PROJECT DESIGN DOCUMENT

JOINT IMPLEMENTATION PROJECT

“Reduction of Greenhouse Gases Emissions Due to Energy Efficiency Improvements and Waste Heat Utilization at JSC “Ukrgrafit””

Position of the manager of the organization, which developed the document

LLC ‘KT-Energy’

_____	_____	_____
(position)	(signature)	(Name)

Date:

Position of the manager of economic entity, which is the owner of the project site at which joint implementation project is planned

JSC ‘Ukrgrafit’

_____	_____	_____
(position)	(signature)	(Name)

Date:

Kyiv, November 2011

JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM FOR SMALL-SCALE PROJECTS
Version 01.1 - in effect as of: 27 October 2006

CONTENTS

SECTION A. General description of the small-scale project

A.1. Title of the small-scale project:

Reduction of Greenhouse Gases Emissions Due to Energy Efficiency Improvements and Waste Heat Utilization at JSC "Ukrgrafit"

Project pertains to the sectoral scope 4 Manufacturing industries, Group II.

JI PDD version number: 2.2

Data of Completion: 7th of November, 2011

A.2. Description of the small-scale project:

Situation before project implementation

Before project implementation JSC 'Ukrgrafit' has been covering its heat (steam) energy demand by purchasing heat power from the nearby industrial enterprise and was using relatively higher quantities of energy for operational processes without implementation of energy efficiency measures.

Baseline scenario

The baseline scenario of the project foresees continuation of previously existing practice within the graphitising and calcination processes without implementation of energy efficiency measures and producing steam by using coal fired boilers (see also section B for details).

Purpose of the project

The purpose of the project is the increased efficiency of the energy resources use through waste heat utilization and the reduction of energy resources consumption accompanied by greenhouse gases emission reductions.

Non technical project summary

Within project boundaries three exhaust boilers will be installed for waste energy utilization from carbon fillers calcination furnaces. Heat energy, which is now being wasted, will be used for covering heat demand of the Enterprise and will substitute heat energy (steam), which would have been generated by coal fired boilers in the absence of the project activity. Besides, project foresees reduction in energy resources consumption (electricity and natural gas), due to reconstruction of furnaces, electrocalcinators and other energy-efficiency improvement measures.

Concept of the project

JSC "Ukrgrafit" executes the project of exhaust boilers installation, reconstruction of electrocalcinators and the kiln, and electrode fillers graphitizing modernization to reduce GHG emissions, organic fuel and electricity consumption.

The project foresees two main parts:

- energy efficiency improvements during graphite products production including reconstruction of electrocalcinators, reconstruction of the calcination kiln and modernization of graphitizing process;

- waste energy utilization through the utilization of heat from industrial processes (exhaust gases from furnaces) that would otherwise be wasted and its use for steam generation.

Expected results of the project:

Project activity aims to achieve the following results:

- greenhouse gases emission reductions in the amount of 105 076 tonnes of CO_{2e} for the period of 2008-2012 and 472 460 for the period 2008-2020,
- waste heat recovery in the amount of 481 505 GJ per year,
- electricity and organic fuel savings due to reconstruction of electrocalcinators and the kiln, and modernisation of graphitizing process.

Grounds for the project implementation

Project implementation was started on the grounds of the necessity to optimize energy resources consumption at the Enterprise with the utilisation of Kyoto Protocol flexible mechanisms. Information about energy consumption of the Enterprise is presented in the table below.

Data	2003	2004	2005	2006	2007
Electricity consumption, MWh	258 201	262 093	280 944	271 824	271 457
Heat energy (steam) consumption from nearby industrial enterprise, Gkal	124 146	121 799	131 103	127 368	125 026
Natural gas consumption, 1000 m^3	18 796	18 914	19 640	16 438	18 647

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)
Party A: Ukraine (Host Party)	JSC "Ukrgrafit" Project owner	No
Party B: Germany	RWE Power Aktiengesellschaft ERUs buyer	No

JSC "Ukrgrafit" is a leading Ukrainian manufacturer of graphite electrodes for electric steel furnaces, submerged-arc furnaces and other types of electric furnaces, commodity carbon pastes for Soderberg electrodes, carbon-based lining materials for metallurgical, machine-building, chemical industries and others.

RWE Power Aktiengesellschaft is one of the leading energy production and generation companies in Germany and is an integral part of the RWE Group. RWE Power banks on a broad energy mix and to a large extent is able to draw on its own raw material base. By now, power plant portfolio of the RWE Power, including affiliates, consists of 24 large-scale power plants and numerous smaller generating facilities. Including the power acquired from third parties, we make available some 205 billion kWh of electricity a year. RWE invests in GHG emission reduction projects to generate carbon certificates that RWE can use as a part of its carbon mitigation activities. RWE is active in all the important CDM and JI host countries and has a portfolio of over 130 projects.

A.4. Technical description of the small-scale project:

A.4.1. Location of the small-scale project:

Project area location – Ukraine, Zaporizhzhya city, Pivnichne shose Str. 20.

Fig. A-1. Project area location, Zaporizhzhya, Ukraine

A.4.1.1. Host Party(ies):

Ukraine

Article 5 of the Kyoto Protocol requires 'Annex 1 Parties to having in place, no later than 2007, national systems for the estimation of greenhouse gas emissions by sources and removal by sinks.' National Inventory System of Ukraine was created by Government Decision "Procedure of the Functioning National System of the Estimation of Anthropogenic Emissions by Sources and Removals by Sinks of GHG not Controlled by the Montreal Protocol" (21.04.06, №554).

According to Article 7 of the Kyoto Protocol Ukraine have submitted annual greenhouse gas inventories on a regular basis. First National Inventory report was submitted on 20th of February, 2004. The last one was submitted on 15th of April, 2011. Ukraine has also submitted its Fifth National Communication report on 29th of December 2009.

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

Zaporizhzhya region

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

Zaporizhzhya

A.4.1.4. Detail of physical location, including information allowing the unique identification of the small-scale project:

The project is implemented at the project site of JSC "Ukrgrafit" in Zaporizhzhya, Pivnichne shose Str. 20. The geographical coordinates of the project site are the following: 47°87' N, 35°12' E.

Fig. A-2. Project site location, Zaporizhzhya, Pivnichne shose Str. 20.

A.4.2. Small-scale project type(s) and category(ies):

The joint implementation project at JSC "Ukrgrafit" is a small scale project.

The small scale project conforms to the type (ii): Energy efficiency improvement project activities, which reduce energy consumption, on the supply and/or demand side, by up to 60 gigawatt hours (GWh) per year (or an appropriate equivalent), and category H. Energy efficiency and fuel switching measures for industrial facilities.

Some of the technologies employed by the project (reconstruction of electrocalcinators, modernisation of graphitizing process) were specially developed for the implementation at the enterprise and some of them (waste heat utilisation) is used at other industrial enterprises but could not be referred as a common practice technology (see also Section B.2).

A.4.3. Technology(ies) to be employed, or measures, operations or actions to be implemented by the small-scale project:

The aim of project execution is the increase of energy resources consumption efficiency and greenhouse gases emission reduction during graphite products production process.

The main stages of the graphite products production process are the following:

- raw materials (coke or anthracite) preparation by primary calcination for lowering the water content and volatile matters content;
- crushing of the raw materials and forming of graded fractions for further preparation of carbon loam composition;
- mixing and pressing with further formation of blocks with certain dimensions and sizes;
- baking of carbon blocks for the formation of integral, homogeneous and solid structure of carbon material;
- impregnation of baked carbon blocks with the carbon binding agent for increasing of the blocks' density and additional baking;
- graphitizing of the carbon blocks for carbon crystalline grid alignment and graphite formation;
- mechanical treatment of the final products.

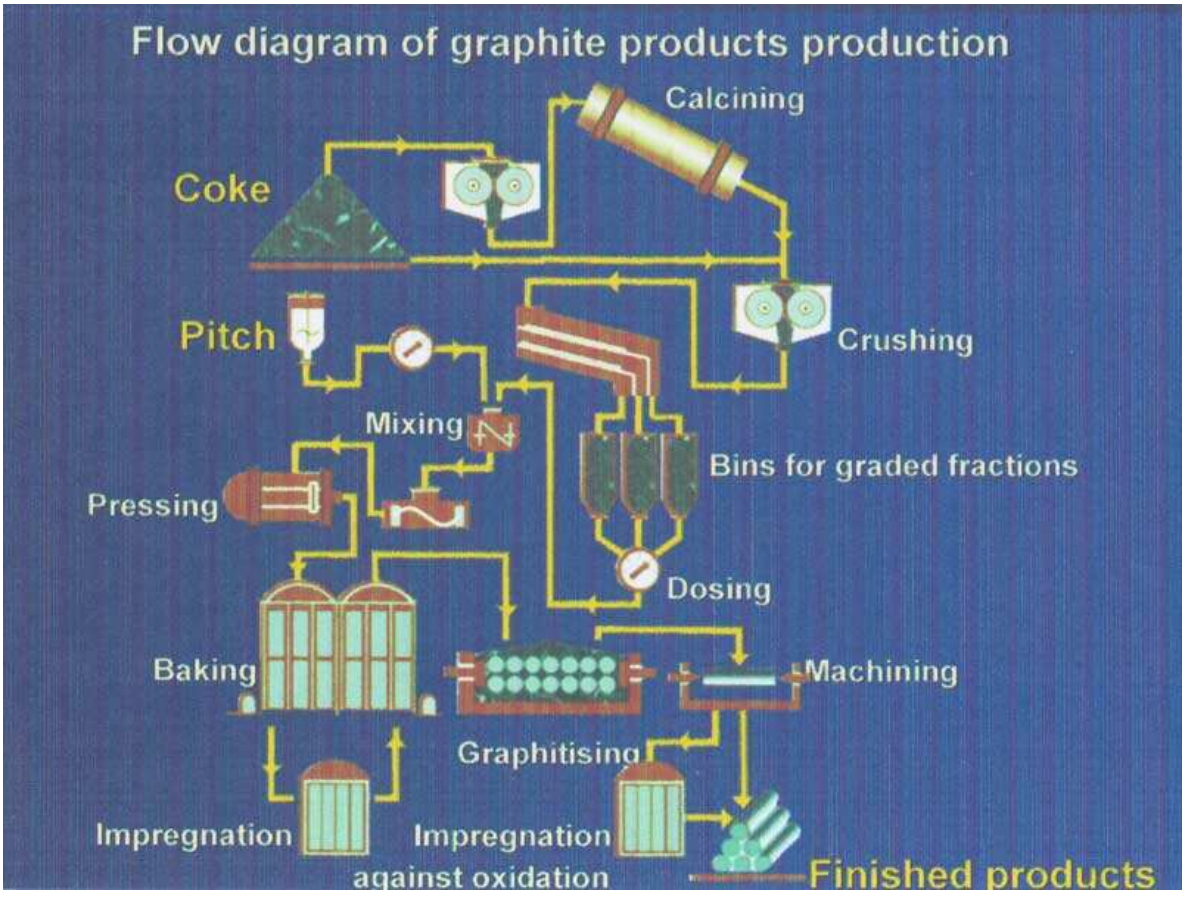

Fig. A-3. Flow diagram of graphite products production using coke as a raw material.

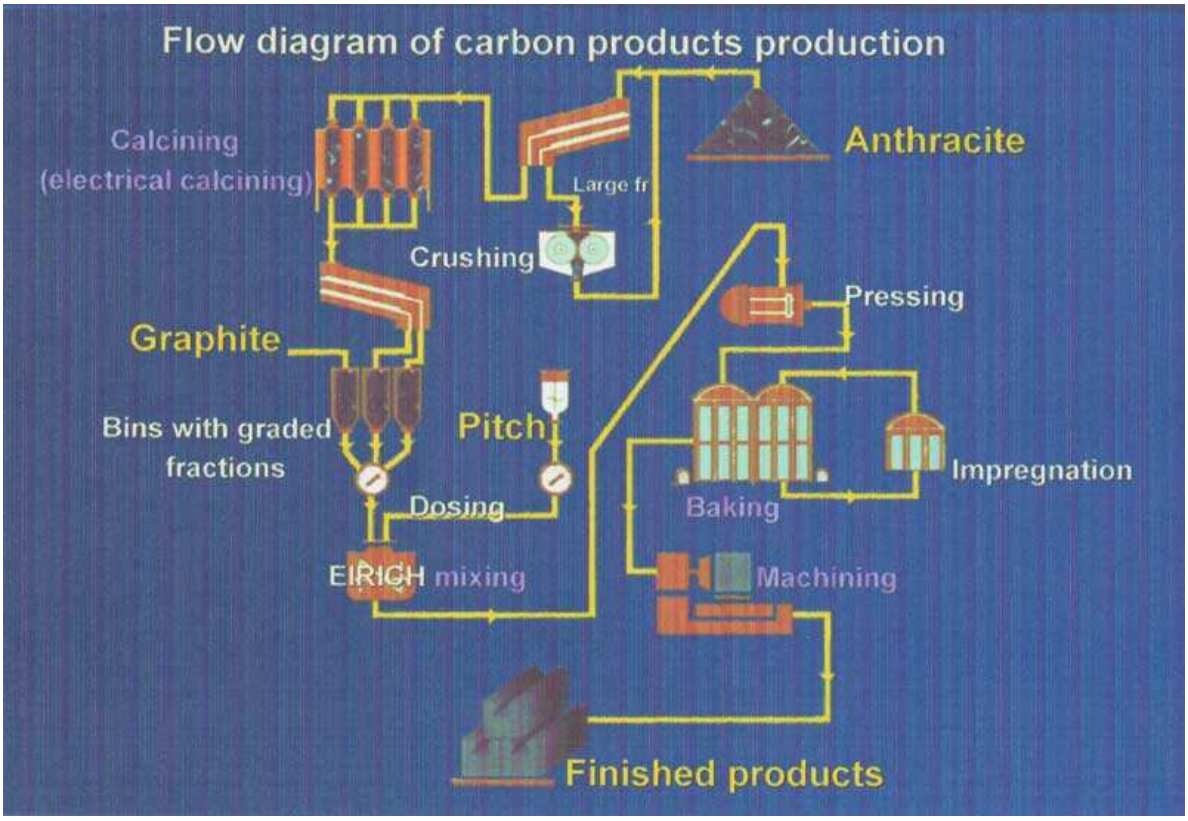

Fig. A-4. Flow diagram of graphite products production using anthracite as a raw material.

The project foresees the implementation of the following technical measures:

- reconstruction of electrocalcinators,
- reconstruction of the calcination furnace (kiln),
- modernization of carbon fillers graphitizing process,
- introduction of waste energy utilization due to exhaust boilers installation.

Reconstruction of electrocalcinators

Electrocalcinator is electrothermic equipment 18 meters high. There are 7 electrocalcinators at the plant located in the industrial workshop #1. Technical characteristics of electrocalcinators are presented in the table below.

Parameter	Value
Type	IET-10-УХЛ4
Producer	OJSC “Sybelectroterm”
Nominal value, kV·A (no more than)	1600
Nominal frequency, Hz	50
Diameter of the upper electrode, mm	500
Maximum power of electrode current, kA (short-term)	20
Water consumption for cooling, m^3/hour	45-55
Breadth, mm	3350
Length, mm	8385
Height, mm	18160
Mass, tonnes	51
Sound level, dBA	85

Source of the data: Electric furnace (electrocalcinator) IET-10-УХЛ4. Technical description.

Reconstruction of electrocalcinators consists of two subcomponents: reconstruction of electrocalcinators to produce thermoanthracite by one-stage process and reconstruction of electrocalcinators to produce synthetic graphite. Both reconstruction measures leaded to significant electricity savings.

Thermoanthracite is being produced when moist anthracite is passing through the stack of electrocalcinator under the influence of electric current in interelectrode space. Within the project execution Paton Electric Welding Institute of National Academy of Science of Ukraine has developed up-to-date patented technology, which allowed decreasing the specific electricity consumption during electrocalcination process without violation of quality standards for thermoanthracite.

Specially constructed chokes were implemented in electrocalcinators to switch from a two-stage coal thermal treatment to a single-stage coal thermal treatment. The changes in the electrocalcinators' design allowed mixing of coal charging material during the calcination process and achieving homogenous heating of the coal charging material. Within the project three electrocalcinators were reconstructed and switched to one stage operation mode and the decision regarding the reconstruction of other electrocalcinators could be made within the project execution.

The furnace shaft is the steel jacket with the outside diameter of 2300 mm. Inside the shaft there is a kiln brick lining and mullite wool. The electrodes are located vertically inside the furnace's shaft. The top electrode has a diameter of 500 mm and is made of high quality graphitized carbon material. The bottom electrode has a diameter of 710 mm and is located at the bottom of the furnace with water cooling system. The chokes were assembled in the middles part of the electrocalcinators. The size of the choke is 2180 x 1000 and it consists of 14 sectors. Assembled choke has a form of a ring with the multifacet hatchway in the centre with the diameter of 25-60% of the furnace shaft's diameter.

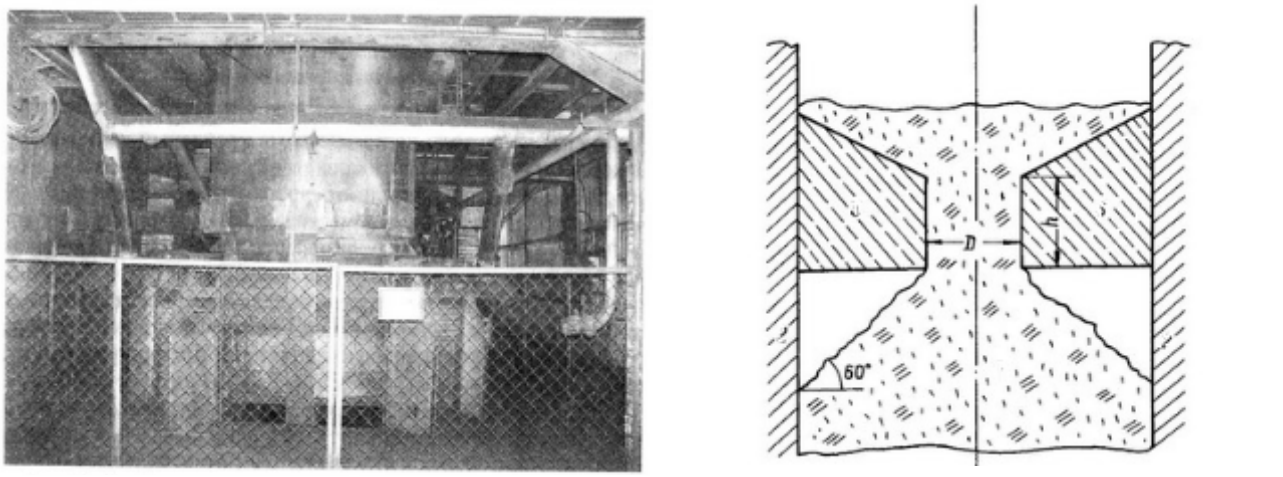

Fig. A-5. Middle part of electrocalcinator and schematic view of the choke inside it.[1]

When the anthracite is moving through the installed choke the particles of the anthracite is moving not only in the vertical direction but also in the horizontal direction from the shaft walls to the middle of the shaft allowing mixing of the coal charging material. Besides, while coming through the installed choke all coal charging material is intensively and homogenous heated by electric current due to increased density of electric current. The performed modernization allowed decreasing the specific electricity consumption from 1.4 MWh/tonne to 0.7-0.8 MWh/tonne.

Synthetic graphite is used in combination with thermoanthracite as filler within carbon product (cathode blocks and blast-furnace blocks) manufacturing. Synthetic graphite is produces by standard technology

[1] Pictures from Petrov B. F. Energy savings in electrode thermoanthracite production. – Kyiv: "Ecotechnologiya", 2006.

of graphite production namely including mixing of coke and pitch, pressing and further calcination and graphitizing in graphitizing furnaces. Produced synthetic graphite blocks are crushed and then used for manufacturing of carbon products. Within the project implementation the technology of synthetic graphite production in electrocalcinators with high temperature processing of calcinated coke was developed and introduced at the enterprise. The new design of electrocalcinators allowing production of synthetic graphite was developed and pilot-scale testing has been successfully accomplished. Implementation of synthetic graphite production in electrocalcinators has significant energy saving effect due to avoiding natural gas consumption for calcination and also due to smaller electricity consumption for production of synthetic graphite in electrocalcinators in comparison with the same process in graphitizing furnaces. The performed modernization allowed decreasing the specific electricity consumption for synthetic graphite production by 1.6 MWh/tonne. Within the project 1 electrocalcinator was reconstructed and switched to synthetic graphite production and the decision regarding the reconstruction of other electrocalcinators could be made within the project execution.

Calcination kiln reconstruction

Within the realization of the first part of the project the kiln #10 was also reconstructed. The kiln is used for fillers' burning in the separate chambers that are being heated or cooled in-series according to the fixed schedule. The process of burning lasts 15 or more days and the period can be changed within determined limits.

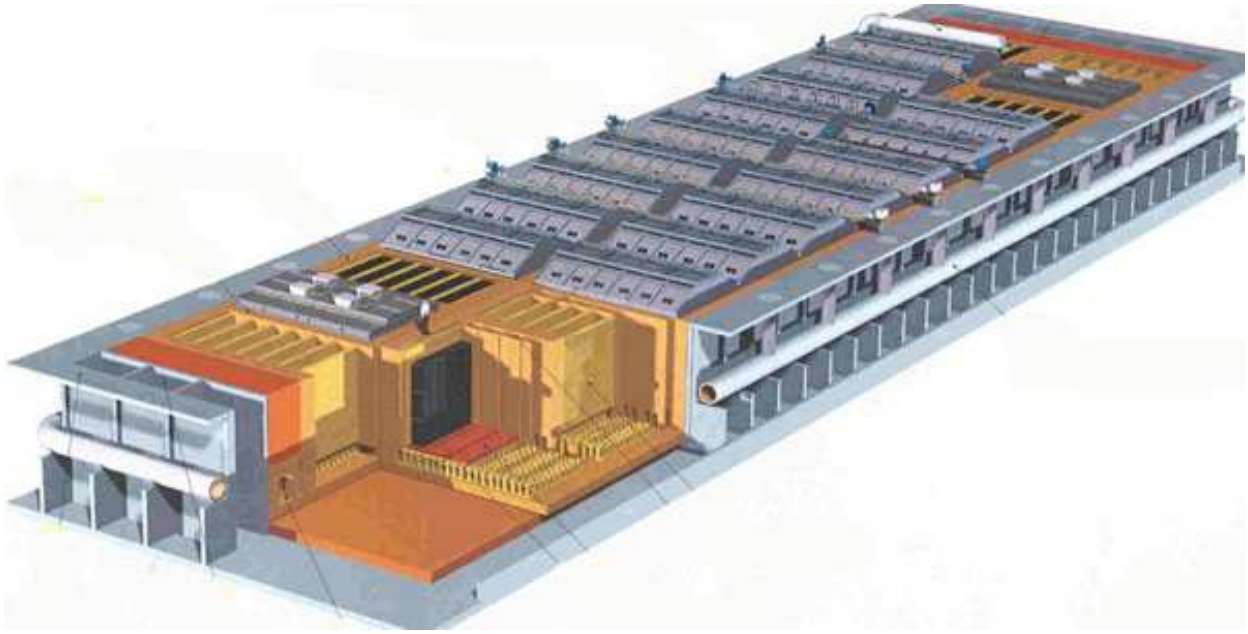

Fig.A-6. General view of the kiln #10

Closed type furnace designed by Riedhammer company was installed within the project for baking of electrodes. The furnace consists of three zones: pre-heating zone, main fire zone and cooling zone.

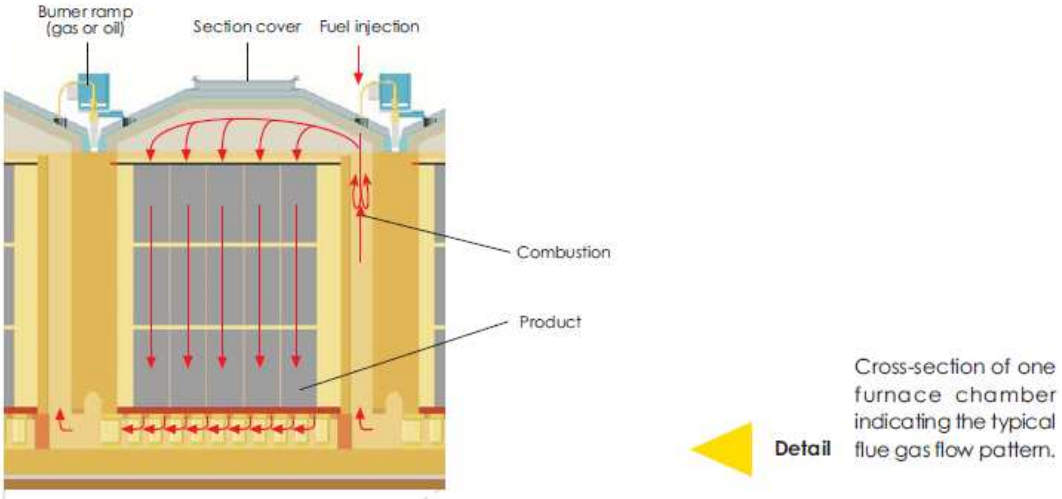

Fig.A-7. Cross-section of one furnace chamber indicating the typical flue gas flow pattern.

Within the reconstruction the volume of the kiln was extended, the quantity of chambers was increased and an automated control system on burning was implemented. Maximum kiln capacity under the burning schedule of 341 hours is 30 000 tonnes/year. Thus, due to design measures and the automation of the burning process the kiln specific natural gas consumption was reduced from 178 m^3/tonne to 70 m^3/tonne.

The installed kiln is characterized by excellent temperature transfer and distribution, reduced fuel consumption, maximum burnout of volatile components and thus reduced levels of emissions. Technical characteristics of the kiln are presented below.

Parameter	**Value**
Model and type	Ring-typed calcination furnace #10 with 36 sections
Size, meters	112,5 x 30
Weight, tonnes	13 800
Number of sections	36
Pits per section	7
Section volume, m^3	98,06
Fuel	Natural gas

The reconstruction of the kiln has been ended in 2007 and the kiln started operation in 2008.

Fig.A-8. Calcination kiln #10.

Graphitizing process modernization

The final step in graphite manufacture is a conversion of baked carbon to graphite, called graphitising, i.e. heat-treating the material at temperatures in the region of 2600°C – 3300°C. During the graphitising process, the more or less pre-ordered carbon (turbostratic carbon) is converted into a three-dimensionally ordered graphite structure (crystallite alignment). During the graphitizing process the density of graphite is increased and the material is becoming better electric and thermal conductor. The process requires high power consumption.

Within the project boundaries the process of carbon fillers graphitizing was also modernized, that allowed to save electrical energy and to reduce greenhouse gases emissions.

The process of electrode fillers graphitizing takes place in electric resistance furnaces, where the input material itself is an active electric resistance in the general chain of the graphitizing aggregate. The input material is being heated due to direct pass of electric current through it. The current is supplied to the load by two water-cooled head electrodes at the narrow sides of the furnace, which is thermally insulated by a mixture of coke, sand, carbon black and/or sawdust, thus protecting the material against oxidation. As the electrical resistance of the furnace decreases with an increasing degree of graphitisation, the power to the head electrodes is controlled and adjusted by transformers. Furnace loading consists of electrode fillers and carbonic charge. As the electric resistance of the charge is higher than the electric resistance of the fillers, almost all the heat is emanating in the charge layer, while the electrode fillers is being heated due to thermal conductivity.

The process requires significant power consumption and the most precise method of process control and consequently control of power consumption is the direct measurement of reaction zone temperature. As there is a lack of methods and devices for temperature measuring in the graphitizing furnaces due to very high temperatures and restorative carbon environment the control on the graphitizing process is provided according to the fixed technological schedule of the power (energy) input to the furnace.

Within the project realization in 2007 the technology of three-dimensional modelling of the graphitizing process in the Acheson furnace based on energy balances method was developed and implemented in the workshop #4 section 4 during the production of electrodes with the diameter of 600 mm. There are 5 graphitising furnaces 12 meter long being operated in a cycle mode in the section 4. The average length of the production cycle is 350 hours and the average capacity is 11 000 tonnes per year. Power is supplied by four furnace transformers TDNP-16000/10 with the capacity of 9350 kV·A each.

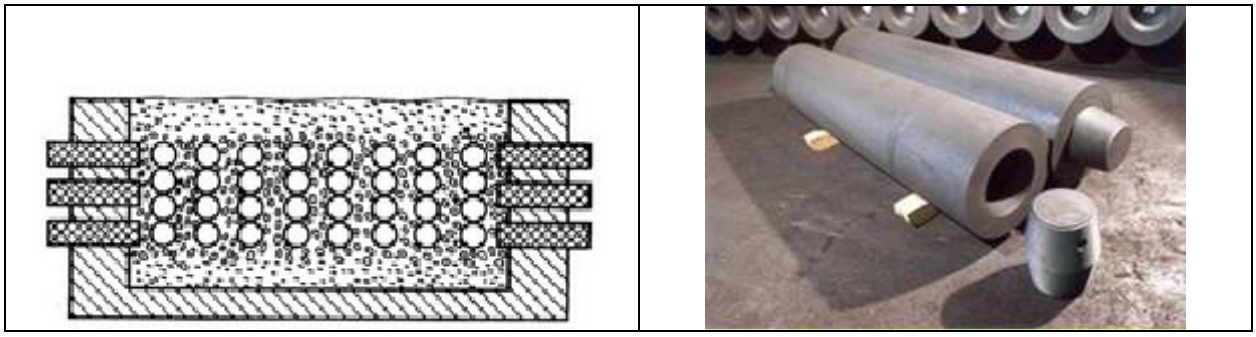

Fig.A-8. Schematic image of graphitizing furnace and graphitized electrodes

The technology allowed to model and to compare on practice the process of temperature change in the different furnace zones while the power (energy) input into the furnace. Received mathematical model enabled to define the furnace temperature field and temperature gradients during definite time while the power (energy) input into the furnace. On the basis of the mathematical model the process of the furnace

heating was optimized, that allowed to reduce specific electricity consumption from 6.425 MWh/tonne to 5.750 MWh/tonne on the most responsible and common fillers section with 600 mm diameter.

Exhaust boilers installation

Within the second part of the project three vertical water tube exhaust boilers with the production capacity of 25 tonnes of steam per hour each will be installed at JSC "Ukrgrafit".

Fig.A-9. Exhaust boilers construction.

Exhaust boilers will use the energy, which is now being wasted (the energy of exhaust gases from calcinating furnaces) and will also combust natural gas for covering heat energy (steam) demand of the enterprise. Exhaust boilers will utilized the energy potential of exhaust gases from the calcination furnaces #1, #2, #3 and #5 located in the workshop #2, which have a single stack flue. Exhaust gases will pass through the primary furnace of the exhaust boilers, where the waste energy is utilized and additional fuel is combusted, combustion chamber, convection heating surface and directed to the gas purification system and further to the existing stack flue. Bag-type filters are used for the purification of the exhaust gases from dust and ash. One exhaust boiler is also equipped with the additional burner, which is able to combust graphite powder, and a bunker with 30 tonnes (8 hours of operation) capacity for loading graphite powder. However, it is not foreseen to use graphite powder as a fuel in significant amount because of its value as a product for potential use in the metallurgical industry.

Generation of heat energy using waste energy of exhaust gases will lead to energy savings and reduction of greenhouse gases emissions. Total annual amount of heat energy generation by three exhaust boilers РК-25-1.4/320 will be about 115 000 Gkal. Heat generation rate depends on the heat demand, which changes during the year. The use of heat insulation materials at the heating surface and securing of the outside surfaces temperature not more than 55° Celsius lead to additional energy saving effect. Technical characteristics of the equipment are presented in the table below.

Parameter	Value
Type	PK-25-1.4/320
Producer	STC "Kotloenergoprom"
Installed heat capacity, Gkal/hour	20
Capacity, tonnes of steam/hour	25
Superheated steam pressure, MPa	1.4
Superheated steam temperature, °C	320
Maximum consumption of the flue gases, m^3/hour	60 000
Flue gases temperature, °C	500-1100
Natural gas consumption in the utilizing mode, m^3/hour	397
Natural gas consumption in the autonomous mode, m^3/hour	2000

Data source: Installation design of heat-utilisation boiler workshop construction. Executive summary.

Expected date of exhaust boilers commissioning is 1st of May, 2011.

Implementation schedule and cost of the project

The decision about Project implementation was made by the scientifical and technical council of the Enterprise on the 4th of October, 2006 taking into consideration the possibility of additional revenues from emission reduction units sale within the framework of joint implementation mechanism of Kyoto Protocol.

In 2007 the investments in energy efficiency improvements (modernization of graphitizing process, reconstruction of two electrocalcinators and reconstruction of kiln #10) have been made and in 2008 the reconstructed equipment was already operational. Thus, the start of the crediting period is the 1st of January, 2008. The second part of the project has been started in 2009 when the agreement on three exhaust boilers construction has been signed. The expected commissioning date of exhaust boilers workshop is the 1st of May, 2011.

Total estimated project cost is about UAH 108.5 million (VAT excluded). See also section B.2 for details. The project is financed by the own investments of the Enterprise. In determining the structure of financing revenues from ERUs sale are not taken into account as their receipt is expected after the execution of main investment costs for the project. Tentative amount of investments from ERUs sale during the first crediting period is expected at the level of UAH 10 million.

The project uses the state-of-the-art technology, which is based on the latest scientific research and developments efforts and will result in a significantly better performance than commonly used technologies in the Host country. Besides, the technologies were specially developed for the implementation of the project and thus are not likely to be substituted by other or more efficient technologies within the project period. All the technological parameters of the project equipment meet environment protection normative requirements.

Due to the use of modern technology project requires initial training of the personal. Namely, the trainings on technical maintenance of the calcination kiln, general structure and process control, electric and mechanical equipment, as well as functioning of automatic control system were conducted for all responsible workers operating calcination kiln. Besides, the responsible workers have been acquainted with the relevant operation and safety regulation manuals and process regulations. The staff responsible for operation of exhaust boilers has successfully passed the training courses on general principles of functioning and the safety rules of operation of steam and water heating boilers, air and gas pipelines as well as has been acquainted with the relevant operation and safety regulation manuals. Additional provisions for meeting training and maintenance needs envisaged due to training of the personal during

the setup mode operation period and enforced requirements for educational and professional background of the working personal.

A.4.4. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed small-scale project, including why the emission reductions would not occur in the absence of the proposed small-scale project, taking into account national and/or sectoral policies and circumstances:

Anthropogenic emissions of greenhouse gases will be reduced due to waste heat utilization and avoidance of use of carbon intensive fuel for heat energy generation. Besides, reduction of electricity and organic fuel use due to reconstruction of electrocalcinators and the kiln, and electrode fillers graphitizing modernization will lead to GHGs emissions reduction. Total amount of greenhouse gases emission reduction over the first crediting period 2008-2012 is 105 076 tonnes of CO_2 equivalent.

Taking into account prevailing practice and financial barriers described in details in Section B, it is concluded that emission reductions would not occur in the absence of the proposed project.

Only CO_2 emissions concerned with fossil fuel combustions and electricity generation are included in the project boundary and addressed in PDD. CH_4 emissions and NO_x emissions were considered negligibly low and were not taken into consideration. Detailed description of project boundaries is presented in Section B.

A.4.4.1. Estimated amount of emission reductions over the crediting period:

Total reductions of greenhouse gases emission within the defined project boundaries over the first crediting period 2008-2012 are 105 076 tonnes of CO_2 equivalent. Total reductions of greenhouse gases emission within the defined project boundaries over the expected second crediting period 2013-2020 are 367 384 tonnes of CO_2 equivalent. The extension of the crediting period beyond 2012 is subject to Host country approval. Overall emission reductions due to project realisation during the period 2008-2020 are 472 460 tonnes of CO_2 equivalent. Estimates of total as well as annual emission reductions for the crediting period 2008-2020 are provided in the table below.

	Years
Length of the crediting period	13
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	8 737
2009	8 765
2010	10 208
2011	31 443
2012	45 923
Subtotal estimated emission reductions over the period 2008-2012 (tonnes of CO_2 equivalent)	105 076
Annual average of estimated emission reductions over the first commitment period (tonnes of CO_2 equivalent)	21 015
2013	45 923
2014	45 923
2015	45 923
2016	45 923

2017	45 923
2018	45 923
2019	45 923
2020	45 923
Subtotal estimated emission reductions over the period 2013-2020 (tonnes of CO_2 equivalent)	367 384
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	472 460
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	36 343

A.4.5. Confirmation that the proposed small-scale project is not a debundled component of a larger project:

The proposed project is not a debundled component of a larger project. JSC "Ukrgrafit" is not a project participant to any joint implementation or small-scale joint implementation project with a publicly available determination in accordance with paragraph 34 of the JI guidelines.

A.5. Project approval by the Parties involved:

The Project Idea Note had been submitted for review of the National Environmental Investment Agency of Ukraine. The National Environmental Investment Agency of Ukraine issued a Letter of Endorsement # 165/23/7 from 26th of January, 2011 for the project providing its support for further development of proposed joint implementation project.

In accordance with the "Requirements for the Joint Implementation Projects preparation" approved by National Environmental Investment Agency of Ukraine (Order #33 from 25th of June, 2008) to receive a Letter of Approval for the JI project the project proponent should provide to the National Environmental Investment Agency of Ukraine the final determination report of the proposed project along with project design documentation and the copy of Letter of Endorsement.

Therefore the final PDD will be sent along with the final determination report to the State Environmental Investment Agency of Ukraine for the Letter of Approval, which usually is expected within 30 days after PDD submission. After receiving the Letter of Approval from Ukraine the documents for receiving the Letter of Approval from Germany (written request for approval, project design document, final determination report, Letter of Approval of the Host country) will be submitted to the designated focal point in Germany (German Emissions Trading Authority (Deutsche Emissionshandelsstelle, DEHSt) within the Federal Environment Agency). Receiving of the Letter of Approval from Germany is expected during two months after documents submission.

SECTION B. Baseline

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

The baseline scenario has been established in accordance with Appendix B of the JI Guidelines and in accordance with the Guidance on Criteria for Baseline Setting and Monitoring by the JISC.

The Guidance on Criteria for Baseline Setting and Monitoring established by the JISC states: *'The baseline for a JI project is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of GHGs that would occur in the absence of the proposed project.'*

Taking into account guidelines mentioned above project participants established the baseline using JI specific approach by identifying and listing possible alternatives on the basis of conservative assumptions and identifying the most plausible one. The Approved consolidated baseline and monitoring methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects" Version 4.0.0[2] was analysed and some elements were used where appropriate. Namely, the approach for the defining of project boundaries (waste energy recovery and useful energy generation equipment, and distribution system for useful project energy) and greenhouse gases included in project boundaries (CO_2 only). Besides, the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12)[3] was also analyzed and the approach of baseline establishment based on the energy baseline (historical average energy consumption levels) of the equipment and technological processes within the project boundaries was partly applied.

Analysis of alternatives for the project activity

Plausible alternatives for the joint implementation project were examined based on the existing practice analysis, national and sectoral policies and project specific circumstances.

For the first part of the project (energy efficiency improvements during graphite products production including reconstruction of electrocalcinators, reconstruction of the calcination kiln and modernization of graphitizing process) the following alternatives were assumed:

- continuation of previously existing practice without implementation of energy efficiency improvements measures; and
- energy efficiency improvements introduction without being registered as joint implementation project.

For the second part of the project (waste energy utilization by means of utilization of heat from industrial processes (exhaust gases from furnaces) that would otherwise be wasted and its use for steam generation) the following alternatives were analyzed:

- continuation of existing practice continuing steam purchase from the nearby industrial facility;
- introduction of coal fired boilers for steam generation;
- introduction of exhaust boilers for waste energy utilization and subsequent steam generation without being registered as joint implementation project;
- introduction of exhaust boilers for waste energy utilization and subsequent steam and electricity generation.

[2] http://cdm.unfccc.int/methodologies/DB/L731WMCXLT0WE6ALG5AYAGLTJP7KW7/view.html

[3] http://cdm.unfccc.int/methodologies/DB/U8L8P68DK81OUF5X0KOR212O09NXYC/view.html

As for the second part of the Project, the alternative foreseeing continuation of the previously existed practice of buying steam from the nearby industrial facility could not be considered as plausible and realistic scenario for the project owner because of technical and economic reasons. In light of the potential changes in raw materials used for graphite products (from coal electrode pitch type B with the softening temperature of 67-73°C and optimal mixing temperature of 140°C to coal electrode pitch type C with the softening temperature of 85-90°C and optimal mixing temperature of 170°C) caused by the deficit of currently used coal electrode pitch type B the steam with higher temperature than supplied by nearby enterprise is needed. The temperature of the steam being supplied from the nearby industrial enterprise is 280°C and the pressure is 7 kg / sm^2 (the maximum mixing temperature that could be reached using steam from the nearby industrial enterprise is 165°C), while the steam characteristics needed is 320°C and 14 kg / sm^2. Besides, the fact that the steam is purchased from the nearby industrial facility brings the risk of steam shortage due lowering of steam generation volumes or stoppages at the facility, which is not under control of the project owner. The economic reasons are connected with the risk of significant increase of heat energy price. During the period 2008 – 2010 the price of heat energy generated by ZALK (nearby industrial facility) has increased by 122% from UAH 166.09 per Gkal at the beginning of 2008 to UAH 369.05 in September 2010.

The alternative foreseeing installation of exhaust boilers with steam and electricity generation using either backpressure or condensing type steam turbine was also excluded from consideration by the project owner due to unstable heat energy demand during the year, which could cause the stoppage of electricity generation during the periods of low heat energy demand and thus lowering the economic efficiency of the project, and also due to significantly higher investments costs (UAH 115,5 – 124,3 million in comparison with UAH 65,2 million VAT included for the project alternative).

Thus, for the both parts of the Project, the following two alternative scenarios to the project activity consistent with mandatory laws and regulations were assumed:

- continuation of previously existing practice without implementation of energy efficiency improvements measures and introduction of coal fired boilers for steam generation (Alternative 1);
- introduction of energy efficiency improvements and exhaust boilers for waste energy generation without being registered as joint implementation project (Alternative 2).

Alternative 1

Alternative 1 foreseeing continuation of previously existing practice without implementation of energy efficiency improvements measures and introduction of coal fired boilers for steam generation corresponds to national and sectoral policies and circumstances, such as national reform initiatives and local fuel availability and thus assumed as a plausible and realistic scenario.

Due to long period of low energy prices and lack of financial resources it is typical for Ukrainian industrial enterprises to continue operation using low energy efficient equipment and performing only basic maintenance of such equipment. Ukrainian industry has high energy intensive factors and even recent positive developments in decreasing of energy intensity of gross domestic products are caused mostly by the scale factor and has occurred against the small number of energy saving and modernization projects in the industry. Even the growth of energy sources prices has not led to the significant energy efficiency improvements due to not economically substantiated process of price formation (subsidies, transfer of the energy cost to the price of produced goods) and ineffective energy resources consumption accounting practices[4]. Factors that have contributed (and still contribute) to the

[4] National report on the status and perspectives of the state energy efficiency policy in 2008. Prepared by the National Agency of Ukraine on Ensuring of Efficient Use of Energy Resources

high energy intensity include slow restructuring of energy-intensive industries; old capital stock in the public, private and household sectors; and inadequate reforms of the heat and power sectors[5].

As for steam generation, it is also typical for Ukrainian industrial facilities to secure steam demand by own steam generation units.

Overall, heat is produced in Ukraine by boiler plants, thermal power plants, combined heat and power plants and nuclear power stations. In 2006 the share of boilers in overall heat generation was 63.8% on average in Ukraine and 67.4% of total heat generation in the region of project realisation (Zaporizhzhya region)[6].

Boilers are operated mainly on natural gas, coal and residual fuel oil. As Ukraine satisfies its demand in natural gas by importing more than 70 % of natural gas used, one of the main goals of its national energy policy is decrease in natural gas consumption[7]. According to the Decree of Cabinet of Ministers of Ukraine № 256-p[8] "On Immediate Actions for Decrease of Natural Gas Consumption for the Period up to 2010", total substitution of natural gas by alternative sources of energy, coal and RFO should be provided. The decree is in line with the National Energy Strategy of Ukraine. There are significant coal and lignite reserves in Ukraine (over 60 billion tonnes[9]) and there is also a potential for coal industry to expend and increase production. Thus, using coal as a fuel is the realistic and plausible alternative.

Alternative 2

Alternative 2 foresees introduction of energy efficiency improvements and exhaust boilers for waste energy generation without being registered as joint implementation project. This alternative foresees implementation of all measures of the project scenario but without being registering as joint implementation project and thus without additional revenues from ERUs sale. This alternative is a plausible scenario but it is not the most financially attractive for the project owner as shown in Section B.2 and thus cannot be considered as a baseline scenario.

Therefore, Alternative 1 – continuation of previously existing practice without implementation of energy efficiency improvements measures and introduction of coal fired boilers for steam generation – is the most plausible and realistic scenario without execution of joint implementation project and is considered as a baseline scenario.

Baseline scenario has been established on a project specific basis and using multi-project emission factor for electricity purchased from national grid.

Emission reductions will be defined based on monitoring data regarding actual electricity and natural gas consumption volumes, production volumes and heat energy generation volumes, and thus cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

---

[5] Financing Energy Efficiency Investments for Climate Change Mitigation Project. Investor Interest and Capacity Building Needs. – United Nations, New York and Geneva, 2010.

[6] Statistical book 'Fuel and Energy Sources of Ukraine – 2009'

[7] The Energy Strategy of Ukraine for the period up to 2030.
http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/archive/docview?typeId=44577

[8] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=256-2009-%F0

[9] http://www.mvp.gov.ua/mvp/control/uk/publish/article?art_id=71629&cat_id=52300&search_param=%D0%B7%D0%B0%D0%BF%D0%B0%D1%81%D0%B8+%D0%B2%D1%83%D0%B3%D1%96%D0%BB%D0%BB%D1%8F+%D0%B2+%D0%A3%D0%BA%D1%80%D0%B0%D1%97%D0%BD%D1%96&searchForum=1&searchDocarch=1&searchPublishing=1

The basic assumptions of the baseline methodology in the context of the project activity could be summarized as following:

- production volumes are assumed based on the historical and forecasted data from the enterprise as well as based on the technical characteristics of installed equipment; production volumes are conservatively assumed equal both in the baseline and project scenarios;
- specific electricity and natural gas consumption for electrocalcinators, calcination furnace and graphitizing furnaces was assumed based on historical data on electricity and natural gas consumption and production volumes at each stage of the technological process;
- emission factors for fossil fuels combustion (coal and natural gas) were assumed based on the default IPCC values;
- specific carbon dioxide non direct emissions factors for consumption of electricity generated by power stations of united energy system of Ukraine were assumed based on standardised determined values for each year of the crediting period (See Annex 2 for more details);
- net calorific values of the fossil fuels (coal and natural gas) were assumed based on the default IPCC and national values.

Detailed information about the parameters used to estimate baseline scenario greenhouse gases emissions within the project boundaries as well as key factors and data sources are clearly described in the tables below.

Data / Parameter	$P_{kiln,\ y}$
Data unit	tonne
Description	Production volumes by calcination kiln
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular updates of standardised tables of weights for each type of carbon blocks used for calculation of production volumes by calcination kiln based on control measurements of carbon blocks on calibrated electronic weights.
Any comment	

Data / Parameter	$SFC_{NG,\ kiln\ baseline}$
Data unit	m^3/tonne
Description	Specific natural gas consumption by the kiln in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last three years of kiln operation before reconstruction measures (2003-2005) based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	178
Justification of the choice of	Conservative. In line with the small scale methodology II.D. Energy

data or description of measurement methods and procedures (to be) applied	efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	**$NCV_{NG,y}$**
Data unit	GJ/1000 m^3
Description	Net calorific value for natural gas
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Supplier documentation
Value of data applied (for ex ante calculations / determinations)	Average natural gas net calorific value was applied for ex ante calculations; according to DBN V.2.5-20-2001 "Gas supply" NCV_{NG} = 34 GJ/1000 m^3
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	***EF_{NG}***
Data unit	kg CO_2/GJ
Description	CO2 emission factor for natural gas combustion
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO_2 emissions.
Value of data applied (for ex ante calculations / determinations)	56.1
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	Carbon emission factor for natural gas 15.3 tC/TJ reported in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) has been multiplied by 44/12 to be converted to CO_2 carbon emission factor.

Data / Parameter	***$P_{calcinators\ th,\ y}$***
Data unit	tonne
Description	Production of thermoanthracite by reconstructed electrocalcinators
Time of determination / monitoring	Parameter is monitored during the crediting period.

Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Quality control is assured by cross-checking of the values recorded by automatic control system and the values recorded manually by the operator of electrocalcinators.
Any comment	

Data / Parameter	$SEC_{calcinators\ th\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption for production of thermoanthracite by the electrocalcinators in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last three years of electrocalcinators operation before reconstruction measures (2004-2006) based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	1.397
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$P_{calcinators\ sq,\ y}$
Data unit	tonne
Description	Production of synthetic graphite by reconstructed electrocalcinators
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Quality control is assured by cross-checking of the values recorded by automatic control system and the values recorded manually by the operator of electrocalcinators.
Any comment	

Data / Parameter	$SEC_{cgraphitizing\ sg\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption for production of synthetic graphite by the graphitizing furnaces in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last three years of operation before reconstruction measures based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	3.575
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	EF_{grid}
Data unit	tonnes CO_{2e}/MWh
Description	Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	*See Annex 2*
Value of data applied (for ex ante calculations / determinations)	*See Annex 2*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the orders of the National environmental investments agency of Ukraine, which approve emission factors for electricity of Ukrainian grid recommended to be used for calculation of emission reductions due to joint implementation projects realization.
QA / QC procedures (to be) applied	
Any comment	For the period 2012-2020 the value for the year 2011 was used, however the value of the parameter would be changed in case of new emission factors for electricity of Ukrainian grid are properly approved.

Data / Parameter	$P_{graphitizing,\ y}$
Data unit	tonne
Description	Production volumes by graphitizing furnaces for 600 mm diameter electrodes production
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante	See Section E.

calculations / determinations)	
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular updates of standardised tables of weights for each type of carbon blocks used for calculation of graphitized electrodes production volumes based on control measurements of carbon blocks on calibrated electronic weights.
Any comment	

Data / Parameter	***SEC*** $_{graphitizing\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption by the graphitizing furnaces in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last two years (data before 2005 is not available due to introduction of automatic control system in 2005) of graphitizing furnaces operation for 600 mm diameter electrodes production before reconstruction measures (2005-2006) based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	6.425
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative.
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	***HG*** $_{exhaust\ boilers,\ y}$
Data unit	GJ
Description	Heat energy generation
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data are based on the technical characteristics of the equipment and thus reflect the most realistic forecast of heat energy generation volumes.
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations.
Any comment	

Data / Parameter	EF_{coal}
Data unit	kg/GJ
Description	Carbon dioxide emission factor for combustion of other bituminous coal
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO2 emissions.
Value of data applied (for ex ante calculations / determinations)	94.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	Carbon emission factor for other bituminous coal 25.8 tC/TJ reported in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) has been multiplied by 44/12 to be converted to CO_2 carbon emission factor.

Data / Parameter	$\dot{\eta}_{coal\ boilers}$
Data unit	%
Description	Coal boilers efficiency
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Technical documentation
Value of data applied (for ex ante calculations / determinations)	90%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative.
QA / QC procedures (to be) applied	
Any comment	

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

In accordance with Article 6 of the Kyoto Protocol a joint implementation project has to provide a reduction in emissions by sources, or an enhancement of net removals by sinks, which is additional to any that would otherwise occur. This supposes that the project scenario is not part of the identified baseline scenario and that the project will lead to reductions of anthropogenic emissions by sources of GHGs.

JI specific approach has been used to demonstrate that anthropogenic emissions of greenhouse gases will be reduced below those that would have occurred in the absence of project activity. Financial analysis and common practice analysis were used to demonstrate project additionality.

Realistic and credible alternatives available to the project participants (see Section B.1), that provide outputs comparable with the proposed joint implementation project activity are the following:

- continuation of previously existing practice without implementation of energy efficiency improvements measures and introduction of coal fired boilers for steam generation (Alternative 1);
- introduction of energy efficiency improvements and exhaust boilers for waste energy generation without being registered as joint implementation project (Alternative 2).

All alternatives are compliant with national law and regulations.

Financial Analysis

Financial analysis was used to demonstrate that proposed project activity is not the most financially attractive. Net present value indicator (NPV) was used to perform the analysis.

The following data on the investments schedule were used during the investment analysis.

Table B 2-1. Investments cost of the project (VAT excluded).

Year	2007	2008	2009	2010	2011
Kiln #10 reconstruction, UAH	51 959 035				
Electrocalcinators reconstruction, UAH	992 259		309 736		774 000
Graphitation ovens reconstruction, UAH	141 599				
Exhaust boilers introduction					
Design works, UAH				645 270	1 188 064
Construction and assembling works, UAH				9 146 671	10 919 996
Other costs, UAH				304 655	1 660 345
Equipment costs, UAH					30 454 167
Total investments, UAH	**53 092 893**		**309 736**	**10 096 596**	**44 996 571**

Financial analysis was performed assuming data available for the project owners at the time of making a decision about project realization, which is the end of 2006, and also taking into consideration conservative assumptions about price increase rates.

Information about the price of natural gas and electricity for the Enterprise as for the time of making a decision about project realization as well as information about other key data, which were used in the financial analysis, is presented in Table B 2-2 below. All prices are indicated with VAT excluded.

Table B 2-2. Assumptions used in the financial analysis

Coal price, UAH/tonne	242.52	Average price of coal in 2006 according to the data of the National electricity regulatory comission of Ukraine
Natural gas price, UAH / 1000 m3	639.12	Price for the Enterprise at the end of 2006. Data provided by the Enterprise
Electricity price for graphitising furnaces (2^{nd} class consumers), UAH / MWh	314.61	Price for the Enterprise at the end of 2006. Data provided by the Enterprise
Electricity price for electrocalcinators (1^{st} class	235.87	Price for the Enterprise at the end of 2006. Data provided by the Enterprise

consumers), UAH / MWh		
Discount rate, %	15%	Average loan rate in national currency for non-financial corporations in 2006 according to the data of the National Bank of Ukraine
ERU price, UAH	100	Market data
Assumed inflation rate, %	7.26%	Average inflation rate for the period five year period before project implementation (2001-2005) according to the date of the State statistics Committee of Ukraine

The results of the financial analysis are the following.

Table B 2-3. Results of the financial analysis

Scenario	NPVC, UAH
Baseline scenario	-60 134 944
Project scenario	-87 185 204
Project scenario with ERU sales	-72 040 338

The results of the financial analysis demonstrate that the project scenario is not the most financially attractive for the project owners.

Sensitivity analysis was used to demonstrate the robustness of the conclusion about project scenario economic attractiveness. Fluctuations of the following main input parameters were assumed during sensitivity analysis: electricity price, natural gas price, coal price. The results of the sensitivity analysis are provided below.

Table B 2-4. Results of the sensitivity analysis

Coal price change	**-10%**	**-5%**	**No change**	**5%**	**10%**
NPV Baseline	-56754951	-58444948	-60134944	-61824941	-63514937
NPV project	-87185204	-87185204	-87185204	-87185204	-87185204
NPV project with ERU sales	-72040338	-72040338	-72040338	-72040338	-72040338
Natural gas price change	**-10%**	**-5%**	**No change**	**5%**	**10%**
NPV Baseline	-60134944	-60134944	-60134944	-60884909	-60134944
NPV project	-84766684	-85975944	-87185204	-87018413	-89603725
NPV project with ERU sales	-69621818	-70831078	-72040338	-73249599	-74458859
Electricity price change	**-10%**	**-5%**	**No change**	**5%**	**10%**
NPV Baseline	-58635014	-59384979	-60134944	-60884909	-61634874
NPV project	-87518786	-87351995	-87185204	-88383728	-86851623
NPV project with ERU sales	-72373920	-72207129	-72040338	-71873547	-71706757

Besides the financial barrier the project faces a number of technical barriers and operation risks. As it was stated above the project uses state-of-the-art technology, which is based on the latest scientific research and developments efforts, and thus faces technological barriers and technological risks of proper equipment operation (decrease of efficiency over time, need of additional technological improvements etc.). The proposed project improves energy efficiency of production processes and the returns on investment depend on the production volume. Thus, lower production volumes will cause less attractive economic performance and using of Kyoto protocol flexible mechanisms allows minimizing this barrier.

Common practice analysis

Ukrainian industry is characterised by high energy intensity level with the GDP energy intensity factor 2.6 times larger than world average. High GDP energy intensity is caused by significant technological inferiority in most industries of the economy due to use of old energy intensive technologies and equipment and not rational energy resources consumption[10].

In Zaporizhzhya region the dominant share in industry also belongs to high resource and energy intensive sectors with energy intensive technologies and low level of the application of innovative energy saving and resource saving technologies. Energy efficiency improvements at the industrial enterprises of the region are supposed to be implemented in accordance with the «Complex program of effective energy resources consumption in Zaporizhzhya region for the period 2007-2010». However, the program lacks the analysis of priority technologies for implementation in the region and the main energy efficiency improvements measures for the industrial enterprises were included in the last stage of the program, which demands the largest financial resources for implementation. At the same time, the investments are supposed to be secured mostly by the enterprises itself and without any significant state support. Thus, most of the claims on investments in energy efficiency remain declarative only[11].

Generally in the Ukrainian industry continuation of the outdated equipment operation is a common practice due to lack of financial resources and high cost of credit financing as well as high investment risks in the country. Most of the modernisation projects are being implemented with the additional economic incentives such as low cost international financing or using flexible mechanisms of Kyoto protocol and involving additional investments due to sale of emission reduction units. Namely, there are a number of joint implementation projects, which are being realized in Ukraine at the moment, having been triggered by carbon financing (the baseline scenario is the continuation of the previously existed practice of using outdated equipment) in different sectors of the economy (thermal power stations reconstruction, energy efficiency improvements in sugar industry, energy efficiency improvements in metallurgical industry etc.).

Summing up, it could be concluded that it is common practise for Ukraine to continue exploitation of low efficient and energy intensive equipment.

The similar conclusion is reached based on the analysis of waste heat utilisation in Ukraine and in the region of project realization. Overall, the share of heat energy generated by waste heat utilisation installations in the total heat energy generation was about 7.7% in Ukraine during the period 2006-2008 and about 6% in Zaporizhzhya region during the same period.

	2006	**2007**	**2008**
Heat energy generation in Ukraine, 1000 Gkal	181 663	167 446	159 600
Heat energy generation by waste heat utilising installations in Ukraine, 1000 Gkal	12 892	14 004	11 935
Heat energy generation in Zaporizhzhya region, 1000 Gkal	8917	8 317	7 959
Heat energy generation by waste heat utilising installations in Zaporizhzhya region, 1000 Gkal	511	495	498

Source of the data: Statistical book 'Fuel and Energy Sources of Ukraine – 2009'

[10] Sectoral program of reducing natural gas consumption by industrial enterprises of Ministry of Industrial Policy and measures of its realization. Approved by the Order #238 of Ministry of Industrial Policy from 30.03.2009. Available online as for 04.02.2011 at http://industry.kmu.gov.ua/control/uk/publish/article;jsessionid=1EAD21815804D614833BA7668437C5BA?art_id=71627&cat_id=71619

[11] P. Flemings and others. Current status on energy saving and low carbon technologies introduction in Doneck, Zaporizhzhya, Lugansk and Dnipropetrovsk regions. – DMGO 'Ecodonbas', 2010. – 44 p.

The overall amount of heat energy generation equals to about 1.85 million tonnes of coal equivalent (average for the period 2006-2008). At the same time the growth potential of heat energy generation by the secondary energy resources (waste energy sources) according to Energy strategy of Ukraine till 2030 is 2.93 million tonnes of coal equivalent till 2015 and 3.59 million tonnes of coal equivalent till 2030[12]. In metallurgical industry, despite the large potential of waste heat utilisation (up to 35% of total heat demand of the enterprises) the majority of heat energy is being produced by boilers[13].

Therefore, despite the significant potential waste energy utilisation for heat energy generation is not a common practice technology in Ukraine.

Thus, based on financial analysis and common practice analysis it could be concluded that the project is additional and greenhouse emission reductions would not have been occurred in the absence of joint implementation activity.

Therefore, the most plausible and realistic scenario without realization of proposed joint implementation project (baseline scenario) is the continuation of previously existed practice without implementation of energy efficiency improvements measures and introduction of coal fired boilers for steam generation. The amount of energy used for production purposes under the baseline scenario is assumed equal to the amount of energy calculated based on average specific energy consumption for each technological process within the project boundaries during three years before project implementation. All waste energy that will be utilised in the project activity would be released to atmosphere under the baseline scenario. Steam generation would have been secured by coal fired boilers without implementation of project activity. Project scenario foresees introduction of energy efficiency improvements and exhaust boilers for waste energy generation.

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

Project boundaries include the sources of all significant greenhouse gases emissions that are under control of the project participants and connected with project activity, namely fossil fuels consumption for heat energy generation, electricity consumption by electrocalcinators and graphitizing furnaces and natural gas consumption by the kiln.

The project boundaries include workshop #2 of JSC “Ukrgrafit”, where reconstructed electrocalcinators are located, workshop #4, where the graphitizing furnaces are located, and workshop #3, where the calcination kiln #10 is located (workshops, where the energy efficiency measures were implemented). Besides, project boundaries include the industrial facility (boiler room), where heat in form of steam is being generated using waste energy of industrial process and equipment providing auxiliary heat to the waste energy recovery process (using natural gas as an additional fuel source).

Only CO_2 emissions concerned with fossil fuel combustions and electricity generation are included in the project boundary and addressed in PDD. CH_4 emissions and NO_x emissions were considered negligibly low and were not taken into consideration.

[12] Energy Strategy of Ukraine till 2030. Approved by the Order of Cabinet of Ministers of Ukraine #145-p from 15.03.2006 Available online as for 04.02.2011 at http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=145%E0-2006-%F0

[13] Sectoral program of reducing natural gas consumption by industrial enterprises of Ministry of Industrial Policy and measures of its realization. Approved by the Order #238 of Ministry of Industrial Policy from 30.03.2009. Available online as for 04.02.2011 at http://industry.kmu.gov.ua/control/uk/publish/article;jsessionid=1EAD21815804D614833BA7668437C5BA?art_id=71627&cat_id=71619

Table B 3-1. Sources of emissions included in consideration or excluded of it

	Source	Gas	Incl./Excl.	Justification/Explanation
Baseline	Emissions due to fossil fuel combustion for heat energy (steam) generation	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to fossil fuel combustion for calcination of carbon fillers	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to electricity generation by power plants of the national grid used for electrocalcinators operation	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to electricity generation by power plants of the national grid used for graphitising process	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
Project	Emissions due to suplemental fossil fuel combustion for heat energy generation by exhaust boilers	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to fossil fuel combustion for calcination of carbon fillers	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to electricity generation by power plants of the national grid used for electrocalcinators operation	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative
	Emissions due to electricity generation by power plants of the national grid used for graphitising process	CO_2	Incl.	**Main source of emissions**
		CH_4	Excl.	Considered negligible. Conservative
		N_2O	Excl.	Considered negligible. Conservative

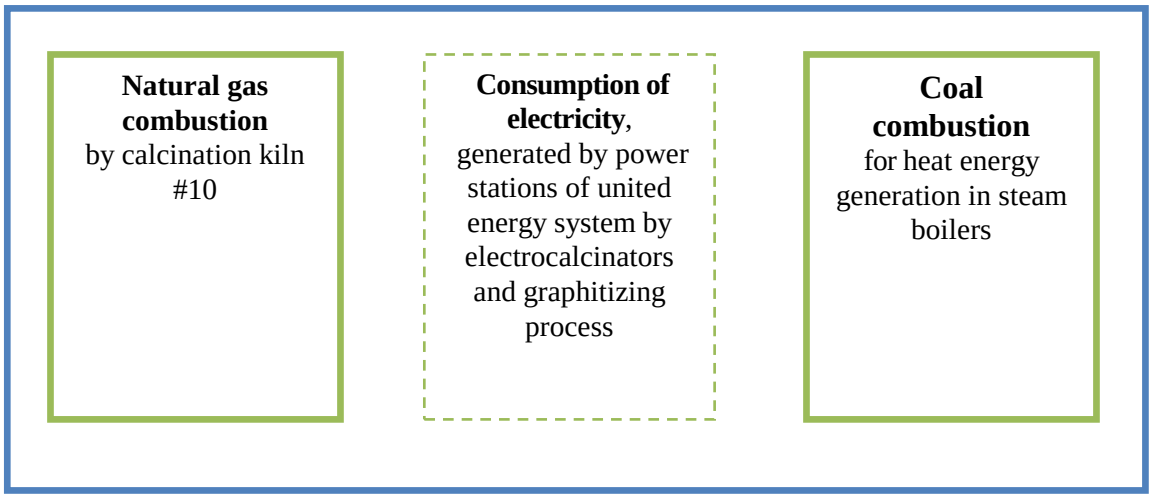

Fig. B-3.1 The scheme of project boundaries under the baseline scenario.

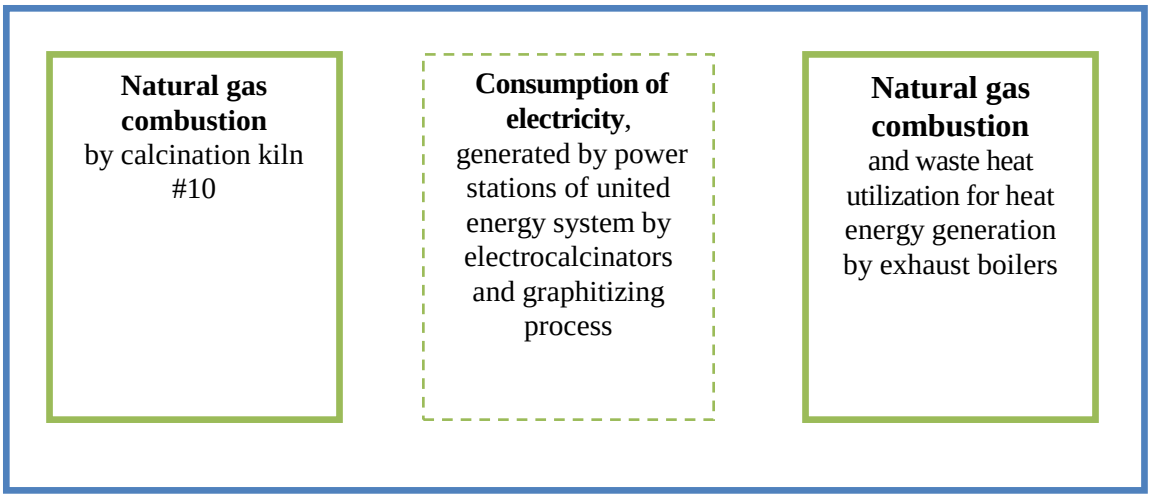

Fig. B-3.2 The scheme of project boundaries under the project scenario.

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

Date: 27/04/2011

The information about the organization, which is responsible for setting the baseline and developed project design documentation, is presented below.

LLC 'KT-Energy' (registered in Ukraine)
15 B/22 Biloruska st., Kiev, 04119, Ukraine
Tel/Fax. + (38 044) 493 83 32, info@kt-energy.com.ua

Kyryl Tomlyak, Director
ktomlyak@kt-energy.com.ua
+38 (044) 493 83 32

LLC 'KT-Energy' is not a project participant listed in annex 1.

SECTION C. Duration of the small-scale project / crediting period

C.1. Starting date of the small-scale project:

Project realization start date is the 4th of October, 2006.

C.2. Expected operational lifetime of the small-scale project:

Expected operational lifetime of the project is 15 years (or 180 months).

C.3. Length of the crediting period:

According to Glossary of Joint Implementation Terms ('Glossary of Joint Implementation Terms', Version 3), approved at 22nd meeting of Joint Implementation Supervisory Committee, crediting period is the period for which reductions in anthropogenic emissions by sources or enhancements of anthropogenic removals by sinks may be determined by an Accredited independent entity. Projects starting as of 2000 may be eligible as JI projects if they meet the requirements of the JI guidelines, but ERUs shall only be issued for a crediting period starting after the beginning of 2008. The project participants shall choose the starting date of the crediting period to be on or after the date the first emission reductions are generated by the JI project and the crediting period shall not extend beyond the operational lifetime of the project.

Start of the crediting period for proposed project activity is 1st of January, 2008.

End of the first crediting period is December 31st, 2012.

Thus, the length of the first commitment period is 5 years (60 months).

The start date of the second commitment period is expected to be January 1st, 2013 and the end date of the second commitment period is expected to be December 31st, 2020. The length of the second commitment period is expected to be 8 years or 96 months. The second commitment period does not extend beyond the operational lifetime of the project and is a subject to the Host Party approval. The length of the expected second commitment period could be changed based on adopted international or national regulations. The estimates of emission reductions are presented separately for the first and second commitment periods in section E below.

Thus, the length of the crediting period is 13 years (156 months).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

JI specific approach was chosen for monitoring of greenhouse emission reductions in accordance with paragraph 9 (a) of the 'Guidance on criteria for baseline setting and monitoring'. Detailed theoretical description, assumptions, formulae, data sources and key factors used in the monitoring plan is described below.

Monitoring plan ensures the collection and archiving of all relevant data necessary for measuring anthropogenic emissions and calculation of GHGs emission reductions occurring within the project boundary during the crediting period. Monitoring plan provides also quality assurance and control procedures for the monitoring process and procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed JI project.

Monitoring plan is established in accordance with Host Party regulations, namely in accordance with Decree of Cabinet of Ministers of Ukraine #206 dated 22.02.2006 'On Approval of the Procedure of Drafting, Review, Approval and Implementation of Projects Aimed at Reduction of Anthropogenic Emissions of Greenhouse Gases' and "Requirements for the Joint Implementation Projects preparation" approved by National Environmental Investment Agency of Ukraine (Order #33 from 25th of June, 2008).

The monitoring plan will serve to trace Project Emissions, Baseline Emissions and to calculate Emission Reductions in accordance with the gathered data fixed by direct measurement of specific related parameters through the application of technical devices and calculations.

Project owner has developed and enforced the system of monitoring of GHG emission reductions at the Enterprise, which defines the procedure of gathering and storing of necessary data and responsibility. Electricity and fossil fuel consumption data will be gathered and submitted to the monthly monitoring reports by the energy resources consumption and electricity consumption accounting groups of workshop #9 based on the data from the relevant workshops and automatic control systems. Data on production volumes will be obtained from the explanatory notes of the monthly technical reports of the relevant workshops.

Monitoring data will be archived in paper and electronic form.

Based on the collected data the annual monitoring reports on actual GHG emission reductions due to implementation of JI project will be prepared. The monitoring reports must be delivered by the contractual party to an accrediting independent entity (AIE) at regular intervals. This entity examines the reports. Monitoring data will be kept for at least 2 years after the end of the crediting period or the last transfer of ERUs.

Detailed information relating to the collection and archiving of all relevant data necessary for estimating or measuring project emissions, determining baseline emissions, and assessing leakage effects provided below.

Formulae used to calculate Emission reductions

Emission reductions for the project are estimated as the difference between baseline and project emissions:

$$ER_y = BE_y - PE_y \quad (1)$$

Formulae used to calculate Project emissions

Project greenhouse gases emissions are connected with fossil fuel consumption for heat energy generation by the exhaust boilers, natural gas consumption for the calcination kiln operation and electricity consumption for electrocalcinators and graphitizing furnaces operation.

$$PE_y = PE_{FF,\ kiln,\ y} + PE_{EL,\ calcinators.,\ y} + PE_{EL,\ graphitizing,\ y},\ +\ PE_{FF,\ exhaust\ boilers,\ y} \quad (2.0)$$

where,

$PE_{FF,\ kiln,\ y}$ – project emissions due to natural gas combustion in the kiln, tonnes CO_{2e};

$PE_{EL,\ calcinators.,\ y}$ – project emissions due to electricity consumption by the electrocalcinators, tonnes CO_{2e};

$PE_{EL,\ graphitizing,\ y}$ – project emissions due to electricity consumption by the graphitizing furnaces, tonnes CO_{2e};

$PE_{FF,\ exhaust\ boilers,\ y}$ – project emissions due to supplementary consumption of fossil fuel by the exhaust boilers, tonnes CO_{2e};

$$PE_{FF,\ kiln,\ y} = FC_{NG,\ kiln\ project,\ y} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3} \quad (2.1)$$

where

$FC_{NG,\ kiln\ project,\ y}$ – natural gas consumption by the kiln in the project scenario, 1000 m^3;

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

EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ

$$PE_{EL,\ calcinators.,\ y} = (EC_{\ calcinators\ th\ project,\ y} + EC_{\ calcinators\ sg\ project,\ y}) \cdot EF_{grid} \quad (2.2)$$

where

$EC_{\ calcinators\ th\ project,\ y}$ – electricity consumption for production of thermoanthracite by electrocalcinators in the project scenario, MWh.

$EC_{\ calcinators\ sg\ project,\ y}$ – electricity consumption for synthetic graphite production by electrocalcinators in the project scenario, MWh.

EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$PE_{EL,\ graphitizing,\ y} = EC_{\ graphitizing\ project,\ y} \cdot EF_{grid} \quad (2.3)$$

where

$EC_{\ graphitizing\ project,\ y}$ – electricity consumption by the graphitizing furnaces in the project scenario, MWh.

EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$PE_{FF,\ exhaust\ boilers,\ y} = (FC_{NG,\ exhaust\ boilers,\ y} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3}) + (FC_{GP,\ exhaust\ boilers,\ y} \cdot NCV_{GP} \cdot EF_{GP} \cdot 10^{-3}) \quad (2.4)$$

where

$FC_{NG,\ boilers,\ y}$ – supplementary consumption of fossil fuel (natural gas) by the exhaust boilers for heat energy generation during the year *y*, 1000 m^3;

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

EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ;

$FC_{GP,\ exhaust\ boilers,\ y}$ – supplementary consumption of graphite powder by the exhaust boilers for heat energy generation during the year *y*, tonne;

NCV_{GP} – net calorific value of graphite powder, GJ/tonne;

EF_{GP} – carbon dioxide emission factor for combustion of graphite powder, tonnes CO_2/GJ.

Formulae used to calculate Baseline scenario emissions

Baseline greenhouse gases emissions are connected with fossil fuel (coal) consumption for heat energy generation by steam boilers, natural gas consumption for the operating of the kiln and electricity consumption for the operating of electrocalcinators and graphitizing furnaces.

$$BE_y = BE_{FF,\ kiln,\ y} + BE_{EL,\ calcinators.,\ y} + BE_{EL,\ graphitizing,\ y} + BE_{FF,\ coal\ boilers,\ y} \quad (3.0)$$

where,

$BE_{FF,\ kiln,\ y}$ – baseline emissions due to natural gas combustion in the kiln, tonnes CO_{2e};
$BE_{EL,\ calcinators.,\ y}$ – baseline emissions due to electricity consumption by the electrocalcinators, tonnes CO_{2e};
$BE_{EL,\ graphitizing,\ y}$ – baseline emissions due to electricity consumption by the graphitizing furnaces, tonnes CO_{2e};
$BE_{FF,\ coal\ boilers,\ y}$ – baseline emissions due to fossil fuel (coal) combustion for heat energy generation, tonnes CO_{2e};

$$BE_{FF,\ kiln,\ y} = P_{kiln,\ y} \cdot SFC_{NG,\ kiln\ baseline} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3}, \quad (3.1)$$

Where
$P_{kiln,\ y}$ – production volumes by calcination kiln, tonnes.
$SFC_{NG,\ kiln\ baseline}$ – specific natural gas consumption by the kiln in the baseline scenario, 1000 m^3/tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data;
NCV_{NG} – net calorific value of the natural gas, GJ/1000 m^3;
EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ.

$$BE_{EL,\ calcinators.,\ y} = P_{calcinators\ th,\ y} \cdot SEC_{calcinators\ th\ baseline} \cdot EF_{grid} \quad (3.2)$$

Where
$P_{calcinators\ th,\ y}$ – production of thermoanthracite by reconstructed electrocalcinators, tonnes.
$SEC_{calcinators\ th\ baseline}$ – specific electricity consumption for production of thermoanthracite by the electrocalcinators in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$BE_{EL,\ graphitizing,\ y} = (P_{graphitizing,\ y} \cdot SEC_{graphitizing\ baseline} + P_{calcinators\ sg,\ y} \cdot SEC_{cgraphitizing\ sg\ baseline}) \cdot EF_{grid} \quad (3.3)$$

Where
$P_{graphitizing,\ y}$ – production volumes of graphitizing furnaces, tonnes.
$SEC_{graphitizing\ baseline}$ – specific electricity consumption by the graphitizing furnaces in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
$P_{calcinators\ sg,\ y}$ – production of synthetic graphite by reconstructed electrocalcinators, tonnes.
$SEC_{cgraphitizing\ sg\ baseline}$ – specific electricity consumption for production of synthetic graphite by the graphitizing furnaces in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$BE_{FF,\ coal\ boilers,\ y} = HG_{exhaust\ boilers,\ y} \cdot EF_{coal} / \dot{\eta}_{coal\ boilers}, \quad (3.4)$$

where
$HG_{exhaust\ boilers,\ y}$ – heat energy generation during the year *y*, GJ;

EF_{coal} – carbon dioxide emission factor for combustion of other bituminous coal, tonnes CO_{2e}/GJ.
$\dot{\eta}_{coal\ boilers}$ – coal boilers efficiency, %.

Table D 1-1. Data to be collected in order to monitor baseline and project emissions

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)
$FC_{NG,\ kiln\ project,\ y}$ Natural gas consumption by the kiln	Natural gas meter	m^3	m	Daily	100%	Electronic / Paper
NCV_{NG} Net calorific value of natural gas	Suppliers data	GJ/ 1000 m^3	m	Monthly	100%	Paper
$P_{kiln,\ y}$ Production volumes by calcination kiln	Operational journals	tonnes	m/c	Monthly	100%	Electronic / Paper
$EC_{calcinators\ th\ project,\ y}$ Electricity consumption for production of thermoanthracite by electrocalcinators	Power meters	MWh	m	Daily	100%	Electronic / Paper
$P_{calcinators\ th,\ y}$ Production of thermoanthracite by reconstructed electrocalcinators	Operational journals	tonnes	m/c	Daily	100%	Electronic / Paper
$EC_{calcinators\ sg\ project,\ y}$ Electricity consumption for synthetic graphite production by electrocalcinators	Power meters	MWh	m	Daily	100%	Electronic / Paper
$P_{calcinators\ sg,\ y}$ Production of synthetic graphite by reconstructed electrocalcinators	Operational journals	tonnes	m/c	Daily	100%	Electronic / Paper
$EC_{graphitizing\ project,\ y}$ Electricity consumption by the graphitizing furnaces	Power meter	MWh	m	Daily	100%	Electronic / Paper
$P_{graphitizing,\ y}$ Production volumes of graphitizing furnaces	Operational journals	tonnes	m/c	Monthly	100%	Electronic / Paper
$FC_{NG,\ boilers,\ y}$ Supplementary consumption of fossil fuel (natural gas) by the exhaust boilers for heat energy generation	Natural gas meter	m^3	m	Daily	100%	Electronic / Paper

$FC_{GP,\ exhaust\ boilers,\ y}$ Supplementary consumption of graphite powder by the exhaust boilers for heat energy generation	Crane scale	tonnes	m	Daily	100%	Paper
$HG_{\ exhaust\ boilers,\ y}$ Heat energy generation	Heat meter	GJ	m	Daily	100%	Electronic / Paper

D.2. Data to be monitored:

Data to be monitored and parameters used in the calculations are described in the single tables below.

Data / Parameter	$P_{\ kiln,\ y}$
Data unit	tonne
Description	Production volumes by calcination kiln
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular updates of standardised tables of weights for each type of carbon blocks used for calculation of production volumes by calcination kiln based on control measurements of carbon blocks on calibrated electronic weights.
Any comment	

Data / Parameter	$FC_{NG,\ kiln\ project,\ y}$
Data unit	1000 m^3
Description	Natural gas consumption by the kiln in the project scenario
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Natural gas meter
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Natural gas metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Accuracy class index of natural gas meter is 1.0.
Any comment	

Data / Parameter	$SFC_{NG,\ kiln\ baseline}$
Data unit	m^3/tonne
Description	Specific natural gas consumption by the kiln in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last three years of kiln operation before reconstruction measures (2003-2005) based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	178
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$NCV_{NG,y}$
Data unit	GJ/1000 m^3
Description	Net calorific value for natural gas
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Supplier documentation
Value of data applied (for ex ante calculations / determinations)	Average natural gas net calorific value was applied for ex ante calculations; according to DBN V.2.5-20-2001 "Gas supply" NCV_{NG} = 34 GJ/1000 m^3
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be based on the approved documents of natural gas supplier obtained from the measurements at accredited laboratory and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	EF_{NG}
Data unit	kg CO_2/GJ
Description	CO_2 emission factor for natural gas combustion
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO2 emissions.
Value of data applied (for ex ante calculations / determinations)	56.1
Justification of the choice of data or description of	The choice of data is based on the standardised and approved value and thus assumed as conservative.

measurement methods and procedures (to be) applied	
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$P_{calcinators\ th,\ y}$
Data unit	tonne
Description	Production of thermoanthracite by electrocalcinators
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Quality control is assured by cross-checking of the values recorded by automatic control system and the values recorded manually by the operator of electrocalcinators.
Any comment	

Data / Parameter	$EC_{calcinators\ th\ project,\ y}$
Data unit	MWh
Description	Electricity consumption for production of thermoanthracite by electrocalcinators in the project scenario
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Power meter
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Power metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Information about accuracy class indexes of power meters is presented in Section D.3.
Any comment	

Data / Parameter	$SEC_{calcinators\ th\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption for production of thermoanthracite by the electrocalcinators in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value based on the historical data of the enterprise.
Value of data applied (for ex ante calculations / determinations)	1.397
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$P_{calcinators\ sq,\ y}$
Data unit	tonne
Description	Production of synthetic graphite by reconstructed electrocalcinators
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	Quality control is assured by cross-checking of the values recorded by automatic control system and the values recorded manually by the operator of electrocalcinators.
Any comment	

Data / Parameter	$EC_{calcinators\ sq\ project,\ y}$
Data unit	MWh
Description	Electricity consumption for synthetic graphite production by electrocalcinators in the project scenario
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Power meter
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.

QA / QC procedures (to be) applied	Power metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Information about accuracy class indexes of power meters is presented in Section D.3.
Any comment	

Data / Parameter	$SEC_{cgraphitizing\ sq\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption for production of synthetic graphite by the graphitizing furnaces in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value for the last three years of operation before reconstruction measures based on the historical data of the enterprise was assumed.
Value of data applied (for ex ante calculations / determinations)	3.575
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative. In line with the small scale methodology II.D. Energy efficiency and fuel switching measures for industrial facilities (Version 12).
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	EF_{grid}
Data unit	tonnes CO_{2e}/MWh
Description	Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	*See Annex 2*
Value of data applied (for ex ante calculations / determinations)	*See Annex 2*
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the orders of the National environmental investments agency of Ukraine, which approve emission factors for electricity of Ukrainian grid recommended to be used for calculation of emission reductions due to joint implementation projects realization.
QA / QC procedures (to be) applied	
Any comment	For the period 2012-2020 the value for the year 2011 was used, however the value of the parameter would be changed in case of new emission factors for electricity of Ukrainian grid are properly approved.

Data / Parameter	$P_{graphitizing, y}$
Data unit	tonne
Description	Production volumes by graphitizing furnaces
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Technical reports of the workshop
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The source of information has been chosen according to the procedures established at the enterprise and existing accounting practices at the enterprise.
QA / QC procedures (to be) applied	QA / QC is assured by regular updates of standardised tables of weights for each type of carbon blocks used for calculation of graphitized electrodes production volumes based on control measurements of carbon blocks on calibrated electronic weights.
Any comment	

Data / Parameter	$EC_{graphitizing\ project, y}$
Data unit	MWh
Description	Electricity consumption by the graphitizing furnaces in the project scenario
Time of determination / monitoring	Parameter is monitored during the crediting period.
Source of data (to be) used	Power meter
Value of data applied (for ex ante calculations / determinations)	See Section E.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Power metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Information about accuracy class index of power meter is presented in Section D.3.
Any comment	

Data / Parameter	$SEC_{graphitizing\ baseline}$
Data unit	MWh / tonne
Description	Specific electricity consumption by the graphitizing furnaces in the baseline scenario
Time of determination / monitoring	Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
Source of data (to be) used	Average value based on the historical data of the enterprise.
Value of data applied (for ex ante calculations / determinations)	6.425
Justification of the choice of	Conservative.

data or description of measurement methods and procedures (to be) applied	
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$HG_{exhaust\ boilers,\ y}$
Data unit	GJ
Description	Heat energy generation
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Heat energy meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Heat energy metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Accuracy class index of heat energy meter is 0.5.
Any comment	

Data / Parameter	$FC_{NG,\ exhaust\ boilers,\ y}$
Data unit	1000 m^3
Description	Supplementary consumption of fossil fuel (natural gas) by the exhaust boilers for heat energy generation during the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Natural gas meter
Value of data applied (for ex ante calculations / determinations)	For ex ante calculations the value estimated based on technical documentation.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Natural gas metering equipment will be calibrated regularly in accordance with producer requirements and national regulations. Accuracy class index of natural gas meter is 0.3.
Any comment	

Data / Parameter	$FC_{GP,\ exhaust\ boilers,\ y}$
Data unit	tonne
Description	Supplementary consumption of graphite dust by the exhaust boilers for heat energy generation during the year *y*
Time of determination / monitoring	Parameter is monitored during the crediting period
Source of data (to be) used	Crane scale
Value of data applied (for ex ante calculations / determinations)	Assumed to be equal zero, because it is not foreseen to use graphite powder as a fuel because of its value as a product for potential use in the metallurgical industry.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Data will be collected within the approved monitoring procedures and using calibrated metering equipment.
QA / QC procedures (to be) applied	Accuracy class index of crane scale is 0.1. Data could be crosschecked based on the technical characteristics of graphite powder burner and time of operation using graphite powder.
Any comment	

Data / Parameter	$\mathbf{NCV_{GP,y}}$
Data unit	GJ/ tonne
Description	Net calorific value for graphite powder
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Technical documentation of exhaust boilers construction project ($\mathbf{NCV_{GP,y}}$ = 24.6 GJ/ tonne)
Value of data applied (for ex ante calculations / determinations)	Parameter is not used in ex ante calculations because the amount of graphite powder combusted in exhaust boilers is assumed to be equal zero.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	$\boldsymbol{EF_{GP}}$
Data unit	kg CO_2/GJ
Description	CO_2 emission factor for graphite powder combustion
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	The conservative value of carbon dioxide emission factor for Industrial Wastes from 2006 IPCC Guidelines for national greenhouse gas inventories, Volume 2: Energy, Table 1.4 Default CO2 emission factors for combustion will be used $\boldsymbol{EF_{GP}}$ = 143 kg CO_2/GJ.
Value of data applied (for ex ante	Parameter is not used in ex ante calculations because the amount of graphite powder combusted in exhaust boilers is assumed to be

calculations / determinations)	equal zero.
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative.
QA / QC procedures (to be) applied	
Any comment	

Data / Parameter	EF_{coal}
Data unit	kg/GJ
Description	Carbon dioxide emission factor for combustion of other bituminous coal
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) converted to CO2 emissions.
Value of data applied (for ex ante calculations / determinations)	94.6
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The choice of data is based on the standardised and approved value and thus assumed as conservative.
QA / QC procedures (to be) applied	
Any comment	Carbon emission factor for other bituminous coal 25.8 tC/TJ reported in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-2 on Page 1.6 of the Workbook) has been multiplied by 44/12 to be converted to CO_2 carbon emission factor.

Data / Parameter	$\dot{\eta}_{coal\ boilers}$
Data unit	%
Description	Coal boilers efficiency
Time of determination / monitoring	Parameter is not monitored during the crediting period
Source of data (to be) used	Technical documentation
Value of data applied (for ex ante calculations / determinations)	90%
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Conservative.
QA / QC procedures (to be) applied	
Any comment	

There are also established procedures of monitoring, collecting, and archiving of data on the environmental impacts of the project, namely emissions of pollutants into the atmospheric air. The control on the compliance with the maximum permissible emission of the polluting substances into the atmospheric air is carried out by the certified laboratory of environmental protection.

Besides, the enterprise files reports by the following official statistical forms:

- 2-tp (air) *Data on protection of atmospheric air*, which contains information on amounts of trapped and neutralized atmospheric pollutants, itemized emissions of specific pollutants, number of emission sources, measures on reduction of emissions into the atmosphere, emissions from particular groups of pollution sources;

- 2-tp (water resources) *Data on water use*, which presents information on consumption of water from natural sources, discharge of waste water, and content of pollutants in it, capacity of treatment facilities, etc.;

- 2-tp (waste) *Data on formation, use, neutralization, transportation and placement of industrial and household waste*, which presents the annual balance of waste flow, by waste types and hazard classes.

Data are monitored with compliance to Law of Ukraine "On metrology and metrological activities'.

D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
$P_{kiln,\ y}$	*low*	*Production volumes are defined based on the amount of carbon blocks calcinated and standardised tables of weights for each type of carbon blocks. The standardised tables are being updated regularly based on control measurement of carbon blocks on calibrated electronic weights.*
$FC_{NG,\ kiln\ project,\ y}$	*low*	*Devices used: natural gas meter G250-LG-10/100-1/20-16-1. Accuracy class index – 1.0. Natural gas meter was installed in 2008 and is calibrated once per 2 years.*
$NCV_{NG,y}$	*low*	*Devices used: data is provided by natural gas supplier on a monthly basis. In case of absence of the data the default value of 34 GJ/1000 m^3 according to DBN V.2.5-20-2001 "Gas supply" could be used.*
$P_{calcinators\ th,\ y}$	*low*	*Production volumes are defined based on the data of batcher (metering unit) located at the unloading zone of each electrocalcinator and the weight of each batch, which is defined and recorded by the operator of electrocalcinators. Data are recorded by automatic control system.*
$EC_{calcinators\ project\ th,\ y}$	*low*	*Devices used: power meters Ф442 (installed in 1995 and calibrated once per 4 years; accuracy class index – 2.0.) and A1200-10MR3T (installed in 2008 and calibrated once per 6 years; accuracy class index – 1.0.) at electrocalcinator #7; power meter A1200-1BR4T (installed in 2008 and calibrated once per 6 years; accuracy class index – 1.0.) at electrocalcinator #5; power meter A1200-10R4T (installed in 2006 and calibrated once per 6 years; accuracy class index – 1.0.) at electrocalcinator #2.*

$P_{calcinators\ sg,\ y}$	*low*	*Production volumes are defined based on the data of batcher (metering unit) located at the unloading zone of each electrocalcinator and the weight of each batch, which is defined and recorded by the operator of electrocalcinators.*
$EC_{calcinators\ project\ sg,\ y}$	*low*	*Devices used: power meter Ф442 (installed in 1995 and calibrated once per 4 years; accuracy class index – 2.0.) at electrocalcinator #4.*
$P_{graphitizing,\ y}$	*low*	*Production volumes are defined based on the amount of carbon blocks graphitized and standardised tables of weights for each type of carbon blocks. The standardised tables are being updated regularly based on control measurement of carbon blocks on calibrated electronic weights. Data is collected by automatic control system "Graphitization", which has a mechanism of reserve copying.*
$EC_{graphitizing\ project,\ y}$	*low*	*Devices used: power meter A1200-10R4T. Accuracy class index – 1.0. Electricity meter was installed in 2006 and has been calibrated in the 1st quarter of 2006. Power meter will be calibrated once per 6 years. Data is collected by automatic control system "Graphitization", which has a mechanism of reserve copying.*
$HG_{exhaust\ boilers,\ y}$	*low*	*Devices used: two analog sensors of pressure difference "Safir M"-XXXX-02-УХЛ.1. Accuracy class index – 0.5. The sensor will be installed in 2011 and will be calibrated once per 2 years. Data is supposed to be collected by automatic control system.*
$FC_{NG,\ exhaust\ boilers,\ y}$	*low*	*Devices used: natural gas meter G1600-LG-K-200-1/30-1.6-1-Ex. Accuracy class index – 0.3. Natural gas meter will be installed in 2011 and will be calibrated once per 2 years. Data is supposed to be collected by automatic control system.*
$FC_{GP,\ exhaust\ boilers,\ y}$	*low*	*Devices used: crane scale CASTON-II. Accuracy – 0,1%.*

All measurement equipment is calibrated according to national regulations. Besides, quality control and quality assurance procedures for data monitored are assured by the general quality management system (ISO 9001) enforced at the enterprise and certified by the independent certification entity.

D.4. Brief description of the operational and management structure that will be applied in implementing the monitoring plan:

All necessary data will be collected by existing departments of JSC 'Ukrgrafit' and the reports will be prepared by the Head of marketing department according to the monitoring system described in Section D.1. Collection of information required for calculations of reductions of greenhouse gases emissions as a result of project implementation will be performed in accordance with procedures established at the enterprise. Data will be stored in operational journals of workshop, and in the relevant electronic databases. The official responsible for monitoring of greenhouse gases emission reductions is the Head of marketing department of JSC 'Ukrgrafit'. Calculations of greenhouse emission reductions will be prepared by LLC 'KT-Energy', Kyiv.

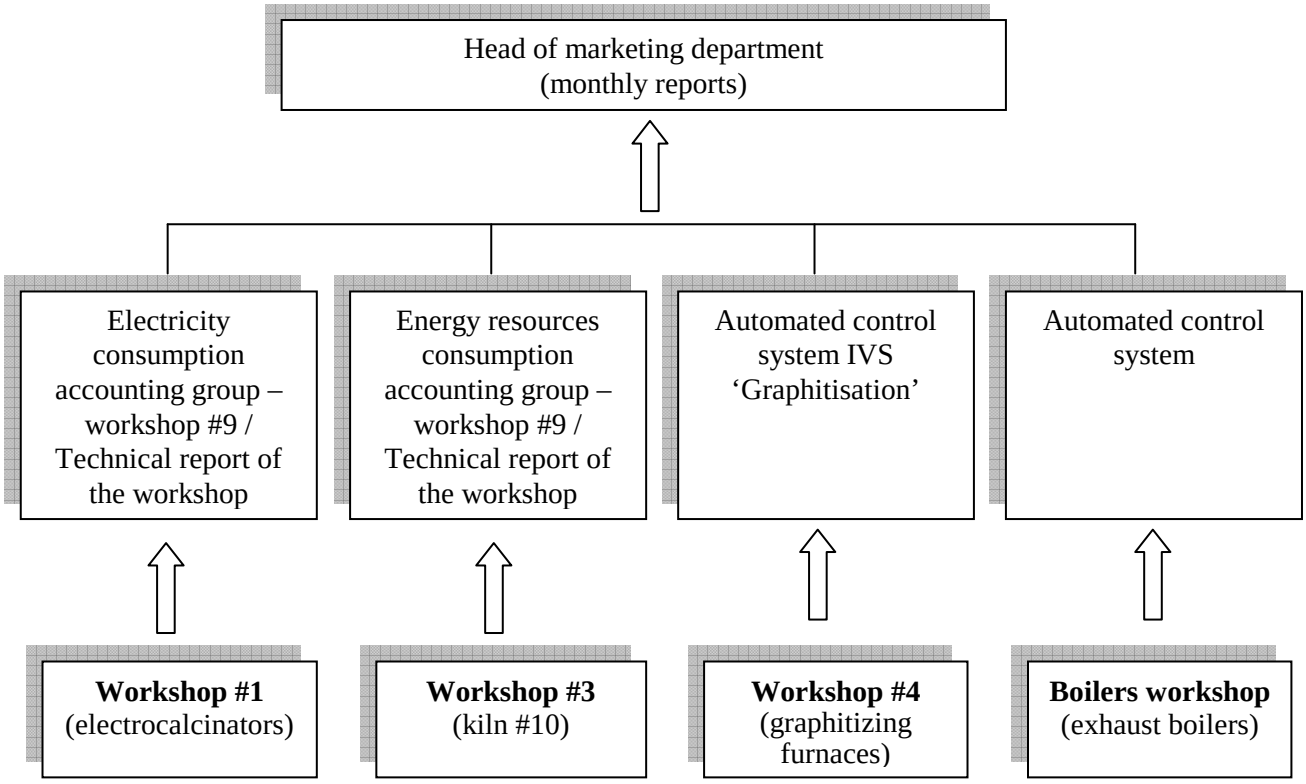

Fig. D-4.1 The scheme of established monitoring system.

The data on production volumes and electricity consumption by electrocalcinators is recorded by the operator in the journal of electrocalcinators operation and is also stored in electronic control system. The data on electricity consumption are reported daily to the electricity consumption accounting group – workshop #9. The reports on electrocalcinators operation are prepared on the monthly basis by the chief foreman of the workshop and economic department and include information on production volumes and electricity consumption by reconstructed electrocalcinators.

The data on natural gas consumption by the calcination kiln #10 is recorded from the natural gas meter by the operator of kiln #10 in the journal of the temperatures in calcination kiln #10 and reported to the energy resources consumption accounting group – workshop #9 to be recorded in the journal of natural gas consumption by the workshops of the enterprise on a daily basis. Data are also stored in automatic control system during 1 year. The data on production volumes are recorded in the journals of loading-unloading and in the report of shift work. The reports on calcination kiln #10 operation are prepared on the monthly basis by the economic department of the workshop and include information on production volumes and natural gas consumption by kiln #10.

The information on electricity consumption by graphitizing furnaces is recorded by the operator of control unit of converting station #4 in the journal of operation modes of converting station #4 and also continuously recorded in electronic form. Data on electricity consumption as well as on production volumes is recorded in automated control system 'Graphitisation'.

Data on natural gas consumption and heat energy generation by exhaust boilers will be recorded by automatic control system with reserve copying and also in the paper operating journals.

D.5. Name of person(s)/entity(ies) establishing the monitoring plan:

Date: 27/04/2011

The information about the organisation, which has established the monitoring plan and developed project design documentation, is presented below.

LLC 'KT-Energy' (registered in Ukraine)
15 B/22 Biloruska st., Kiev, 04119, Ukraine
Tel/Fax. + (38 044) 493 83 32, info@kt-energy.com.ua

Kyryl Tomlyak, Director
ktomlyak@kt-energy.com.ua
+38 (044) 493 83 32

LLC 'KT-Energy' is not a project participant listed in annex 1.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions and formulae used in the estimation:

The following assumptions were considered during calculation of project emissions:

- Heat generation by exhaust boilers is estimated based on forecasted heat energy demand of the Enterprise;
- Heat energy generation as well as production volumes within different technological processes included in project boundaries are assumed to be equal both in project and baseline scenarios;
- Graphite dust consumptions was considered to be equal zero because it supposed to sell the dust to industrial consumers for the use as a raw material and not to use it as an energy resource in exhaust boilers;
- Production volumes were considered equal both in project and baseline scenario and the values for the years 2011-2012 and further years were considered equal to production volumes in 2010.

Project greenhouse gases emissions are connected with natural gas and electricity consumption by the exhaust boilers for heat energy generation, natural gas consumption for the kiln operating and electricity consumption for electrocalcinators and graphitizing furnaces operating.

$$PE_y = PE_{FF,\ kiln,\ y} + PE_{EL,\ calcinators.,\ y} + PE_{EL,\ graphitizing,\ y}, \ + \ PE_{FF,\ exhaust\ boilers,\ y}$$

where,

$PE_{FF,\ kiln,\ y}$ – project emissions due to natural gas combustion in the kiln, tonnes CO_{2e};

$PE_{EL,\ calcinators.,\ y}$ – project emissions due to electricity consumption by the electrocalcinators, tonnes CO_{2e};

$PE_{EL,\ graphitizing,\ y}$ – project emissions due to electricity consumption by the graphitizing furnaces, tonnes CO_{2e};

$PE_{FF,\ exhaust\ boilers,\ y}$ – project emissions due to supplementary consumption of fossil fuel by the exhaust boilers, tonnes CO_{2e};

$$PE_{FF,\ kiln,\ y} = FC_{NG,\ kiln\ project,\ y} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3}$$

where

$FC_{NG,\ kiln\ project,\ y}$ – natural gas consumption by the kiln in the project scenario, 1000 m^3;

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

EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ

$$PE_{EL,\ calcinators.,\ y} = (EC_{\ calcinators\ th\ project,\ y} + EC_{\ calcinators\ sg\ project,\ y}) \cdot EF_{grid}$$

where

$EC_{\ calcinators\ th\ project,\ y}$ – electricity consumption for production of thermoanthracite by electrocalcinators in the project scenario, MWh.

$EC_{\ calcinators\ sg\ project,\ y}$ – electricity consumption for synthetic graphite production by electrocalcinators in the project scenario, MWh.

EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$PE_{EL,\ graphitizing,\ y} = EC_{\ graphitizing\ project,\ y} \cdot EF_{grid}$$

where

$EC_{\ graphitizing\ project,\ y}$ – electricity consumption by the graphitizing furnaces in the project scenario, MWh.

EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$PE_{FF,\ exhaust\ boilers,\ y} = FC_{NG,\ exhaust\ boilers,\ y} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3}$$

where
$FC_{NG,\ boilers,\ y}$ – supplementary consumption of fossil fuel (natural gas) by the exhaust boilers for heat energy generation during the year *y*, 1000 m^3;
NCV_{NG} – net calorific value of natural gas, GJ/1000 m^3;
EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ.

Project emissions have been estimated on the basis of data that is presented in the table below.

Year	Electricity consumption by the electrocalcinators for thermoanthracite production, MWh	Electricity consumption by the electrocalcinators for synthetic graphite production, MWh	Electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, MWh	Natural gas consumption by the kiln, 1000 m^3	Heat energy generation by the exhaust boilers, GJ	Natural gas consumption by the heat utilizers, 1000 m^3
2008	2 441		12 622	1 508		
2009	2 167		18 655	1 613		
2010	3 294		17 867	1 959		
2011	3 294	1 000	17 867	1 959	321 003	7 133
2012	3 294	5 000	17 867	1 959	481 505	10 700
2013	3 294	5 000	17 867	1 959	481 505	10 700
2014	3 294	5 000	17 867	1 959	481 505	10 700
2015	3 294	5 000	17 867	1 959	481 505	10 700
2016	3 294	5 000	17 867	1 959	481 505	10 700
2017	3 294	5 000	17 867	1 959	481 505	10 700
2018	3 294	5 000	17 867	1 959	481 505	10 700
2019	3 294	5 000	17 867	1 959	481 505	10 700
2020	3294	5 000	17 867	1 959	481 505	10 700

Yearly parameters (electricity consumption by the electrocalcinators for thermoanthracite production, electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, natural gas consumption by the kiln) for the years 2008-2010 used in the table above has been provided by the enterprise according to the technical reports of the relevant workshops. The same parameters for the years 2011-2020 were considered equal to the values for the year 2010. Data on heat energy generation by exhaust boilers were considered according to the data of the enterprise based on expected production start date and production plan for heat generation. Data on electricity consumption by the electrocalcinators for synthetic graphite production were considered according to the data of the enterprise based on production plans and expected specific energy consumption for synthetic graphite production by electrocalcinators.

Estimated project emissions within the project boundary for the period 2008-2020 are presented in table below.

Year	Project emissions due to electricity consumption for thermoanthracite production, tonnes CO_{2e}	Project emissions due to electricity consumption for synthetic graphite production, tonnes CO_{2e}	Project emissions due to electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, tonnes CO_{2e}	Project emissions due to natural gas consumption by the kiln, tonnes CO_{2e}	Project emissions due to natural gas consumption by the exhaust boilers, tonnes CO_{2e}	Total project emissions, tonnes CO_{2e}
2008	2 642		15 386	2 876		20 904
2009	2 375		23 076	3 076		28 527
2010	3 600		21 887	3 737		29 224
2011	3 590	1 090	21 923	3 737	13 606	43 946
2012	3 590	5 450	21 923	3 737	20 409	55 109
2013	3 590	5 450	21 923	3 737	20 409	55 109
2014	3 590	5 450	21 923	3 737	20 409	55 109
2015	3 590	5 450	21 923	3 737	20 409	55 109
2016	3 590	5 450	21 923	3 737	20 409	55 109
2017	3 590	5 450	21 923	3 737	20 409	55 109
2018	3 590	5 450	21 923	3 737	20 409	55 109
2019	3 590	5 450	21 923	3 737	20 409	55 109
2020	3 590	5 450	21 923	3 737	20 409	55 109

Thus, total project emissions during the period 2008-2012 will be 177 710 tonnes CO_{2e}. Total project emissions during the period 2013-2020 will be 440 872 tonnes CO_{2e}.

E.2. Estimated leakage and formulae used in the estimation, if applicable:

No leakage is expected during the project activity.

E.3. Sum of E.1. and E.2.:

Due to the fact that no leakage is expected during the project activity the sum of E.1 and E.2 equals E.1.

E.4. Estimated baseline emissions and formulae used in the estimation:

Baseline greenhouse gases emissions are connected with coal consumption for heat energy generation, natural gas consumption for the operating of the kiln and electricity consumption for the operating of electrocalcinators and graphitizing furnaces.

$$BE_y = BE_{FF,\ kiln,\ y} + BE_{EL,\ calcinators.,\ y} + BE_{EL,\ graphitizing,\ y} + BE_{FF,\ coal\ boilers,\ y}$$

where,

$BE_{FF,\ kiln,\ y}$ – baseline emissions due to natural gas combustion in the kiln, tonnes CO_{2e};
$BE_{EL,\ calcinators.,\ y}$ – baseline emissions due to electricity consumption by the electrocalcinators, tonnes CO_{2e};
$BE_{EL,\ graphitizing,\ y}$ – baseline emissions due to electricity consumption by the graphitizing furnaces, tonnes CO_{2e};
$BE_{FF,\ coal\ boilers,\ y}$ – baseline emissions due to coal combustion for heat energy generation, tonnes CO_{2e};

$$BE_{FF,\ kiln,\ y} = P_{kiln,\ y} \cdot SFC_{NG,\ kiln\ baseline} \cdot NCV_{NG} \cdot EF_{NG} \cdot 10^{-3},$$

Where
$P_{kiln,\ y}$ – production volumes by calcination kiln, tonnes.
$SFC_{NG,\ kiln\ baseline}$ – specific natural gas consumption by the kiln in the baseline scenario, 1000 m^3/tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data;
NCV_{NG} – net calorific value of the natural gas, GJ/1000 m^3;
EF_{NG} – carbon dioxide emission factor for combustion of natural gas, tonnes CO_2/GJ.

$$BE_{EL,\ calcinators.,\ y} = P_{calcinators,\ y} \cdot SEC_{calcinators\ baseline} \cdot EF_{grid}$$

Where
$P_{calcinators,\ y}$ – production volumes by electrocalcinators, tonnes.
$SEC_{calcinators\ baseline}$ – specific electricity consumption by the electrocalcinators in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$BE_{EL,\ graphitizing,\ y} = (P_{graphitizing,\ y} \cdot SEC_{graphitizing\ baseline} + P_{calcinators\ sg,\ y} \cdot SEC_{cgraphitizing\ sg\ baseline}) \cdot EF_{grid}$$

Where
$P_{graphitizing,\ y}$ – production volumes of graphitizing furnaces, tonnes.
$SEC_{graphitizing\ baseline}$ – specific electricity consumption by the graphitizing furnaces in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
$P_{calcinators\ sg,\ y}$ – production of synthetic graphite by reconstructed electrocalcinators, tonnes.
$SEC_{cgraphitizing\ sg\ baseline}$ – specific electricity consumption for production of synthetic graphite by the graphitizing furnaces in the baseline scenario, MWh / tonne. Parameter is not monitored during the crediting period but estimated ex ante based on historical data.
EF_{grid} – specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine, tonnes CO_2/MWh.

$$BE_{FF,\ coal\ boilers,\ y} = HG_{exhaust\ boilers,\ y} \cdot EF_{coal} / \dot{\eta}_{coal\ boilers},$$

where
$HG_{exhaust\ boilers,\ y}$ – heat energy generation during the year *y*, tonnes;
EF_{coal} – carbon dioxide emission factor for combustion of other bituminous coal, tonnes CO_{2e}/GJ.
$\dot{\eta}_{coal\ boilers}$ – coal boilers efficiency, %.

Baseline emissions were estimated according to the data that is presented in the table below. Data used in the table (electricity consumption by the electrocalcinators for thermoanthracite production, electricity consumption by the electrocalcinators for synthetic graphite production, electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, natural gas consumption by the kiln) are based on the production volumes used for calculation of the project emissions in section E.1 and specific energy (natural gas or electricity) consumption parameters presented in Section B.1 and D.2. Heat energy generation by coal fired boilers was considered equal to heat energy generation by exhaust boilers under the project scenario.

Year	Electricity consumption by the electrocalcinators for thermoanthracite production, MWh	Electricity consumption by the electrocalcinators for synthetic graphite production, MWh	Electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, MWh	Natural gas consumption by the kiln, 1000 m^3	Heat energy generation by by coal fired boilers, GJ
2008	4 663		13 968	3 968	
2009	4 088		20 509	3 902	
2010	5 727		19 706	4 736	
2011	5 727	1 787	19 706	4 736	321 003
2012	5 727	8 936	19 706	4 736	481 505
2013	5 727	8 936	19 706	4 736	481 505
2014	5 727	8 936	19 706	4 736	481 505
2015	5 727	8 936	19 706	4 736	481 505
2016	5 727	8 936	19 706	4 736	481 505
2017	5 727	8 936	19 706	4 736	481 505
2018	5 727	8 936	19 706	4 736	481 505
2019	5 727	8 936	19 706	4 736	481 505
2020	5 727	8 936	19 706	4 736	481 505

Estimated baseline emissions for the period of 2008-2020 are presented in table below.

Year	Baseline emissions due to electricity consumption for thermoanthracite production, tonnes CO_{2e}	Baseline emissions due to electricity consumption for synthetic graphite production, tonnes CO_{2e}	Baseline emissions due to electricity consumption by the graphitizing furnaces for Ø600 mm electrodes production, tonnes CO_{2e}	Baseline emissions due to natural gas consumption by the kiln, tonnes CO_{2e}	Baseline emissions due to coal consumption for heat generation, tonnes CO_{2e}	Total baseline emissions, tonnes CO_{2e}
2008	5 045		17 027	7 569		29 641
2009	4 480		25 369	7 443		37 292
2010	6 259		24 139	9 034		39 432
2011	6 242	2 193	24 179	9 034	33 741	75 389
2012	6 242	10 965	24 179	9 034	50 612	101 032
2013	6 242	10 965	24 179	9 034	50 612	101 032
2014	6 242	10 965	24 179	9 034	50 612	101 032
2015	6 242	10 965	24 179	9 034	50 612	101 032
2016	6 242	10 965	24 179	9 034	50 612	101 032
2017	6 242	10 965	24 179	9 034	50 612	101 032
2018	6 242	10 965	24 179	9 034	50 612	101 032
2019	6 242	10 965	24 179	9 034	50 612	101 032
2020	6 242	10 965	24 179	9 034	50 612	101 032

Thus, total baseline emissions during the period 2008-2012 will be 282 786 tonnes CO_{2e}. Total baseline emissions during the period 2013-2020 will be 808 256 tonnes CO_{2e}.

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

Reductions of anthropogenic emissions by sources of greenhouse gases (GHGs) generated by joint implementation (JI) projects are estimated/calculated by comparing the quantified anthropogenic emissions by sources within the project boundary in the baseline scenario with those in the project scenario and adjusting for leakage.

Year	Emission reductions, tonnes CO_2e
2008	8 737
2009	8 765
2010	10 208
2011	31 443
2012	45 923
2013	45 923
2014	45 923
2015	45 923
2016	45 923
2017	45 923
2018	45 923
2019	45 923
2020	45 923
Total	472 460

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

Year	Estimated project emissions (tonnes of CO_2 equivalent)	Estimated leakage (tonnes of CO_2 equivalent)	Estimated baseline emissions (tonnes of CO_2 equivalent)	Estimated emission reductions (tonnes of CO_2 equivalent)
2008	20 904	0	29 641	8 737
2009	28 527	0	37 292	8 765
2010	29 224	0	39 432	10 208
2011	43 946	0	75 389	31 443
2012	55 109	0	101 032	45 923
Subtotal over the period of 2008-2012 (tonnes of CO_2 equivalent)	177 710	0	282 786	105 076
2013	55 109	0	101 032	45 923
2014	55 109	0	101 032	45 923
2015	55 109	0	101 032	45 923
2016	55 109	0	101 032	45 923
2017	55 109	0	101 032	45 923
2018	55 109	0	101 032	45 923
2019	55 109	0	101 032	45 923
2020	55 109	0	101 032	45 923
Subtotal over the period of	440 872	0	808 256	367 384

2013-2020 (tonnes of CO_2 equivalent)				
Total over the period of 2008-2020 (tonnes of CO_2 equivalent)	618 582	0	1 091 042	472 460

SECTION F. Environmental impacts

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

The project will have positive impact on the environment due to reduction of electricity and fossil fuel consumption during the graphite electrodes production process.

Due to the realization of the project coal consumption will be avoided, that will lead to the decrease of air pollution with such polluting substances as nitrous oxides, sulphur trioxides and dioxides, volatile ash with fuel particles, which have not been burnt, carbon oxides etc. Moreover, utilization of waste energy from exhaust gases will lead to decreasing of nitrous oxides and carbon monoxide emissions as well as dust emissions into the atmospheric air.

Besides, natural gas and electricity consumption will be reduced in the technological processes, which will also result in air pollution decrease and will have positive influence on environment.

The project does not have significant impact on biotic and water mediums as well as any transboundary environmental impact. In general, project realization will have positive environmental impact.

Project activity is in consistence with all mandatory laws and regulations. While project realization the environmental legislation will be complied and all necessary permits on polluting substances emission will be obtained. The Ministry of Environmental protection of Ukraine has issued an Allowance for emissions of polluting substances into the atmospheric air by stationary sources #2310137200-16, which will remain valid till 25.06.2014.

Environmental impact assessment regarding the construction of exhaust boilers workshop has been prepared and properly approved. Environmental impact assessment of the planned activity as a part of detailed design of exhaust boilers workshop construction project has been developed by LLC NTP "Kotloenergoproect" (Executive Summary №179.021585 – EIA) in 2009. Statement of environmental effects of the activity has been published in "Nashe vremya plus: newspaper №52 (551) dated 30.12.2009. Positive conclusion of the state environmental expertise of the detailed design of the project №08/29.01.10-18 dated 18.02.2010 has been approved by the State environmental administration in Zaporizhzhya region.

Since 2002 there is an environmental management system introduced at the enterprise, which is certified by independent authority, and its proper operation is confirmed by the certification body in 2010. Thus, the environmental policy and objectives which take into account legal requirements and other requirements as well as information about significant environmental aspects is established and functioning at the enterprise.

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

Total environmental impacts of project scenario in comparison with baseline scenario will be positive.

SECTION G. Stakeholders' comments

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

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

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	JSC "Ukrgrafit"
Street/P.O.Box:	Pivnichne shose
Building:	20
City:	Zaporizhzhya
State/Region:	
Postal code:	69600
Country:	Ukraine
Phone:	+38 (061) 2895110
Fax:	+38 (061) 2895141
E-mail:	
URL:	http://ukrgrafit.com.ua/
Represented by:	
Title:	Head of marketing department
Salutation:	
Last name:	Yankovskyi
Middle name:	
First name:	Kyryll
Department:	
Phone (direct):	+38 (061) 213-71-90
Fax (direct):	+38 (061) 213-71-90
Mobile:	
Direct e-mail:	yankovsky@ukrgrafit.com.ua

Organization:	RWE Power Aktiengesellschaft
Street/P.O.Box:	Huyssenallee 2
Building:	/
City:	Essen
State/Region:	/
Postfix/ZIP:	45128
Country:	Germany
Telephone:	+49 (0)201 12-24770
FAX:	+49 (0)201 12-20216
E-Mail:	antonio.aguilera@rwe.com
URL:	http://www.rwe.com
Represented by:	Antonio Aguilera Lagos
Title:	Head of Carbon Credit Purchase
Salutation:	/
Last Name:	Aguilera Lagos
Middle Name:	/
First Name:	Antonio
Department:	Climate Protection
Mobile:	/
Direct FAX:	+49 (0)201 12-20216
Direct tel:	+49 (0)201 12-24770

Personal E-Mail:	antonio.aguilera@rwe.com

- - - - -

Annex 2

SPECIFIC CARBON DIOXIDE NON DIRECT EMISSION FACTORS FOR CONSUMPTION OF ELECTRICITY GENERATED BY POWER STATIONS OF UNITED ENERGY SYSTEM OF UKRAINE

DATA	VALUE	SOURCE
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 1st class consumers for 2008, tonne CO_{2e}/MWh	1,082	Order #62 from 15th of April, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 2nd class consumers for 2008, tonne CO_{2e}/MWh	1,219	Order #62 from 15th of April, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 1st class consumers for 2009, tonne CO_{2e}/MWh	1,096	Order #63 from 15th of April, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 2nd class consumers for 2009, tonne CO_{2e}/MWh	1,237	Order #63 from 15th of April, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 1st class consumers for 2010, tonne CO_{2e}/MWh	1,093	Order #43 from 28th of March, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 2nd class consumers for 2010, tonne CO_{2e}/MWh	1,225	Order #43 from 28th of March, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for 1st class consumers for 2011, tonne CO_{2e}/MWh	1,090	Order #75 from 12th of May, 2011, of National Environmental Investment Agency of Ukraine
Specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of	1,227	Order #75 from 12th of May, 2011, of National Environmental Investment Agency of Ukraine

united energy system of Ukraine for 2nd class consumers for 2011, tonne CO_{2e}/MWh		

For the years 2012-2020 the value of specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine approved for the year 2011 was used in the calculations. At the stage of monitoring report preparation and in case of approval of specific carbon dioxide non direct emissions factor for consumption of electricity generated by power stations of united energy system of Ukraine for the year 2012 and forthcoming years calculations will be properly adjusted.