Nevertheless, given the complexity of the basic data requirements for the project, the project developer will take the following steps to ensure data quality:

- Each new meter installed will be calibrated according to manufacturer’s specifications and frequency, national requirements, and the corporate standard STP 230-35-07, *Metrological Support of Measuring Equipment*.

- All new meters will be installed and calibrated before flows requiring monitoring commence.
- All existing meters that are used in new functions or are subject to some physical disruption in their use due to construction will be recalibrated according to STP 230-35-07, *Metrological Support of Measuring Equipment* and manufacturer's specifications before measuring any flow.

The monitoring procedures and responsibilities at DIISW are regulated by STP 230-35-07 *Metrological Support of Measuring Equipment* and national standards, including:

1) *Metrological Product Quality Assurance* (RMI-I-19.0.1-07)
2) *Metrological Due Diligence of Documentation* (RMI-I-19.0.2-07) and STP 11.02-00 *Organisation and Performance of Metrological Due Diligence of Standards and Technical Documentation*
3) *Management of Metering Devices* (RMI-I-19.1.1-07)

The procedures for calibration of all monitoring equipment are described in RMI-I.19.0.1-07 and RMI-I.19.1.1-07.

Control of metering process and requirements to metrological support of metering equipment is assured as provided in DSTU 3921.1-1999 (ISO 10012-1:1992) *Requirements to Quality Assurance of Metering Equipment* and DSTU 3921.2- 2000 (ISO 10012-2:1997) *Quality Assurance by Means of Metering Equipment*.

These instructions have been developed in accordance with ISO 9001:2001 requirements. They secure accuracy of all the measurements done using monitoring equipment. The Chief Metrological Specialist (Head of I&C Department) is in charge for maintenance of the monitoring equipment and installations as well as for their accuracy required by paragraphs 2.1.1, 3.1.1, 7.1 of the Regulation PP 229-Э-056-863/02-2005 *On Metrological Services of the Iron Works*, STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07. In case of defect discovered in the monitoring equipment the actions of the personnel are determined by STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07 (p.5.4.4)

The measurement of the parameters included into the monitoring plan of the project is envisaged by the provisions of the STP 230-35-07 *Metrological Support of Measuring Equipment*, *Guideline on Plant Metrology Department*, and I.19.0.1-07 (paragraph 5.3.2).

The measurements are conducted on continuous basis and automatically according to the STP 230-35-07 *Metrological Support of Measuring Equipment* and I-19.1.1-07 (p. 5.4).

Data is collected into electronic database of DIISW as well as in paper format. Data is further compiled in (i) day-to-day records, (ii) quarterly records, and (iii) annual records. All records are finally stored in Planning Department.

The results of the measurements are being used by relevant services and technical personnel of the Steel Mill. They will be reflected in the technological instructions for the regimes of conducting the technological processes and in the document I.19.1.1-07.

Best available techniques are used in order to minimize uncertainties. Uncertainties are generally low (with the exception of the use of limestone in furnace process in baseline case) - typically below 2% for all parameters that are or will be monitored. All the equipment used for monitoring purposes is in line with national legislative requirements and standards and also with ISO 9001:2001 standards. Details are given in STP 230-35-07 *Metrological Support of Measuring Equipment*. The data will be cross checked as well as internal audits and corrective actions are taken as defined in STP 230-18-03 *Quality*

Management System Internal Audits. For the project case, similar procedures will be followed based on forthcoming Order of Director General of the Plant defining the exact JI monitoring procedures. Responsibilities for JI monitoring are indicated in table 5.

No major emergencies are expected having major influence on ERs. Should there be unusual events related to emissions, these can be captured at monitoring and verification stage.

Monitoring device table will be included in Monitoring Database and schematic is provided in figure 5 and 6. Monitoring Database will be available for monitoring purposes.

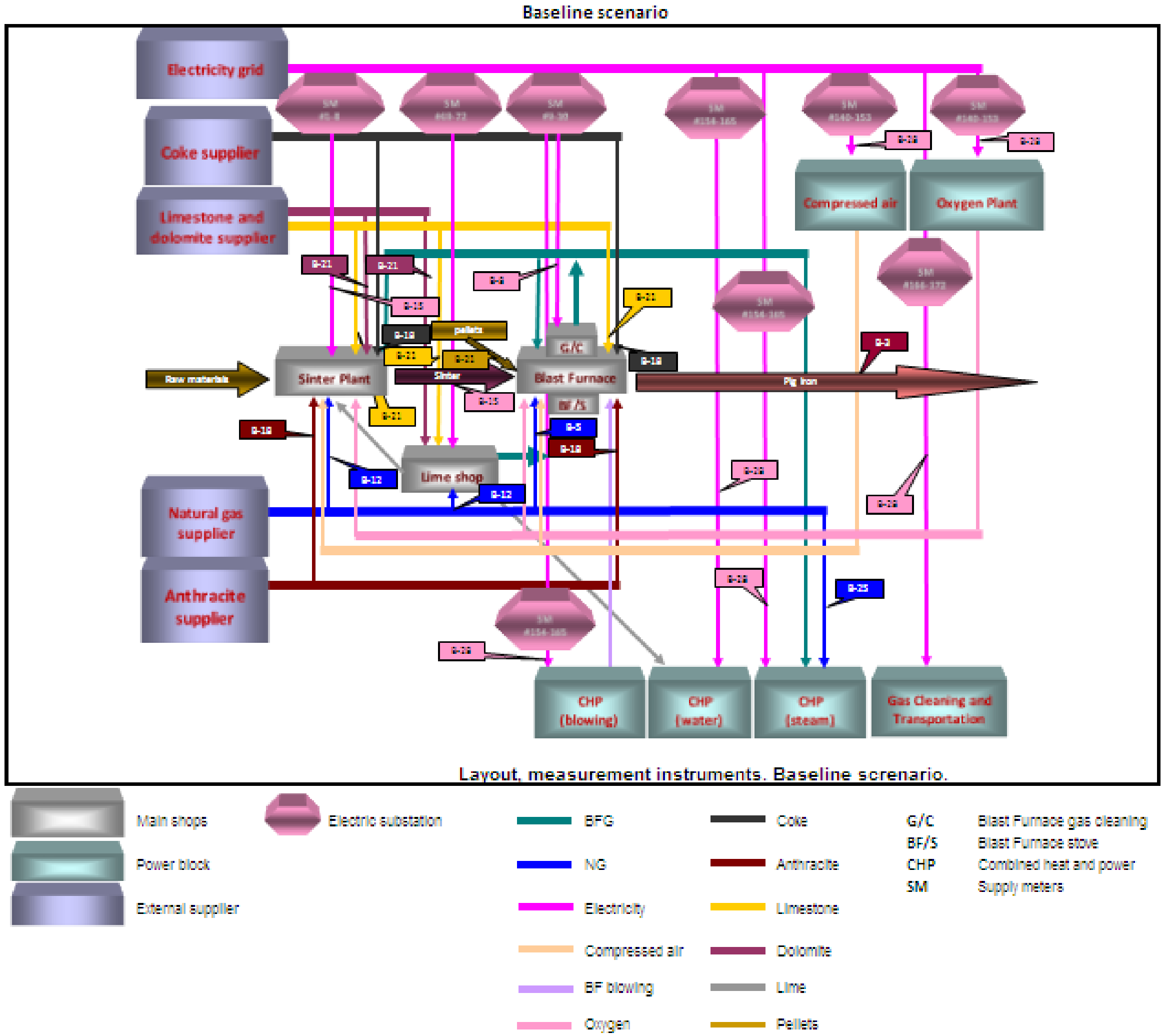

Fig. 5 Baseline monitoring outline for GHG emissions

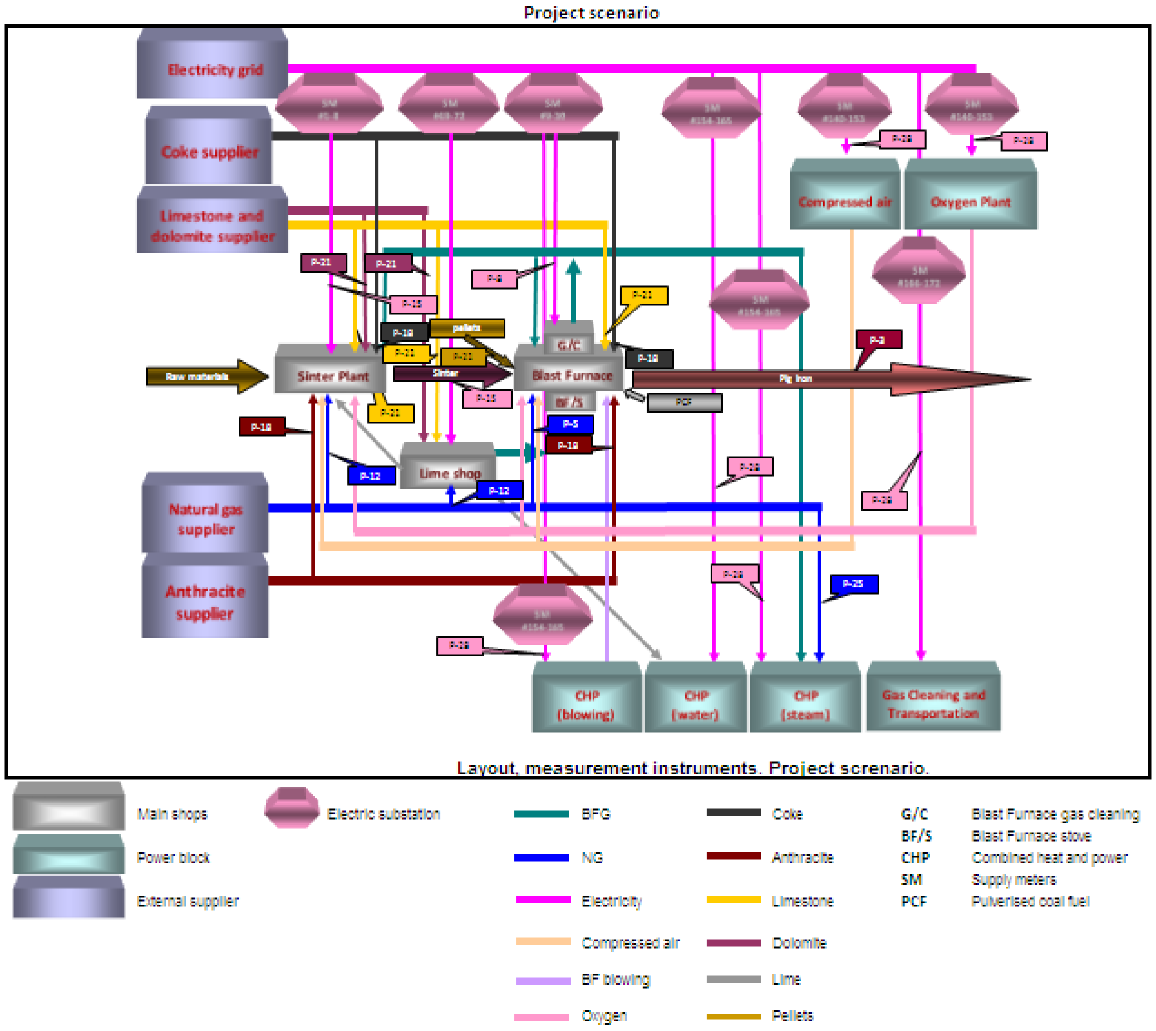

Fig. 6 Project monitoring outline for GHG emissions

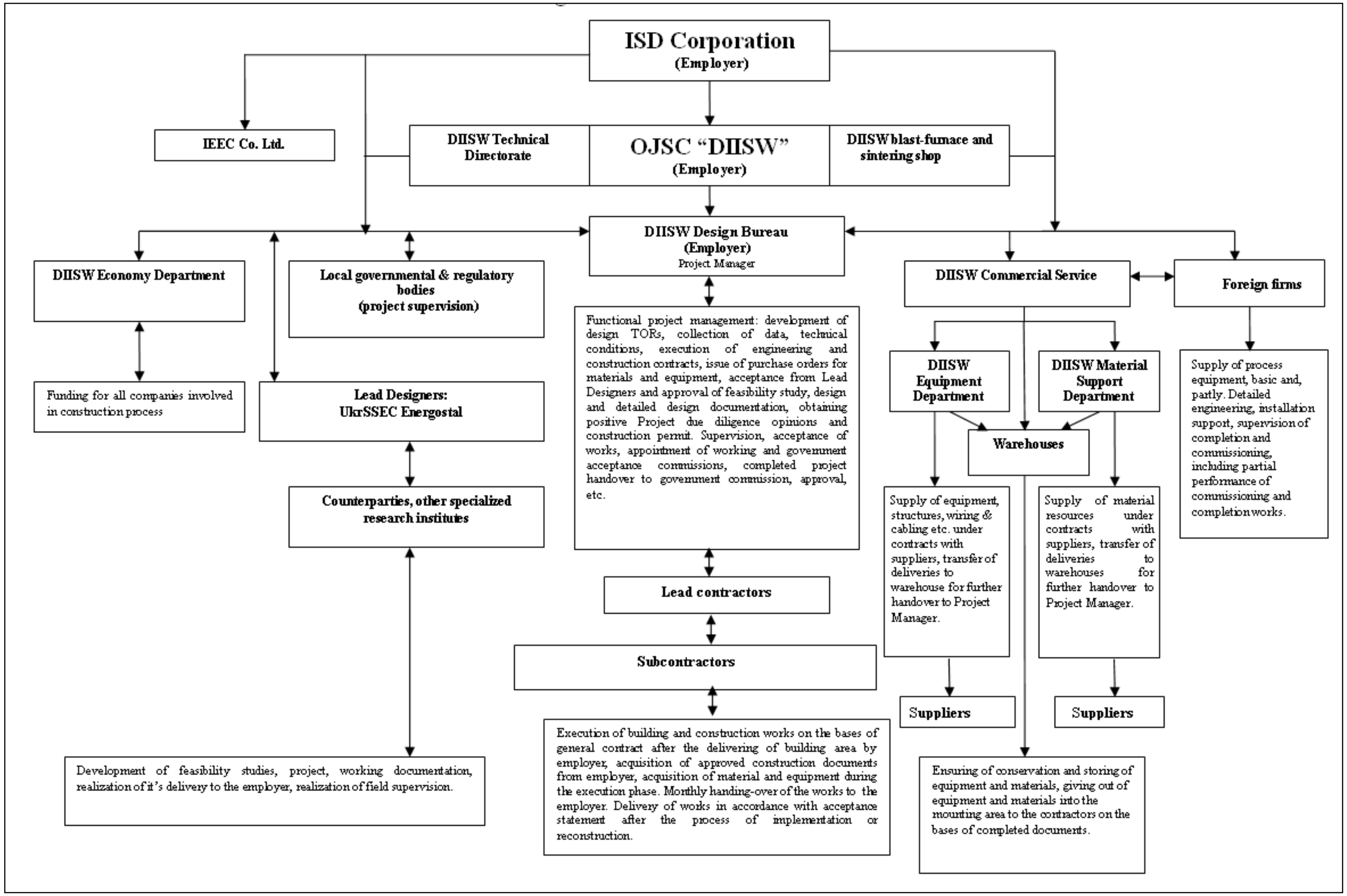

Fig. 7 Organization chart of DIISW JI Project management

Table 25. Outline for monitoring methods for the project scenario

Pig Iron		
P-3	Volume of pig iron output, tonnes	scales
P-5, P-12	Fuel consumption for pig iron production, 1000 m^3	flow meter
P-8, P-15	Electricity consumption for pig iron production, MWh	supply meter
P-18, P-21	Materials consumption for pig iron production, tonnes	scales
Balance of process needs		
P-25	Fuel consumption for balance of process needs, 1000 m^3	flow meter
P-28	Electricity consumption for balance of process needs, MWh	supply meter

All devices used will be in line with applicable Ukrainian standards and requirements of STP 230-35-07 *Metrological Support of Measuring Equipment*.

Tables 26 and 27 provide detailed estimations of project emissions before and during Kyoto protocol crediting period.

Table 26. Detailed Project emissions estimations (before the start of Kyoto protocol crediting period)

ID number	Data variable	Units	01/04/2004 - 31/12/2004	2005	2006	2007
P-1	**Total CO_2 in the project scenario (PE_i)**	Tonnes CO_2	**6 356 809**	**7 600 481**	**8 421 557**	**8 834 827**
P-2	**Total CO_2 from Pig Iron ($TCPI_{p,i}$)**	Tonnes CO_2	**5 917 652**	**7 095 446**	**7 901 185**	**8 168 533**
P-3	**Total Pig Iron Output ($TPII_{p,i}$)**	Tonnes	2 280 137	2 878 071	3 210 604	3 449 711
P-4	**Total CO_2 from fuel consumption in producing Pig Iron ($TCFCPI_{p,i}$)**	Tonnes CO_2	**381 085**	**471 269**	**463 198**	**465 522**
P-5	**Quantity of each fuel (fpi_p) used in making Pig Iron ($Q_{fpi,p,i}$)**	1000 m^3				
	Natural gas (NG)	1000 m^3	201 312	248 952	244 689	245 917
P-6	**Emission factor of each fuel $EF_{f,p}$**	Tonnes CO_2/1000 m^3				
	Natural gas (NG)	Tonnes CO_2/1000 m^3	1,89301	1,89301	1,89301	1,89301
P-7	**Total CO_2 from electricity consumption in producing Pig Iron ($TCEPI_{p,i}$)**	Tonnes CO_2	**155 233**	**177 998**	**134 736**	**155 854**
P-8	**Electricity Consumed in producing Pig Iron ($ECPI_{p,i}$)**	MWh	173 251	198 659	150 375	173 944
P-9	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	Tonnes CO_2/MWh	0,896	0,896	0,896	0,896
P-10	**Total CO_2 from Inputs into Pig Iron ($TCIPI_{p,i}$)**	Tonnes CO_2	**5 381 335**	**6 446 179**	**7 303 250**	**7 547 157**
P-11	**Total CO_2 from fuel used to prepare Iron Ore ($TCFIO_{p,i}$)**	Tonnes CO_2	**36 691**	**46 604**	**49 460**	**43 407**
P-12	**Quantity of each fuel (fio_p) used in Sintering ($Q_{fio,p,i}$)**	1000 m^3				
	Natural gas (NG)	1000 m^3	19 382	24 619	26 128	22 930

P-13	**Emission factor of each fuel $EF_{f,p}$**	**Tonnes CO_2/1000 m^3**				
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301
P-14	**Total CO_2 from electricity consumption in preparing iron ore ($TCEIO_{p,i}$)**	**Tonnes CO_2**	**93 739**	**93 549**	**93 515**	**84 556**
P-15	**Electricity Consumed in Sintering ($ECIO_{p,i}$)**	**MWh**	104 619	104 407	104 369	94 371
P-16	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	**Tonnes CO_2/MWh**	0,896	0,896	0,896	0,896
P-17	**Total CO_{2e} from Reducing Agents in Pig Iron Production ($TCRAPI_{p,i}$)**	**Tonnes CO_2**	**4 901 852**	**5 900 442**	**6 711 570**	**7 009 627**
P-18	**Quantity of each reducing agent ($rapi_p$) in Pig Iron Production ($Q_{rapi,p,i}$)**	**Tonnes**				
	Reducing agent (coke)	**Tonnes**	1 224 058	1 386 129	1 596 557	1 743 540
	Reducing agent (anthracite)	**Tonnes**	160 993	315 729	331 363	239 798
P-19	**Emission factor of each reducing agent, $EF_{ra,p}$**	**Tonnes CO_{2e}/Tonne**				
	Default emission factor	**Tonnes CO_2/Tonne**	3,66	3,66	3,66	3,66
	Default emission factor	**Tonnes CO_2/Tonne**	2,62	2,62	2,62	2,62
P-20	**Total CO_{2e} from other inputs ($TCOIPI_{p,i}$)**	**Tonnes CO_2**	**349 053**	**405 584**	**448 707**	**409 566**
P-21	**Quantity of each other input ($oipi_p$) in Pig Iron Production ($Q_{oipi,p,i}$)**	**Tonnes**				
	Limestone	**Tonnes**	435 015	580 194	725 342	745 970
	Dolomite	**Tonnes**	306 569	306 429	250 350	107 894
	Pellets	**Tonnes**	380 430	137 733	337 970	995 780
P-22	**Emission factor of each other input, $EF_{oi,p}$**	**Tonnes CO_{2e}/Tonne**				
	Default emission factor	**Tonnes CO_2/Tonne**	0,44	0,44	0,44	0,44
	Default emission factor	**Tonnes CO_2/Tonne**	0,477	0,477	0,477	0,477
	Default emission factor	**Tonnes CO_2/Tonne**	0,03	0,03	0,03	0,03
P-23	**Total tones of CO_2 related to the balance of process need of energy required for the project activity ($TCBPN_{p,i}$)**	**Tonnes CO_2**	**439 156**	**505 035**	**520 373**	**666 294**
P-24	**Total CO_2 from fuel consumption for balance of process needs of project activity ($TCFCBPN_{p,i}$)**	**Tonnes CO_2**	**95 514**	**115 697**	**121 900**	**169 222**
P-25	**Quantity of each fuel ($fbpn_p$) used for balance of process needs ($Q_{fbpn,p,i}$)**	**1000 m^3**				
	Natural gas (NG)	**1000 m^3**	50 456	61 118	64 395	89 393
P-26	**Emission factor of each fuel $EF_{f,p}$**	**Tonnes CO_2/1000 m^3**				
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301
P-27	**Total CO_2 from electricity consumption for balance of process needs of project activity ($TCEBPN_{p,i}$)**	**Tonnes CO_2**	**343 643**	**389 338**	**398 472**	**497 072**
P-28	**Electricity Consumed for balance of process needs ($ECBPN_{p,i}$)**	**MWh**	383 530	434 529	444 724	554 768

P-29	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	**Tonnes CO_2/MWh**	0,896	0,896	0,896	0,896

Table 27. Detailed Project emissions estimations (during Kyoto protocol crediting period)

ID number	Data variable	Units	2008	2009	2010	2011	2012
P-1	**Total CO_2 in the project scenario (PE_i)**	**Tonnes CO_2**	**8 320 682**	**9 081 101**	**9 077 733**	**8 330 958**	**8 996 974**
P-2	**Total CO_2 from Pig Iron ($TCPI_{p,i}$)**	**Tonnes CO_2**	**7 535 087**	**8 129 742**	**8 128 650**	**7 538 843**	**8 221 391**
P-3	**Total Pig Iron Output ($TPII_{p,i}$)**	**Tonnes**	3 060 211	3 195 230	3 195 230	3 060 211	3 449 711
P-4	**Total CO_2 from fuel consumption in producing Pig Iron ($TCFCPI_{p,i}$)**	**Tonnes CO_2**	**409 204**	**419 521**	**419 521**	**409 204**	**465 522**
P-5	**Quantity of each fuel (fpi_p) used in making Pig Iron ($Q_{fpi,p,i}$)**	**1000 m^3**					
	Natural gas (NG)	**1000 m^3**	216 166	221 616	221 616	216 166	245 917
P-6	**Emission factor of each fuel $EF_{f,p}$**	**Tonnes CO_2/1000 m^3**					
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301	1,89301
P-7	**Total CO_2 from electricity consumption in producing Pig Iron ($TCEPI_{p,i}$)**	**Tonnes CO_2**	**274 337**	**286 401**	**285 617**	**277 126**	**190 121**
P-8	**Electricity Consumed in producing Pig Iron ($ECPI_{p,i}$)**	**MWh**	253 546	261 315	261 315	253 546	173 944
P-9	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	**Tonnes CO_2/MWh**	1,082	1,096	1,093	1,093	1,093
P-10	**Total CO_2 from Inputs into Pig Iron ($TCIPI_{p,i}$)**	**Tonnes CO_2**	**6 851 547**	**7 423 820**	**7 423 511**	**6 852 514**	**7 565 748**
P-11	**Total CO_2 from fuel used to prepare Iron Ore ($TCFIO_{p,i}$)**	**Tonnes CO_2**	**34 196**	**29 566**	**29 566**	**34 196**	**43 407**
P-12	**Quantity of each fuel (fio_p) used in Sintering ($Q_{fio,p,i}$)**	**1000 m^3**					
	Natural gas (NG)	**1000 m^3**	18 064	15 619	15 619	18 064	22 930
P-13	**Emission factor of each fuel $EF_{f,p}$**	**Tonnes CO_2/1000 m^3**					
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301	1,89301
P-14	**Total CO_2 from electricity consumption in preparing iron ore ($TCEIO_{p,i}$)**	**Tonnes CO_2**	**95 112**	**112 546**	**112 238**	**96 079**	**103 148**
P-15	**Electricity Consumed in Sintering ($ECIO_{p,i}$)**	**MWh**	87 904	102 688	102 688	87 904	94 371
P-16	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	**Tonnes CO_2/MWh**	1,082	1,096	1,093	1,093	1,093
P-17	**Total CO_{2e} from Reducing Agents in Pig Iron Production ($TCRAPI_{p,i}$)**	**Tonnes CO_2**	**6 383 266**	**6 947 549**	**6 947 549**	**6 383 266**	**7 009 627**
P-18	**Quantity of each reducing agent ($rapi_p$) in Pig Iron Production ($Q_{rapi,p,i}$)**	**Tonnes**					
	Reducing agent (coke)	**Tonnes**	1 663 264	1 838 034	1 838 034	1 663 264	1 743 540
	Reducing agent (anthracite)	**Tonnes**	112 870	84 101	84 101	112 870	239 798
P-19	**Emission factor of each reducing agent, $EF_{ra,p}$**	**Tonnes CO_{2e}/Tonne**					

	Default emission factor	**Tonnes CO_2/Tonne**	3,66	3,66	3,66	3,66	3,66
	Default emission factor	**Tonnes CO_2/Tonne**	2,62	2,62	2,62	2,62	2,62
P-20	**Total CO_{2e} from other inputs ($TCOIPI_{p,i}$)**	**Tonnes CO_2**	**338 973**	**334 158**	**334 158**	**338 973**	**409 566**
P-21	**Quantity of each other input ($oipi_p$) in Pig Iron Production ($Q_{oipi,p,i}$)**	**Tonnes**					
	Limestone	**Tonnes**	569 802	632 019	632 019	569 802	745 970
	Dolomite	**Tonnes**	147 887	65 835	65 835	147 887	107 894
	Pellets	**Tonnes**	590 595	822 221	822 221	590 595	995 780
P-22	**Emission factor of each other input, $EF_{oi,p}$**	**Tonnes CO_{2e}/Tonne**					
	Default emission factor	**Tonnes CO_2/Tonne**	0,44	0,44	0,44	0,44	0,44
	Default emission factor	**Tonnes CO_2/Tonne**	0,477	0,477	0,477	0,477	0,477
	Default emission factor	**Tonnes CO_2/Tonne**	0,03	0,03	0,03	0,03	0,03
P-23	**Total tones of CO_2 related to the balance of process need of energy required for the project activity ($TCBPN_{p,i}$)**	**Tonnes CO_2**	**785 595**	**951 359**	**949 083**	**792 115**	**775 584**
P-24	**Total CO_2 from fuel consumption for balance of process needs of project activity ($TCFCBPN_{p,i}$)**	**Tonnes CO_2**	**144 265**	**119 722**	**119 722**	**144 265**	**169 222**
P-25	**Quantity of each fuel ($fbpn_p$) used for balance of process needs ($Q_{fbpn,p,i}$)**	**1000 m^3**					
	Natural gas (NG)	**1000 m^3**	76 209	63 244	63 244	76 209	89 393
P-26	**Emission factor of each fuel $EF_{f,p}$**	**Tonnes CO_2/1000 m^3**					
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301	1,89301
P-27	**Total CO_2 from electricity consumption for balance of process needs of project activity ($TCEBPN_{p,i}$)**	**Tonnes CO_2**	**641 330**	**831 637**	**829 361**	**647 850**	**606 362**
P-28	**Electricity Consumed for balance of process needs ($ECBPN_{p,i}$)**	**MWh**	592 726	758 793	758 793	592 726	554 768
P-29	**Emissions Factor for Electricity Consumption $EF_{f,p}$**	**Tonnes CO_2/MWh**	1,082	1,096	1,093	1,093	1,093

Tables 28 - 30 provide detailed estimations of baseline emissions before and during Kyoto protocol crediting period.

Table 28. Detailed information regarding identification of Baseline emissions estimations subject to variable emission factor for electricity consumption[109]

ID number	Data variable	Units	01/01/1999 - 31/12/2003			
			01/04/2004 - 31/12/2007	01/01/2008 - 31/12/2008	01/01/2009 - 31/12/2009	01/01/2010 - 31/12/2020
B-1	**Total CO_2 in the project scenario (BE_i)**	**Tonnes CO_2**	**38 541 979**	**39 616 841**	**39 697 745**	**39 680 408**
B-2	**Total CO_2 from Pig Iron**	**Tonnes CO_2**	**33 525 327**	**33 809 637**	**33 831 036**	**33 826 451**

[109] The table is required for identification of baseline emissions, which are based on historical data (1999-2003) for further identification of baseline CO_2 emissions per 1 ton of pig iron produced during the project activity.

	($TCPI_{b,i}$)					
B-3	**Total Pig Iron Output ($TPII_{b,i}$)**	**Tonnes**	12 160 278	12 160 278	12 160 278	12 160 278
B-4	**Total CO_2 from fuel consumption in producing Pig Iron ($TCFCPI_{b,i}$)**	**Tonnes CO_2**	**1 684 024**	**1 684 024**	**1 684 024**	**1 684 024**
B-5	**Quantity of each fuel (fpi_b) used in making Pig Iron ($Q_{fpi,b,i}$)**	**1000 m^3**				
	Natural gas (NG)	**1000 m^3**	889 601	889 601	889 601	889 601
B-6	**Emission factor of each fuel $EF_{f,b}$**	**Tonnes CO_2/1000 m^3**				
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301
B-7	**Total CO_2 from electricity consumption in producing Pig Iron ($TCEPI_{b,i}$)**	**Tonnes CO_2**	**728 281**	**879 465**	**890 844**	**888 406**
B-8	**Electricity Consumed in producing Pig Iron ($ECPI_{b,i}$)**	**MWh**	812 814	812 814	812 814	812 814
B-9	**Emissions Factor for Electricity Consumption $EF_{f,b}$**	**Tonnes CO_2/MWh**	0,896	1,082	1,096	1,093
B-10	**Total CO_2 from Inputs into Pig Iron ($TCIPI_{b,i}$)**	**Tonnes CO_2**	**31 113 022**	**31 246 148**	**31 256 169**	**31 254 021**
B-11	**Total CO_2 from fuel used to prepare Iron Ore ($TCFIO_{b,i}$)**	**Tonnes CO_2**	**232 380**	**232 380**	**232 380**	**232 380**
B-12	**Quantity of each fuel (fio_b) used in Sintering ($Q_{fio,b,i}$)**	**1000 m^3**				
	Natural gas (NG)	**1000 m^3**	122 757	122 757	122 757	122 757
B-13	**Emission factor of each fuel $EF_{f,b}$**	**Tonnes CO_2/1000 m^3**				
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301
B-14	**Total CO_2 from electricity consumption in preparing iron ore ($TCEIO_{b,i}$)**	**Tonnes CO_2**	**641 295**	**774 421**	**784 441**	**782 294**
B-15	**Electricity Consumed in Sintering ($ECIO_{b,i}$)**	**MWh**	715 731	715 731	715 731	715 731
B-16	**Emissions Factor for Electricity Consumption $EF_{f,b}$**	**Tonnes CO_2/MWh**	0,896	1,082	1,096	1,093
B-17	**Total CO_{2e} from Reducing Agents in Pig Iron Production ($TCRAPI_{b,i}$)**	**Tonnes CO_2**	**28 458 032**	**28 458 032**	**28 458 032**	**28 458 032**
B-18	**Quantity of each reducing agent ($rapi_b$) in Pig Iron Production ($Q_{rapi,b,i}$)**	**Tonnes**				
	Reducing agent (coke)	**Tonnes**	7 500 315	7 500 315	7 500 315	7 500 315
	Reducing agent (anthracite)	**Tonnes**	384 305	384 305	384 305	384 305
B-19	**Emission factor of each reducing agent, $EF_{ra,b}$**	**Tonnes CO_{2e}/Tonne**				
	Default emission factor	**Tonnes CO_2/Tonne**	3,66	3,66	3,66	3,66
	Default emission factor	**Tonnes CO_2/Tonne**	2,62	2,62	2,62	2,62
B-20	**Total CO_{2e} from other inputs ($TCOIPI_{b,i}$)**	**Tonnes CO_2**	**1 781 315**	**1 781 315**	**1 781 315**	**1 781 315**
B-21	**Quantity of each other input ($oipi_b$) in Pig Iron Production ($Q_{oipi,b,i}$)**	**Tonnes**				

	Limestone	**Tonnes**	2 063 162	2 063 162	2 063 162	2 063 162
	Dolomite	**Tonnes**	1 699 180	1 699 180	1 699 180	1 699 180
	Pellets	**Tonnes**	2 100 503	2 100 503	2 100 503	2 100 503
B-22	**Emission factor of each other input, $EF_{oi,b}$**	**Tonnes CO_{2e}/Tonne**				
	Default emission factor	**Tonnes CO_2/Tonne**	0,440	0,440	0,440	0,440
	Default emission factor	**Tonnes CO_2/Tonne**	0,477	0,477	0,477	0,477
	Default emission factor	**Tonnes CO_2/Tonne**	0,030	0,030	0,030	0,030
B-23	**Total tones of CO_2 related to the balance of process need of energy required for the project activity ($TCBPN_{b,i}$)**	**Tonnes CO_2**	**5 016 652**	**5 807 204**	**5 866 708**	**5 853 957**
B-24	**Total CO_2 from fuel consumption for balance of process needs of project activity ($TCFCBPN_{b,i}$)**	**Tonnes CO_2**	**1 208 401**	**1 208 401**	**1 208 401**	**1 208 401**
B-25	**Quantity of each fuel ($fbpn_b$) used for balance of process needs ($Q_{fbpn,b,i}$)**	**1000 m^3**				
	Natural gas (NG)	**1000 m^3**	638 349	638 349	638 349	638 349
B-26	**Emission factor of each fuel $EF_{f,b}$**	**Tonnes CO_2/1000 m^3**				
	Natural gas (NG)	**Tonnes CO_2/1000 m^3**	1,89301	1,89301	1,89301	1,89301
B-27	**Total CO_2 from electricity consumption for balance of process needs of project activity ($TCEBPN_{b,i}$)**	**Tonnes CO_2**	**3 808 251**	**4 598 803**	**4 658 307**	**4 645 556**
B-28	**Electricity Consumed for balance of process needs ($ECBPN_{b,i}$)**	**MWh**	4 250 280	4 250 280	4 250 280	4 250 280
B-29	**Emissions Factor for Electricity Consumption $EF_{f,b}$**	**Tonnes CO_2/MWh**	0,896	1,082	1,096	1,093

Table 29. Detailed Baseline emissions estimations (before the start of Kyoto protocol crediting period)

ID number	Data variable	Units	01/04/2004 - 31/12/2004	2005	2006	2007
B-2	**Total CO_2 from Pig Iron ($TCPI_{b,i}$)**	**Tonnes CO_2**	**33 525 327**	**33 525 327**	**33 525 327**	**33 525 327**
B-23	**Total tones of CO_2 related to the balance of process need of energy required for the project activity ($TCBPN_{b,i}$)**	**Tonnes CO_2**	**5 016 652**	**5 016 652**	**5 016 652**	**5 016 652**
B-3	**Total Pig Iron Output ($TPII_{b,i}$)**	**Tonnes**	12 160 278	12 160 278	12 160 278	12 160 278
B-30	**Total CO_2 per 1 tonne of Pig Iron produced ($TCPTPIP_b$)**	**Tonnes CO_2/1 t. of Pig Iron Produced**	**3,169**	**3,169**	**3,169**	**3,169**
P-3	**Total Pig Iron Output ($TPII_{p,i}$)**	**Tonnes**	2 280 137	2 878 071	3 210 604	3 449 711
B-1	**Total CO_2 in the project scenario (BE_i)**	**Tonnes CO_2**	**7 226 889**	**9 122 041**	**10 176 004**	**10 933 853**

Table 30. Detailed Project emissions estimations (during Kyoto protocol crediting period)

ID number	Data variable	Units	2008	2009	2010	2011	2012

B-2	**Total CO_2 from Pig Iron ($TCPI_{b,i}$)**	**Tonnes CO_2**	**33 809 637**	**33 831 036**	**33 826 451**	**33 826 451**	**33 826 451**
B-23	**Total tones of CO_2 related to the balance of process need of energy required for the project activity ($TCBPN_{b,i}$)**	**Tonnes CO_2**	**5 807 204**	**5 866 708**	**5 853 957**	**5 853 957**	**5 853 957**
B-3	**Total Pig Iron Output ($TPII_{b,i}$)**	**Tonnes**	12 160 278	12 160 278	12 160 278	12 160 278	12 160 278
B-30	**Total CO_2 per 1 tonne of Pig Iron produced ($TCPTPIP_b$)**	**Tonnes CO_2/1 t. of Pig Iron Produced**	**3,258**	**3,265**	**3,263**	**3,263**	**3,263**
P-3	**Total Pig Iron Output ($TPII_{p,i}$)**	**Tonnes**	3 060 211	3 195 230	3 195 230	3 060 211	3 449 711
B-1	**Total CO_2 in the project scenario (BE_i)**	**Tonnes CO_2**	**9 969 829**	**10 430 964**	**10 426 409**	**9 985 826**	**11 256 810**

Table 31. Abbreviations[110]

DIISW	Open Joint Stock Company Dniprovsky Integrated Iron and Steel Works named after Dzerzhynsky
BF	Blast Furnace
BFG	Blast Furnace gas
NG	Natural gas
N/A	Not applicable
ERU	Emission reduction unit
ER	Emission reductions
CHP	Combined heat and power

[110] For details of data variable please see tables D.1.1.1 and D.1.1.3.