# Monitoring report of GHGs emission reduction

JI PROJECT:

## « IMPLEMENTATION OF ARC-FURNACE STEELMAKING AT MAGNITOGORSK IRON AND STEEL WORKS »

**Monitoring period: 01.01.2008 – 31.12.2009**

Version 1.3. Data of development of this version: 18 October 2010.

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# A. General information on the project

## *A.1. Introduction*

The aim of report is representation of the monitoring results and results of calculation of emission reduction units generated by the JI project "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works" for the period from January 01, 2008 to December 31, 2009.

## *A.2. Brief description of the project*

The proposed Joint Implementation project envisages a complex resource-saving effect from the transition to the technology of production of profiled steel in the electric arc furnaces (EAF) and its teeming in the continuous casting machines (CCM) instead of production of the same steel and profiled billet in the open-hearth plant and blooming mill plant.

Electric steelmaking process in EAFP and further teeming in CCM is a resource-saving technology, which allows at the same output rate to save the carbon-containing materials and fuels – coking coal, coke, pig iron, natural gas compared to the conventional OHFP process with ingots teeming. It is assumed that production of profiled steel billet in the project and the baseline is equivalent and corresponds to the actual steel production according to the monitoring data.

## *A.3. Emission reduction during monitoring period*

The project has been realized in 2003-2006. In the current report we take into account emission reduction generated during 2008 and 2009. In accordance with calculations in the section D **actual emission reduction units (ERUs) are:**

From January 1 to December 31, 2008: **1 699 581 tones** $CO_{2e}$

From January 1 to December 31, 2009: **421 275 tones** $CO_{2e}$

In accordance with PDD, version 1.4 from January 15, 2010 **expected emission reduction units (ERUs) are:**

From January 1 to December 31, 2008: 1 699 642 tones $CO_{2e}$

From January 1 to December 31, 2009: 654 663 tones $CO_{2e}$

The actual generating of ERUs in 2009 is less than calculated in the PDD because of use of the substantial quantities of pig iron for the production of liquid steel in the EAF plant (specific consumption of pig iron in PDD calculations - 661 kg/ton of steel, on the fact - 731 kg/ton of steel), and decreased consumption of coke in the blast-furnace plant in the spring of 2009 as a result of implementation of resource-saving measures (mastering of bell-less top charging devices at blast furnace #9, 10) and recovery of metal production after a period of acute crisis in late 2008 - early 2009.

### *A.4. Contact information on project participants*

Contact person on project participants:

| | |
|---|---|
| Company: | OJSC "Magnitogorsk Iron and Steel Works" |
| Street: | Kirova |
| Building: | 93 |
| City: | Magnitogorsk |
| State/region | - |
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| Phone: | +7 (3519) 24-78-98 |
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| Position: | Manager of environmental and regional programs |
| Title: | Mr. |
| Family name: | Mitchin |
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| Department: | Department for relations with state authorities and markets protection |

Contact person on consultant of project participant and project developer and developer of monitoring report:

| | |
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| Title: | |
| Family name: | Myachin |
| Name: | Konstantin Yurevich |
| Department: | - |

# B. Monitoring system of GHGs emission reduction

## *B.1 Information on the collection and archiving of information on the environmental impacts of the project*

In accordance with requirements of Articles 14, 22 the Federal Law on environmental protection # 7-FZ OJSC "MMK" has the approved Maximum Permissible Emissions (MPE) document. This document is approved by Chelyabinsk Regional Department of Technological and Environmental Surveillance of Rostechnadzor. This decision is valid for one year. Under this decision the harmful emission permit is issued. This permit quantified impacts to atmosphere by OJSC "MMK".

For confirmation of MPE the air emissions were estimated by OJSC "Magnitogorsk GIPROMEZ" in accordance with Russian "Guidelines for calculation of industrial emissions of air pollutants" (OND-86)[1]. These estimations were based on OJSC "MMK" Emission Inventory and Emission Sources Report done by Federal State Unitary Enterprise "All-Russian Institute for Carbon Chemistry" in Yekaterinburg (2008). This report was approved according to the established procedure.

Laboratory for Control of Air Quality of OJSC "MMK" performs environmental monitoring according to the monitoring schedule.

According to the provisions of Russian environmental law (Federal Law №7-FZ of 10.01.2002 "On Environmental Protection"), environmental experts and managers of polluting enterprises must have qualifications in environmental protection and environmental safety. Functions of the Department of environmental protection are ensuring compliance with environmental quality standards, obtaining government permits for emissions and discharges of hazardous substances, disposal of waste.

In accordance with referred above Federal Law OJSC "MMK" has the approved Maximum Permissible Discharge of Sewage document (MPDS) and Permissible Norm of Producing and Placement of Wastes document (PNPPW). In these documents procedure of collecting and archiving of information on the environmental impacts is defined.

There is a monitoring plan in MPDS document, which is defined the monitoring parameters, frequency of measurement for each parameter and responsible personnel. Monitoring plan is approved by OJSC "MMK". In PNPPW document list and quantity of produced wastes, frequency of producing, places of storage and responsible personnel are defined. This document is approved by OJSC "MMK".

Considering the above we can conclude that OJSC "MMK" conduct the periodic monitoring of the environment impacts. The enterprise also has an environmental management system certified by ISO 14001.

According to the information from Environmental department of OJSC "MMK" received during visit 16-18.08.2010:

The project was fully put into operation is 2006 and environmental protection equipment designed for it (gas purification units at EAFs, etc) operates normally. The total environmental impact for the section steel production has been radically reduced in comparison with the open-hearth/ingots casting technology.

Emissions of polluting substances are normalized in the permission to emission of the polluting substances, given out by Rostehnadzor in the Chelyabinsk area. Results of inventory of emissions prepares annually.

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[1] http://www.vsestroi.ru/snip_kat/ad977f56010639c6e1ba95802d182677.php

According to the permission, emissions of pollutant substances don't create maximum concentration limit excess, except for a number of substances (nitrogen (IV) a dioxide, sulfur a dioxide, hydrogen sulfide, carbon оксид, phenol) for which temporarily permission is established.

Dump of polluting substances occurs on local treatment facilities. After clearing water is dumped in the river Sukhaya (inflow of the river Ural).

Placing of a waste occurs in conformity to the project of specifications of formation of a waste and limits on their placing, confirmed by Rostehnadzor in the Chelyabinsk area.

### *B.2 Methodological approach*

JI specific approach is applied for the monitoring of GHGs emission in accordance with paragraph 9 (a) of the "Guidance on criteria for baseline setting and monitoring" (Version 02).

Methodological approach applied for calculation of the $CO_2$ emissions by carbon balance method is in line with Tier 3 approach described in Section 4.2.2 of Chapter 4 of "2006 IPCC Guidelines for National Greenhouse Gas Inventories" (IPCC Guidelines 2006). This approach was complemented with monitoring of $CO_2$ emission factor for generation of electricity at MMK own power plants, $CO_2$ emissions due to consumption of electricity in EAFP, $CO_2$ emissions from generation and consumption of air blast in blast furnace plant.

Since MMK is a full-cycle iron and steel works, the production of coke and pig iron meets apart from EAFP the demand of basic oxygen furnace plant, even though the latter lies outside the project boundaries. EAFP produces profiled steel billet and slab steel billet, the latter is outside the project boundaries. To calculate $CO_2$ emissions within the project boundaries the specific $CO_2$ emissions per ton of coke, pig iron and steel billet are defined. Then specific emissions are multiplied by the output of these products within the project boundaries.

The project boundaries include (Diagram B.2.1, B.2.2 below):

- Metallurgical conversion production works: by-product coke plant, blast-furnace plant, EAFP (or OHFP and BMP in the baseline scenario)
- Own power generation capacities of MMK: Combined heat power plant (CHPP), Central power plant (CPP), Steam-air blowing power plant (SABPP), turbine section in the steam plant, gas recovery section in the steam plant
- Unified energy system of Urals.

Diagram B.2.1. Project boundaries. Project scenario

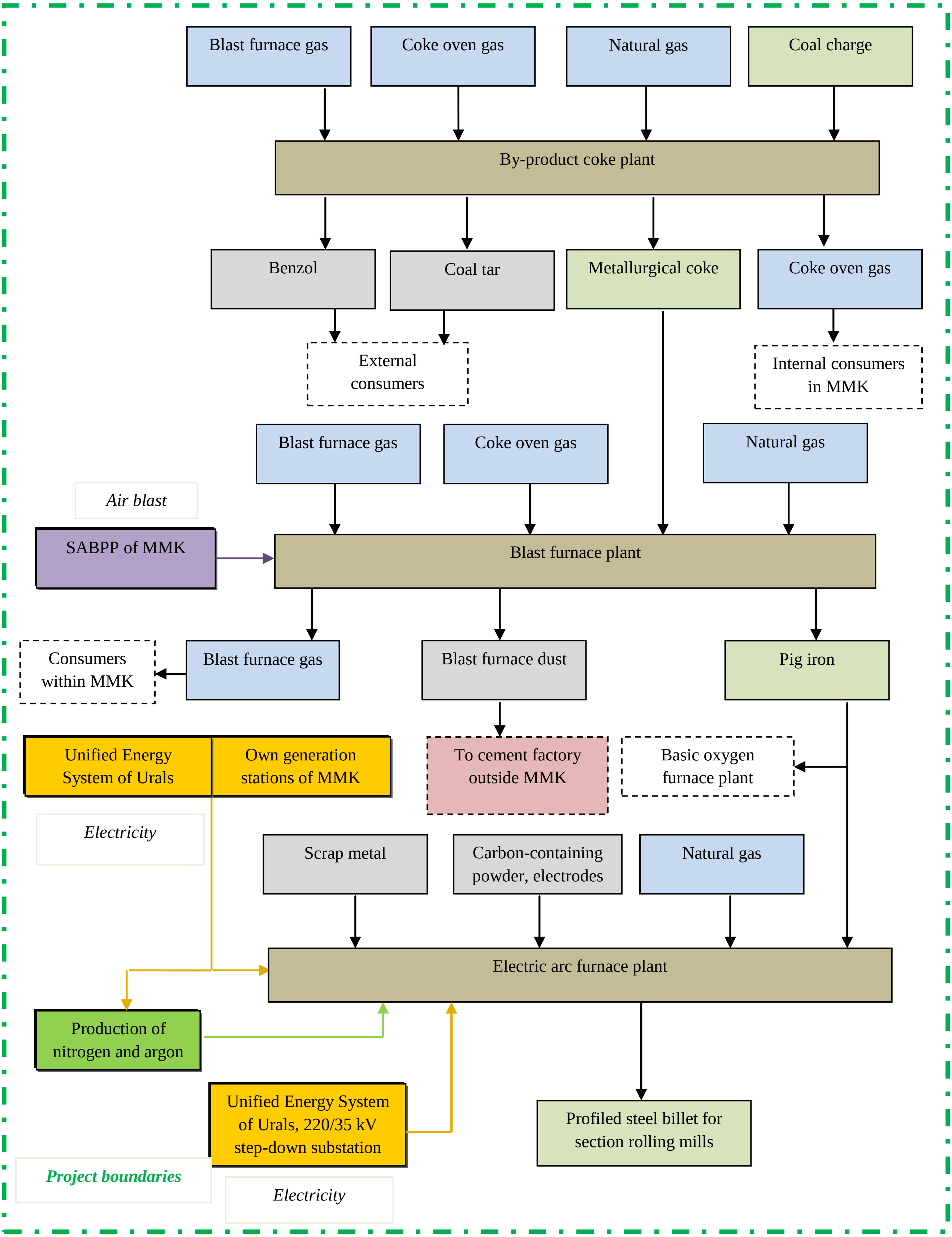
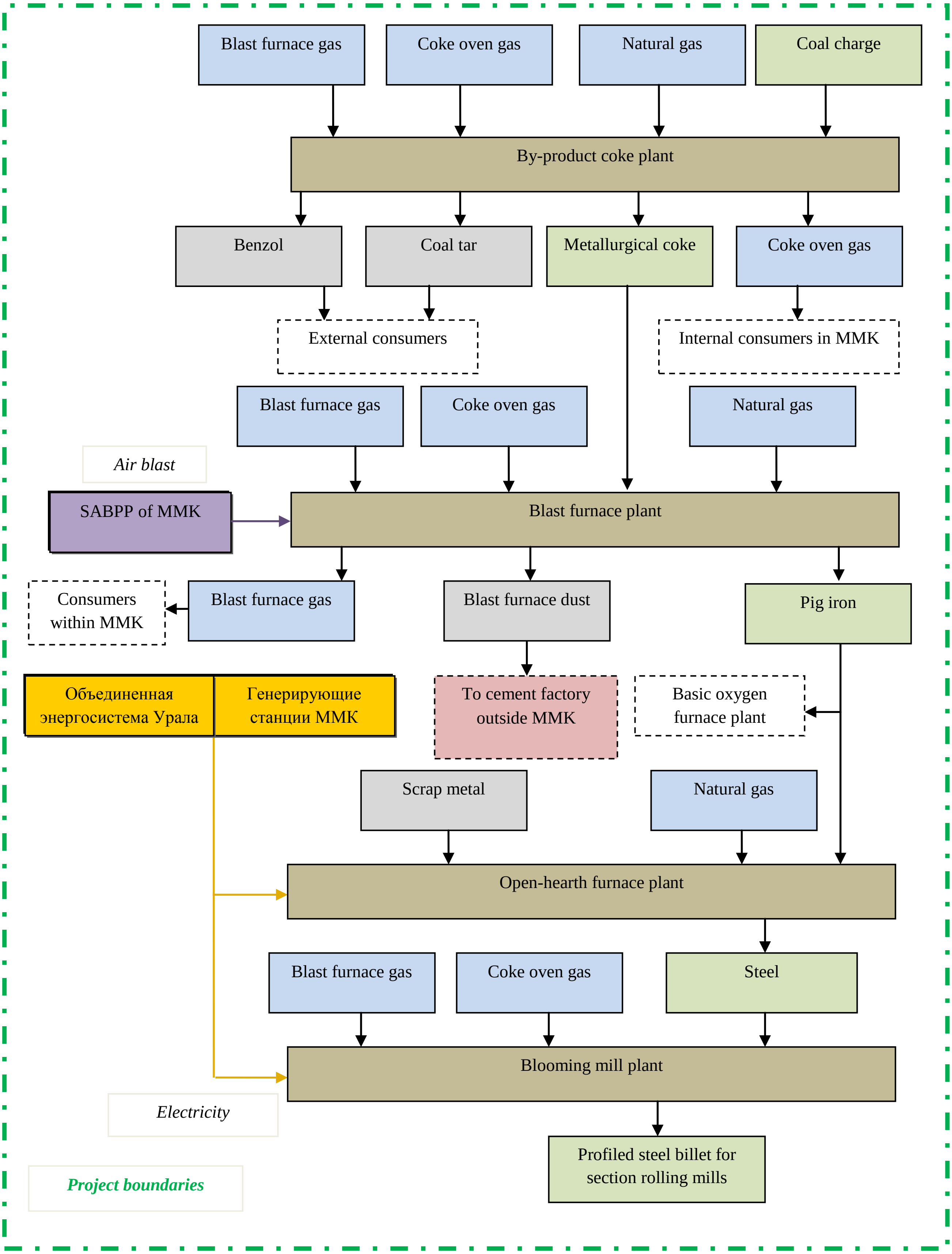


Diagram B.2.2. Project boundaries. Baseline scenario




Basic oxygen furnace plant - This plant/source is beyond the project boundaries

To calculate the project $CO_2$ emissions we estimated the following parameters:

1. $CO_2$ emission from metallurgical conversions within the project boundaries (using carbon balance method)
2. Specific $CO_2$ emission per ton of coke, pig iron and steel billet (profiled and slab all together).
3. Specific consumption of pig iron and scrap metal for production of one ton of steel billet and specific consumption of metallurgical coke per one ton of pig iron.
4. Project $CO_2$ emission from metallurgical conversions during production of profiled steel billet using defined specific values and coefficients
5. $CO_2$ emission coefficients from generation of electricity and air blast at MMK, and accordingly the project emissions from consumption of electricity in EAFP and consumption of air blast in BFP required for production of the profiled steel billet.
6. Total project $CO_2$ emissions associated with production of profiled steel billet are summarized.

Blast furnace dust and scrubber sludge are particular kinds of industrial waste generated in blast furnace process. They originate in the system of dry cleaning of blast furnace gas and contain significant amounts of carbon. These materials are transported to agglomeration plant and consumed during production of fluxed agglomerate. The carbon from blast furnace dust and scrubber sludge is fully released as $CO_2$. Therefore, these emissions are included in emissions during production of pig iron in blast furnace plant. A small fraction of blast furnace dust comes to the cement plant. By conservative approach this fraction is considered as leakage emission outside OJSC “MMK” and included in the corresponding chapter of monitoring plan.

The consumption of production inputs, raw materials, energy resources, and the output of commercial products are routinely monitored by MMK applying the system of factory monitoring and reporting. These parameters are measured in accordance with applicable standards and rules in the iron and steel industry of Russia as well as international standards (OJSC “MMK” is certified by ISO 9001 standard). All required parameters are available within the production monitoring and reporting system of Magnitogorsk Metallurgical Works and thus associated procedure for monitoring of $CO_2$ emissions does not require any additional changes or improvements in the existing system.

The majority of carbon content parameters included in the monitoring plan are regularly determined by direct analyses in Central Laboratory of OJSC “MMK” or calculated on the basis of chemical composition of carbon-containing substances. The samples of blast furnace gas and coke oven gas are analyzed in CEST laboratory and the data on chemical composition of natural gas are taken from its technical passport issued and provided by the supplier.

Carbon content of materials and fuels listed in Table B.2.1 is either stable or standardized (e.g. in steel and pig iron) or may vary insignificantly, and therefore based on conservativeness principle the maximum value (with some excess) of carbon content in the benzol, tar, carbon-containing powder, etc was fixed ex-ante. We used the default value from IPCC Guidelines (2006) for carbon content in power station coal because at MMK this parameter is not measured.

Table B.2.1. Carbon content of raw materials, fuels and produced substances fixed ex ante for the project and baseline

| № | Parameter and measurement units, source of data | Variable | Value |
|---|---|---|---|
| 1. | Carbon content in crude benzol, % by mass | **$\%C_{benzol}$** | 90.0 |

| | | | |
|---|---|---|---|
| | In accordance with analysis of chemical composition of crude benzol (was made by CL (BpCP Lab)) carbon content of crude benzol is 87.8%. As a conservative assumption, we use maximum value, with a certain margin (2,2%), i.e. 90% | | |
| 2. | Carbon content in coal tar, % by mass<br>Form #BPCP-C296 of 26.06.2009, signed by Director of BPCP. Similar measurements in several preceding years showed the maximum value of 84%. As a conservative assumption, we use maximum value, with a certain margin (2%), i.e. 86% | **$\%C_{coal\text{-}tar}$** | 86.0 |
| 3. | Carbon content in pig iron, % by mass<br>This is an important technological indicator, which determines the end of blast furnace smelting. Final carbon content of pig iron is a technological standard and for 2002 and 2007 the measurements performed by MMK Lab has shown the average value of 4.7 % | **$\%C_{pig\ iron}$** | 4.70 |
| 4. | Carbon content in scrap metal, % by mass<br>As a conservative assumption, carbon content of steel is applied | **$\%C_{scrap}$** | 0.18 |
| 5. | Carbon content in carbon-containing powder, % by mass<br>In accordance with standard specification 1971-003-13303593-2006, which is confirmed by quality certification | **$\%C_{carbon\ powder\_EAFP}$** | 95.0 |
| 6. | Carbon content in electrodes, % by mass<br>In accordance with standard specification 1911-109-052-2003, which is confirmed by quality certification | **$\%C_{electrodes\_EAFP}$** | 99.0 |
| 7. | Carbon content in steel, % by mass<br>This is an important technological indicator, which determines quality of steel and may vary only within very narrow bounds depending on type of steel. The average carbon content of steel product mix, produced by the EAFP within one quarter or one year, based on MMK Lab measurements is quite stable | **$\%C_{steel}$** | 0.18 |
| 8. | Carbon content in power station coal, % by mass<br>IPCC Guidelines 2006 default value | **$\%C_{energy\ coal}$** | 73.0 |

To estimate project emission reduction it is necessary to calculate the difference in baseline and project $CO_2$ emissions. Project implementation involves major changes in production assets: the equipment of open-hearth furnace plant is replaced leaving in operation only one Double-bath steelmaking unit (DBSU), and blooming mill plant is shut down. In these circumstances we use fixed specific coefficients, which characterize consumption of energy and materials in the baseline (Table B.2.2).

The following parameters have been determined to calculate baseline $CO_2$ emissions:

1. Specific $CO_2$ emissions from metallurgical conversion during production of one ton of metallurgical coke and pig iron are the same in the project and baseline scenarios;
2. Specific $CO_2$ emissions from metallurgical conversions for steel smelting in open-hearth furnace plant (OHFP) and production of profiled steel billet in blooming mill plant (BMP) are calculated by carbon balance method based on historical consumption of carbon-containing materials and fuels, historical output of production under baseline technology, and actual carbon content in BFG, COG and NG;
3. $CO_2$ emission from metallurgical conversion for production of profiled steel billet in the baseline in amount equal to the actual project one are calculated on the basis of historical specific consumption of pig iron and scrap metal per ton of profiled steel in OHFP-BMP process, actual specific consumption of metallurgical coke per ton of pig iron and actual output of profiled steel billet in the project;
4. $CO_2$ emissions from consumption of electricity in the baseline are calculated on the basis of historical electricity consumption in OHFP and BMP (they produced only profiled steel), actual $CO_2$ emission factors from electricity consumption and actual output of profiled steel billet in the project;
5. $CO_2$ emissions during generation of air blast were calculated using actual specific consumption of air blast per ton of pig iron, $CO_2$ emission factor from generation of air blast and demand for pig iron required for production of profiled steel billet in the baseline;
6. Total $CO_2$ emissions associated with production of profiled steel billet in the baseline are summarized.

Table B.2.2. Historical averages of parameters, which characterize OHFP-BMP process

| № | Parameter and measurement units, source of data | Symbol | Value |
|---|---|---|---|
| 1. | Annual average consumption of pig iron in OHFP, ths. tons<br>Archives of Economic Department (calculation of production costs) | $\mathbf{M}_{\text{pig iron\_OHFP}}$ | 1941.1 |
| 2. | Annual average consumption of scrap metal in OHFP, ths. tons<br>Archives of Economic Department (calculation of production costs) | $\mathbf{M}_{\text{scrap\_OHFP}}$ | 715.3 |
| 3. | Annual average smelting of steel in OHFP, ths. tons<br>Archives of Economic Department (calculation of production costs) | $\mathbf{P}_{\text{steel\_OHFP}}$ | 2335.7 |
| 4. | Annual average specific consumption of pig iron in OHFP per ton of steel, ton per ton<br>Archives of Economic Department (calculation of production costs) | $\mathbf{SM}_{\text{pig iron\_OHFP}}$ | 0.831 |
| 5. | Annual average specific consumption of scrap metal in OHFP per ton of steel, ton per ton<br>Archives of Economic Department (calculation of production costs) | $\mathbf{SM}_{\text{scrap\_OHFP}}$ | 0.306 |
| 6. | Annual average production of profiled steel billet in BMP, ths. tons<br>Archives of Economic Department (calculation of | $\mathbf{P}_{\text{profiled steel\_BM}}$ | 2029.9 |

| | | | |
|---|---|---|---|
| | production costs) | | |
| 7. | Annual average specific consumption of steel in OHFP per ton of profiled steel billet in BMP<br>Archives of Economic Department (calculation of production costs) | **SC** $_{steel\_profiled\ steel\_BM}$ | 1.151 |
| 8. | Annual average specific consumption of natural gas in OHFP, $m^3$ per ton of steel<br>Data has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs) | **SC** $_{NG\_OHFP}$ | 23.3 |
| 9. | Annual average specific consumption of blast furnace gas in BMP, $m^3$ per ton of steel<br>Data has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs) | **SC** $_{BFG\_BM}$ | 267.1 |
| 10. | Annual average consumption of blast furnace gas in BMP, mln. $m^3$<br>CEST technical reports | **C** $_{BFG\_BM}$ | 542.0 |
| 11. | Annual average specific consumption of coke oven gas in BMP, $m^3$ per ton of steel<br>Data has been stored in CEST technical reports. Historical data on steel production is stored in archives of Economic Department (calculation of production costs) | **SC** $_{COG\_BM}$ | 7.7 |
| 12. | Annual average consumption of coke oven gas in BMP, mln. $m^3$<br>CEST technical reports | **C** $_{COG\_BM}$ | 16.0 |
| 13. | Annual average consumption of electricity in OHFP, GWh<br>CEST technical reports | **EC** $_{OHFP}$ | 16.2 |
| 14. | Annual average consumption of electricity in BMP, GWh<br>CEST technical reports | **EC** $_{BM}$ | 83.8 |

### *B.3 Approach for organization and implementation of monitoring*

It should be noted that OJSC "MMK" had monitored all parameters used in the monitoring plan before development and determination the PDD but the specialized corporate procedure for the monitoring organization for the Joint Implementation project was adopted at MMK in February 2010 (PD MMK 3-SSGO-01-2010 "Regulation on monitoring of GHG emissions reduction, created as a result of the realization of the project: "Implementation of arc-furnace steelmaking at Magnitogorsk Iron and Steel Works"), i.e. after approval of the project by an independent accredited entity. Therefore the monitoring results for 2008 and 2009 are based on reporting system existed prior to this point in time which is the same as nowadays with only exception of the involvement of Department for relations with state authorities and markets protection. Hereby all relevant monitoring information was collected and stored with accordance with MMK corporate rules and regulations but was not qualified as related to JI project boundaries. The mentioned internal Regulation MMK 3-SSGO-01-2010 has been designed to establish a clear and transparent set of authorities and responsibilities for identification of monitoring parameters, timely transfer of relevant reporting forms to MMK JI coordinator and to external consultant (CTF Consulting, LLC) and creation of provisions for secure long-term conservation of monitoring data in accordance with international requirements to JI.

Monitoring of greenhouse gases emission reduction is carried out at OJSC “MMK” based on continuous monitoring of the monitoring parameters (Table B.3.1) specified in the PDD. Monitoring report is subject for verification. Information about each parameter is presented in the form of an information matrix of the approved form. The data relating to the monitoring of the project is posted on a dedicated server of OJSC “MMK”.

Departments responsible for monitoring of each parameter in the JI project carry a responsibility for the treatment of primary reporting documents, processing, preparation, verification and transfer to the Department for relations with state authorities and markets protection (JI project implementation coordinator)  of the reporting documents containing the information about monitored parameters. In each department of OJSC “MMK” involved in monitoring under the JI project the head of the department assigns a person responsible for provision of the reporting documents and tracking of the parameters change.

Picture B.3.1. Management structure of monitoring process

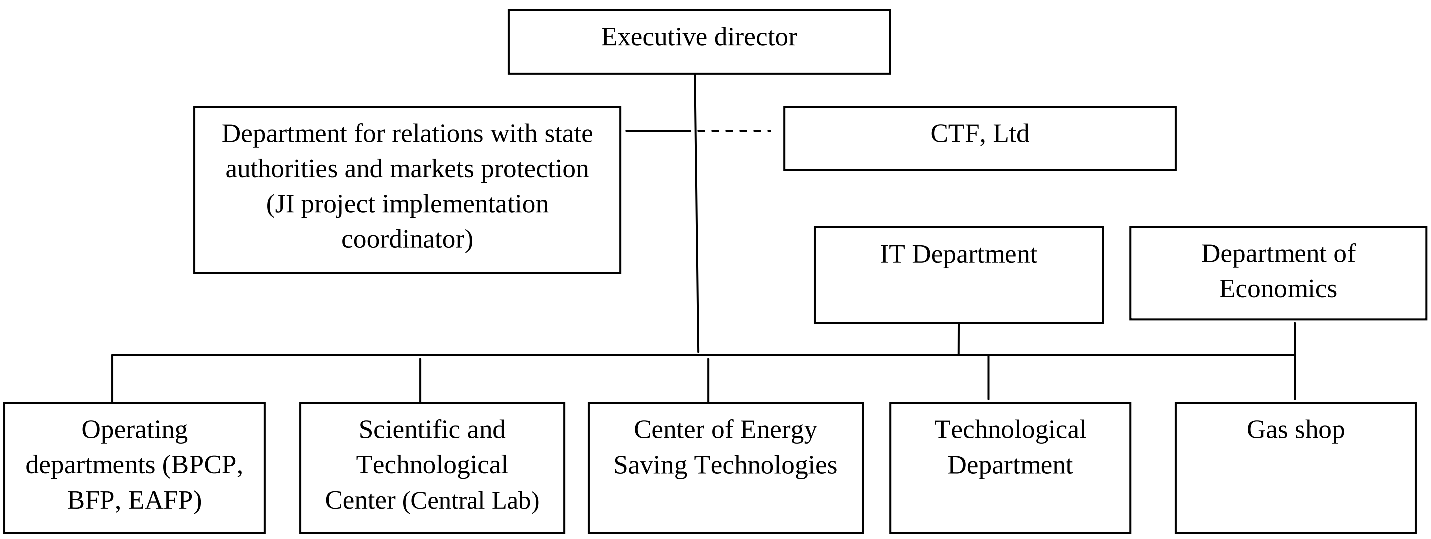



Table B.3.1. Responsibility of departments for monitoring parameters

| # | Department | Monitoring parameter |
|---|---|---|
| 1 | By-product coke plant | 1. Consumption of dry coal charge<br>2. Production of dry metallurgical coke<br>3. Production of crude benzol<br>4. Output of dry coal tar |
| 2 | Blast-furnace plant | 5. Consumption of dry skip metallurgical coke<br>6. Production of pig iron<br>7. Supply of blast furnace dust to the cement factory |

| | | |
|---|---|---|
| | | outside MMK |
| 3 | Electric arc-furnace plant | 8. Consumption of pig iron in EAFP<br>9. Consumption of carbon-containing powder in EAFP<br>10. Consumption of scrap metal in EAFP<br>11. Consumption of electrodes in EAFP<br>12. Output of profiled steel billet in EAFP<br>13. Total production of slab and profiled steel billet in EAFP<br>14. Total smelting of steel in EAF-180 |
| 4 | Technological department | 15. Total electricity consumption by MMK<br>16. Electricity purchase from Unified Energy System of Urals grid<br>17. Total electricity consumption in EAFP<br>18. Consumption of grid electricity by EAF-180<br>19. Specific electricity consumption for nitrogen production at MMK<br>20. Specific electricity consumption for production of pure nitrogen at MMK<br>21. Specific electricity consumption for production of argon at MMK<br>22. Consumption of BFG in CPP<br>23. Consumption of NG in CPP<br>24. Consumption of NG in CHPP<br>25. Consumption of BFG in SABPP<br>26. Consumption of COG in SABPP<br>27. Consumption of NG in SABPP<br>28. Consumption of NG in turbine section of SP<br>29. Consumption of NG in recovery unit of SP<br>30. Consumption of power station coal by CHPP<br>31. Generation of air blast at MMK<br>32. Consumption of BFG in SABPP for generation of air blast<br>33. Consumption of COG in SABPP for generation of air blast<br>34. Consumption of NG in SABPP for generation of air blast |
| 5 | Center of Energy Saving Technologies | 35. Consumption of BFG in BPCP<br>36. Carbon content in BFG<br>37. Consumption of COG in BPCP<br>38. Carbon content in COG<br>39. Consumption of NG in BPCP<br>40. Output of COG in BPCP<br>41. Consumption of COG in BFP<br>42. Consumption of NG in BFP |

| | | |
|---|---|---|
| | | 43. Consumption of BFG in BFP<br>44. Output of BFG in BFP<br>45. Consumption of NG in EAFP<br>46. Consumption of nitrogen in EAFP<br>47. Consumption of pure nitrogen in EAFP<br>48. Consumption of argon in EAFP |
| 6 | Central Laboratory of Control in structure of Scientific and Technological Center | 49. Carbon content in dry coal charge<br>50. Carbon content in dry metallurgical coke<br>51. Carbon content in blast furnace dust |
| 7 | Gas shop | 52. Carbon content in NG |

The pereodicity of data transfer by structural departments of OJSC "MMK" is monthly within 5 working days after their preparation and approval of paper form. Submission of the reports to Department for relations with state authorities and markets protection is performed by responsible person in electronic form. The annual report on an accrual basis is attached to the report of December.

Responsible person from Department prepares documents containing information about monitoring parameters in electronic format *. doc, *. xls. From e-mail address assigned for each Department these files are sent to the e-mail address of Department of informational technologies that is registered as a resource for the monitoring of the project "Implementation of arc-furnace steelmaking at OJSC "MMK". Then received files are placed on the server of OJSC "MMK". Read access to this server is provided to users on the basis of an application for access to information resource. Editing rights of the electronic documents are restricted. Approved reported documents in paper form are stored in accordance with existing procedures in Departments.

A storage of all records of monitoring JI project (describing the period from January 1, 2008 to December 31, 2012) in electronic and hard copies is provided until January 1, 2015 by Department for relations with state authorities and markets protection.

The Department of information technologies takes the responsibility for server disk space on ensuring of the secure storage and protection of electronic documents used for monitoring purposes.

Department for relations with state authorities and markets protection controls the completeness of the data and the term of data transfer. Every quarter all the relevant data are transferred to CTF Consulting Ltd (consultant of the project) by e-mail. Similarly the information matrix of parameters, which were changed and other important information is sent to CTF Consulting Ltd in order that relevant definitions are made during a preparation of the monitoring report.

Within 10 working days after receipt of the complete set of reporting forms the specialists of CTF Consulting Ltd. calculate $CO_2$ emission reduction achieved by JI project for each quarter. The results of calculation are reported to the Department for relations with state authorities and markets protection.

CTF Consulting Ltd. develops for OJSC "MMK" the annual monitoring report under the quarterly reporting on $CO_2$ emission reduction, which is sent then to Department for relations with state authorities and markets protection and Department of Economics of MMK upon receipt of the report on $4^{th}$ quarter and year. The Department of Economics has to compare the figures contained in the monitoring report of the consumption of raw materials and manufacture of products with Calculation of prime costs and confirm their compliance. Annual monitoring report is approved by Executive Director of MMK.

Table B.3.2. List of reporting documents prepared by departments of OJSC “MMK”, which are used in project monitoring

| # | Department | The name of the reporting documents fixed in the Quality Management System (QMS) |
|---|---|---|
| 1 | By-product coke plant | Technical report on coking<br>Report on recovery of main products from coke oven gas |
| 2 | Blast-furnace plant | Monthly technical report of BFP |
| 3 | Electric arc-furnace plant | Technical report of EAFP<br>The balance of consumption of raw materials and products of the electric arc-furnace plant (until March 2010) |
| 4 | Electric arc-furnace plant | Reference on actual consumption of graphite electrodes at electric arc furnaces and ladle-furnace aggregates (until March 2010) |
| 5 | Technological department | Summary of energy consumption by departments of OJSC “MMK” |
| 6 | Technological department | Analysis of energy resources consumption by OJSC “MMK”<br>(form QMS (2) -32-0 (in Russian СМК ОН и АР ТЭР ТУ (2) -32-0)) |
| 7 | Technological department | Fuel consumption by type of product of power plant |
| 8 | Central Laboratory of Control in structure of Scientific and Technological Center | Carbon content in dry coal charge and metallurgical coke of BPCP of OJSCC “MMK”. Monthly average data |
| 9 | Central Laboratory of Control in structure of Scientific and Technological Center | Monthly average data of agglomerates, iron-ore raw materials and flux |
| 11 | Center of Energy Saving Technologies | Report on balance of blast furnace gas consumption in workshops |
| 12 | Center of Energy Saving Technologies | Report on balance of coke over gas consumption in workshops |
| 13 | Center of Energy Saving Technologies | Report on balance of natural gas consumption in workshops |
| 14 | Center of Energy Saving Technologies | Products distribution of the oxygen plant, delivered by pipeline to consumers |
| 15 | Center of Energy Saving Technologies | Results of analysis of coke over gas |
| 16 | Center of Energy Saving Technologies | Results of analysis of blast furnace gas |
| 17 | Gas shop | Natural gas quality passport (provided by supplier) |

### *B.4 Technical means of measurements and its accuracy*

| *№* | *Monitoring parameter* | *Measuring device* | *Inaccuracy of measurements,* |
|---|---|---|---|
| 1 | Consumption of coal charge in BPCP (on dry mass) | Consumption of coal charge is calculated based on gross coke production that is calculated as a sum of weighed amounts of metallurgical coke and coke breeze/coke nut after quenching and sifting of every shipment of the gross coke from the coke batteries. Besides humidity is measured to recalculate all material flows on dry mass. | 1% |
| 2 | Production of dry metallurgical coke | Railway scales | 1% |
| 3 | Production of crude benzol | Fluid level gauge | 0,1% |
| 4 | Output of dry coal tar | Reverse calculation via sum of products of tar distillation measured by fluid level gauge | 0,1% |
| 5 | Consumption of skip metallurgical coke in BFP | Weighting funnels with strain sensor VDD6-0.5. Besides humidity is measured to recalculate on dry mass | 1% |
| 6 | Production of pig iron in BFP | Railway scales | 0,3-1% depending on the scales type |
| 7 | Supply of blast furnace dust to the cement factory outside MMK | Railway scales | 0,3-1% depending on the scales type |
| 8 | Consumption of pig iron in EAFP | Railway scales | 0,3-1% depending on the scales type |
| 9 | Consumption of scrap metal in EAFP | | |
| 10 | Consumption of carbon-containing powder in EAFP | Strain-gauge weight-hopper | 1% |
| 11 | Consumption of electrodes in EAFP | Visual control | - |
| 12 | Output of profiled steel billet in EAFP | Calculation through geometric size of production output | - |
| 13 | Total production of slab and profiled steel billet in EAFP | | |

| | | | |
|---|---|---|---|
| 14 | Total smelting of steel in EAF-180 | | |
| 15 | Total electricity consumption by MMK | Electricity meters | Accuracy rating 0,5; 2,0; 2,5 depending on the type of meter |
| 16 | Electricity purchase from Unified Energy System of Urals grid | Electricity meters | Accuracy rating 0,5 |
| 17 | Total electricity consumption in EAFP | Electricity meters | Accuracy rating 0,5; 2,0; 2,5 depending on the type of meter |
| 18 | Consumption of grid electricity by EAF-180 | Electricity meters | Accuracy rating 0,5 |
| 19 | Specific electricity consumption for nitrogen production at MMK | - | - |
| 20 | Specific electricity consumption for production of pure nitrogen at MMK | | |
| 21 | Specific electricity consumption for production of argon at MMK | | |
| 22 | Consumption of BFG in CPP | Pressure differential flow meters Metran-100-DD-1411, Metran-22-DD-1420 and Sapphire-22-DD-2410 measure flows of COG, BFG and NG. Then the consumption of these gases is calculated by SPG-762 calculator.<br><br>Pressure differential flow meters Yokogava Eja110a measure flows of NG in BFP, CHPP, CPP, SABPP and the turbine section of the steam plant. Then the consumption of natural gas is calculated by SPG-762 calculator. | 1% |
| 23 | Consumption of NG in CPP | | |
| 24 | Consumption of NG in CHPP | | |
| 25 | Consumption of BFG in SP | | |
| 26 | Consumption of COG in SP | | |
| 27 | Consumption of NG in SP | | |
| 28 | Consumption of NG in turbine section of SP | | |
| 29 | Consumption of NG in recovery unit of SP | | |
| 30 | Consumption of BFG in BPCP | | |
| 31 | Consumption of COG in BPCP | | |
| 32 | Consumption of NG in BPCP | | |
| 33 | Consumption of COG in BFP | | |

| | | | |
|---|---|---|---|
| 34 | Consumption of BFG in BFP | | |
| 35 | Consumption of nitrogen in EAFP | | |
| 36 | Consumption of BFG in SABPP for generation of air blast | | |
| 37 | Consumption of COG in SABPP for generation of air blast | | |
| 38 | Consumption of NG in SABPP for generation of air blast | | |
| 39 | Consumption of NG in BFP | | |
| 40 | Consumption of NG in EAFP | | |
| 41 | Output of COG in BPCP | | |
| 42 | Output of BFG in BFP | | |
| 43 | Generation of air blast at MMK | Air flow meter | 1% |
| 44 | Consumption of pure nitrogen in EAFP | Air flow meter | 1% |
| 45 | Consumption of argon in EAFP | | |
| 46 | Consumption of power station coal by CHPP | Railway scale | 1% |
| 47 | Carbon content in BFG | Calculation through gas composition which is measured by VTI-2 gas analyzer | 0,3% |
| 48 | Carbon content in COG | | |
| 49 | Carbon content in dry coal charge | Carbon analyzer LECO SC144DR | 0,25% |
| 50 | Carbon content in dry metallurgical coke | | |
| 51 | Carbon content in blast furnace dust | Express carbon analyzer AN-7529 | 0,5% |
| 52 | Carbon content in NG | Component composition of NG is specified in technical passport by the supplier. Carbon content is then estimated on the basis of that measured composition of gas | 0,5% |
| 53 | Power transmission and distribution losses in Unified energy Systems of Urals grid | Specified in Annual report of Urals Inter-regional Power Distribution Company | - |

## C. Adjustments and deviations from the monitoring plan presented in PDD

Some adjustments and deviations were made in the monitoring plan presented in section D of PDD, version 1.4 from January 15, 2010 (this version of PDD has been determined by Bureau Veritas Certification Holding SAS № Russia/0043-3/2009. Expert opinion of January 18, 2010). The changes have been made for adaptation monitoring plan and representation the actually existing situation. Another monitoring parameters and calculation formulae are in compliance with PDD.

| Mentioned in PDD | Implemented in practice | Explanation |
|---|---|---|
| Table D.1.1.1. **Parameter $\%C_{coking\ coal\_CP\_PJ}$ - Carbon content in dry coal charge**<br>Recording frequency – 2 times a day<br>Each incoming batch of coal is analyzed. Monthly average value is used. | BPCP lab of OJSC "MMK" did not perform systematic measurements of carbon content in coal charge in 2008 and in January 2009 due to replace the old measuring device on a new one (carbon analyzer LECO SC144DR), which entailed the development and approval of new measurements methodologies and staffed training.<br>Therefore in the calculations the value of the carbon content in dry coal charge for the period January 2008-January 2009 was taken as monthly average value of for the period February 2009-December 2009 (**80,35 % by mass.**). | A deviation in average values of carbon content in coal charge and metallurgical coke (on dry weight) was less than 1% by mass in the period from February 2009 to December 2009, which suggests a stable composition of the coal charge loaded into the coke ovens. It is achieved by pre-mixing of different types of coking coal before it is fed to the ovens. This is a common practice of the enterprise.<br>According to the MMK data based on regular measurements in previous years, the carbon content in coal charge didn't fell below 79% by mass and in metallurgical coke didn't fell below 83% by mass[2].<br>Besides the recent monitoring data from MMK shows that the average carbon content in coal charge is 80.47 % by mass for the period January-June 2010 and the average carbon content in metallurgical coke is 83.12 % by mass respectively what confirms that these values are fairly stable in the long-term period.<br>In case of application of default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Chapter 4. Table 4.3. (carbon content in |
| Table D.1.1.1. **Parameter $\%C_{metallurgical\ coke\_PJ}$ - Carbon content in dry metallurgical coke**<br>Recording frequency – 2 times a day<br>Averaged over sample measurements. | BPCP lab of OJSC "MMK" did not perform systematic measurements of carbon content in dry metallurgical coke in 2008 and in January 2009 due to replace the old measuring device on a new one (carbon analyzer LECO SC144DR), which entailed the development and approval of new measurements methodologies and staffed training.<br>Therefore in the calculations the value of the carbon content in dry metallurgical coke for the period | |

[2] Letter from Head of BPCP production mr. Shashkov to CTF Consulting, LLC by 29 May 2009

| | | |
|---|---|---|
| | January 2008-January 2009 was taken as monthly average value of for the period February 2009-December 2009 (**83,51 % by mass.**). | coal charge is 73 % by mass and carbon content in metallurgical coke is 83 % by mass) the existing carbon balance for coke and iron production processes developed in the PDD and Monitoring report will be heavily disturbed. Applying the default values of IPCC 2006 for $CO_2$ emission calculations in year 2008 the total mass of carbon in the input flow for production of metallurgical coke in BPCP would be decreased by 8.4% (446.5 ths. tones C) meanwhile total mass of carbon in the output flow from production of metallurgical coke would be decreased only by 0.5 % (21.8 ths. tones C). Thereby for production of 4269.3 ths. tones of metallurgical coke in BPCP in 2008 the greater quantities of coal charge would need to be used in case of proposed lower carbon content of coal charge (73 % by mass instead of actually applied 80.35 % by mass).<br><br>As soon as production data are fixed based on actual reporting for 2008 the $CO_2$ emissions would be estimated with great deviation from the PDD values which seems to be unreasonable as on the stage of development the PDD (April 2009) all available data of raw materials consumption and output in the project were used from actual MMK reports for 2008. Therefore the value of emission reduction in 2008 in the PDD report should coincide with the value of emission reduction in 2008 in the Monitoring report.<br><br>Take into account statements above it seems to be rather correct and acceptable approach to apply the monthly average value of carbon content in coal charge and metallurgical coke in accordance with instrumental |

| | | |
|---|---|---|
| | | data of February 2009-December 2009 in $CO_2$ emissions calculation for the period January 2008 – January 2009 instead of using of respective IPCC default values. |
| ***Specific $CO_2$ emissions per ton of produced metallurgical coke***<br>**$SPE_{metallurgical\ coke} = PE_{metallurgical\ coke} / P_{metallurgical\ coke\_PJ}$ (D.1.1.2.-2)**<br>Where:<br>$SPE_{metallurgical\_coke}$ – Specific $CO_2$ emissions per ton of dry metallurgical coke produced in BPCP, ton $CO_2$/ton<br>$PE_{metallurgical\_coke}$ – Project emissions from production of metallurgical coke in BPCP, thousand tons of $CO_2$<br>$P_{metallurgical\ coke\_PJ}$ – Production of dry metallurgical coke, thousand tons | The monitoring plan means that OJSC “MMK” fully meets their requirements for metallurgical coke, which was the practice in recent years. However in 2nd and 3rd quarters of 2009 OJSC “MMK” purchased a part of required metallurgical coke from other coke producers by reason of shut down of several coke batteries at the end of 2008 (due to the global economic and financial crisis). Thereby the value of specific $CO_2$ emissions per ton of dry metallurgical coke produced in BPCP was the same for own produced and purchased coke since other producers of coke have not lesser carbon intensity during its production. | Mentioned deviation in the calculation model have been illustrated in section E.1 of PDD and approved by independent accredited entity during determination. |
| Tables D.1.1.1 и D.1.1.3<br>**Parameter $C_{NG\_PJ}$ - Carbon content in NG**<br>Recording frequency – monthly<br>Calculated on the basis of composition of natural gas, specified in the technical quality passport by the supplier. | Technical quality passport for July 2008 is unreadable because of bad quality of printing. The value of carbon content in NG for this month was taken as **0.49 кg C/m³**. | According to data of the quality passports of natural gas for the other months in 2008 the carbon content of natural gas from April to December 2008 was 0.49 kg C/$m^3$. Therefore, this value is characteristic and arithmetic average for 2008. So mentioned deviation is a conservative assumption. |
| Table D.1.1.1<br>**$CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades** | **In April-July and November-December 2009 the** steel was not melted in EAF-180 furnaces that have been shut down. But ancillary equipment of complex EAF-180 consumed a small amount of electricity. | |

| | | |
|---|---|---|
| **$PE_{EC\_grid\_profiled\_steel\_EAF} = SEC_{grid\_steel\_EAF} * P_{profiled\ steel\_EAFP} * \sum P_{steel\_EAF} / \sum P_{profiled\ \&slab\ steel\_EAFP} * EF_{grid} * (1+TDL)$ (D.1.1.2.-14)**<br><br>Where:<br>$PE_{EC\_grid\_profiled\_steel\_EAF}$ – $CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades, thousand tons of $CO_2$<br>$SEC_{grid\_steel\_EAF}$ – Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel, MWh/ton<br>$P_{profiled\ steel\_EAFP}$ – Output of profiled steel billet in EAFP, thousand tons<br>$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons<br>$\sum P_{profiled\&slab\ steel\_EAFP}$ – Total production of slab and profiled steel billet in EAFP, thousand tons<br>$EF_{grid}$ – $CO_2$ emission factor for grid electricity from Unified Energy Systems of Urals ($EF_{grid}$ = 0.541 t $CO_2$/MW-h)<br>TDL – Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals, %<br>**Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades**<br>**$SEC_{grid\_steel\_EAF} = EC_{grid\_steel\_EAF} / \sum P_{steel\_EAF}$ (D.1.1.2.-15)** | Therefore **for these months** the formula D.1.1.2.-14 was reduced to the form:<br>**$PE_{EC\_grid\_profiled\_steel\_EAF} = EC_{grid\_steel\_EAF} * EF_{grid} * (1+TDL)$** | |

| | | |
|---|---|---|
| Where:<br>$SEC_{grid\_steel\_EAF}$ – Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel, MWh/t<br>$EC_{grid\_steel\_EAF}$ – Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation, GW-h<br>$\sum P_{steel\_EAF}$ – Total smelting of steel in EAF-180, thousand tons | | |
| Table D.1.1.1<br>**$EC_{import\_PJ}$**<br>**Electricity purchase from Unified Energy System of Urals grid, GW-h**<br>**$EC_{grid\_sleel\_EAF}$**<br>**Consumption of grid electricity by EAF-180, GW-h** | According to the reports: Summary of energy consumption by departments of OJSC “MMK” and Analysis of energy resources consumption by OJSC “MMK” the import of grid electricity from the grid (“Chelyabinsk Energy” an affiliate of OJSC “Interregional distribution grid company of Urals”) **in November-December 2008 and January 2009** was the value less than consumption of grid electricity by EAF-180 via 220/35 kV step-down substation registered by the meters.<br>For correctness of the calculations the value of the import of grid electricity **for these months** has been equated in the calculation tables to the value of consumption of grid electricity by EAF-180 via 220/35 kV step-down substation. | Mentioned deviation is due to both: the specifics of the registration of electricity consumption in OJSC “MMK” and influence of the sharp setback in production in the end of 2008 – beginning 2009.<br>As shown in Annex 3 of PDD all high-voltage power lines can work two-way including the connecting lines between MMK’s substations and block-station power plants. Electricity can be transmitted to and from MMK. The volume of electricity purchased by OJSC “MMK” from grid supplier during each accounting period (usually one month) is calculated as a balance in transmission of electricity.<br>In November-December 2008 and January 2009, MMK was actually a net exporter of electricity into the Unified Energy System of Urals grid which is reflected in the reports.<br>Electric arc furnaces are powered by 35 kV from substation №77 (this substation is directly connected to the external grid of UES Urals) without possibility of electricity consumption from other sub-stations. |

| | | |
|---|---|---|
| | | Therefore the actual electricity consumption by EAF-180 cannot be less than the import of grid electricity. |
| ***Specific consumption of air blast per ton of pig iron produced***<br><br>$\mathbf{SC_{air\ blast\ generation\_PJ} = P_{air\ blast\ generation} / P_{pig\ iron\_BF\_PJ}}$ **(D.1.1.2.-29)**<br><br>Where:<br><br>$SC_{air\ blast\ generation\_PJ}$ – Specific consumption of air blast in BFP per ton of produced pig iron, thousand $m^3$/ton<br><br>$P_{air\ blast\ generation}$ – Generation of air blast at MMK, $m^3$ of air blast<br><br>$P_{pig\ iron\_BF\_PJ}$ – Production of pig iron in BFP, thousand tons | There is a misprint in PDD. Generation of air blast at MMK is designated $\mathbf{OC_{air\ blast\ generation\_PJ}}$ which follows from the table D.1.1.1 and formula D.1.1.2.-27. | |

# D. Calculation of GHG emissions reduction

## *D.1 $CO_2$ emissions from metallurgical conversions calculated by carbon balance method*

**<u>Production of metallurgical coke</u>**

**$PE_{metallurgical\_coke} = [(M_{coking\ coal\_PJ} * \%C_{coking\ coal\_PJ}) + (FC_{BFG\_CP\_PJ} * C_{BFG\_PJ}) + (FC_{COG\_CP\_PJ} * C_{COG\_PJ}) + (FC_{NG\_CP\_PJ} * C_{NG\_PJ}) -$**
**$- (P_{metallurgical\ coke\_PJ} * \%C_{metallurgical\ coke\_PJ}) - (P_{COG\_CP\_PJ} * C_{COG\_PJ}) - (P_{benzol\_PJ} * \%C_{benzol}) - (P_{coal\text{-}tar\_PJ} * \%C_{coal\text{-}tar})] * 44/12$ (PDD formula D.1.1.2.-1)**

***Specific $CO_2$ emissions per ton of produced metallurgical coke***

**$SPE_{metallurgical\ coke} = PE_{metallurgical\ coke} / P_{metallurgical\ coke\_PJ}$ (PDD formula D.1.1.2.-2)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|---|---|---|
| **$M_{coking\ coal\_PJ}$** | Consumption of coal charge in BPCP (on dry mass) | ths. tons | **$C_{COG\_PJ}$** | Carbon content in COG | kg $C/m^3$ | **$P_{COG\_CP\_PJ}$** | Output of COG in BPCP | mln. $m^3$ |
| **$\%C_{coking\ coal\_PJ}$** | Carbon content in dry coal charge | % by mass | **$FC_{NG\_CP\_PJ}$** | Consumption of NG in BPCP | mln. $m^3$ | **$P_{benzol\_PJ}$** | Production of crude benzol | ths. tons |
| **$FC_{BFG\_CP\_PJ}$** | Consumption of BFG in BPCP | mln. $m^3$ | **$C_{NG\_PJ}$** | Carbon content in NG | kg C/m3 | **$P_{coal\text{-}tar\_PJ}$** | Output of dry coal tar | ths. tons |
| **$C_{BFG\_PJ}$** | Carbon content in BFG | kg $C/m^3$ | **$P_{metallurgical\ coke\_PJ}$** | Production of dry metallurgical coke | ths. tons | **$PE_{metallurgical\_coke}$** | Project emissions from production of metallurgical coke in BPCP | ths. tons $CO_2$ |
| **$FC_{COG\_CP\_PJ}$** | Consumption of COG in BPCP | mln. $m^3$ | **$\%C_{metallurgical\ coke\_PJ}$** | Carbon content in dry metallurgical coke | % by mass | **$SPE_{metallurgical\ coke}$** | Specific $CO_2$ emissions per ton of dry metallurgical coke produced in BPCP | ton $CO_2$/ ton |

*Specific $CO_2$ emissions from metallurgical conversions, same for project and baseline. Production of metallurgical coke*

## *12 months of 2008*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of coal charge in BPCP (on dry mass) | ths. tons | 602,5 | 573,9 | 605,6 | 578,4 | 621,1 | 578,6 | 503,1 | 559,8 | 597,0 | 442,0 | 219,7 | 192,8 | 6074,5 |
| | Carbon content in dry coal charge | % by mass | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 | 80,35 |
| | | ths. tons C | 484,1 | 461,2 | 486,6 | 464,7 | 499,0 | 464,9 | 404,2 | 449,8 | 479,7 | 355,2 | 176,5 | 154,9 | 4880,8 |
| 2 | Consumption of COG in BPCP | mln. m3 | 50,8 | 49,6 | 49,8 | 47,3 | 56,0 | 51,8 | 40,8 | 47,5 | 52,8 | 36,9 | 18,1 | 19,3 | 520,7 |
| | Carbon content in COG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | 0,19 |
| | | ths. tons C | 10,0 | 9,7 | 9,5 | 9,2 | 11,0 | 10,0 | 7,7 | 9,0 | 9,7 | 7,0 | 3,3 | 3,3 | 99,4 |
| | Consumption of BFG in BPCP | mln. m3 | 163,2 | 155,0 | 168,8 | 162,4 | 152,2 | 143,8 | 141,7 | 150,7 | 151,7 | 121,5 | 73,6 | 50,9 | 1635,4 |
| | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | 0,20 |
| | | ths. tons C | 33,0 | 31,7 | 34,6 | 33,2 | 29,6 | 29,4 | 28,3 | 29,4 | 29,6 | 23,9 | 12,7 | 8,6 | 324,0 |
| | Consumption of NG in BPCP | mln. m3 | 2,3 | 2,3 | 2,1 | 1,0 | 0,8 | 0,7 | 0,8 | 0,8 | 0,8 | 0,9 | 0,7 | 1,3 | 14 |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 |
| | | ths. tons C | 1,1 | 1,1 | 1,0 | 0,5 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,5 | 0,3 | 0,6 | 7,1 |
| 3 | **Total mass of carbon in the input flow for production of metallurgical coke** | **ths. tons C** | **528,2** | **503,7** | **531,8** | **507,5** | **540,0** | **504,7** | **440,6** | **488,6** | **519,4** | **386,5** | **192,9** | **167,5** | **5311,4** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Production of dry metallurgical coke | ths. tons | 423,0 | 406,0 | 428,5 | 406,0 | 433,4 | 402,5 | 352,1 | 395,3 | 421,3 | 312,8 | 154,0 | 134,4 | 4269,3 |
| | Carbon content in dry metallurgical coke | % by mass | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 |
| | | ths. tons C | 353,2 | 339,0 | 357,9 | 339,1 | 361,9 | 336,2 | 294,0 | 330,1 | 351,8 | 261,2 | 128,6 | 112,2 | 3565,3 |
| 2 | Output of COG in BPCP | mln. m3 | 202,0 | 189,6 | 201,3 | 191,8 | 206,7 | 193,1 | 167,8 | 185,4 | 197,4 | 147,0 | 70,0 | 59,1 | 2011,2 |
| | Carbon content in COG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | 0,19 |
| | | ths. tons C | 39,7 | 36,9 | 38,5 | 37,2 | 40,6 | 37,3 | 31,6 | 35,1 | 36,4 | 27,8 | 12,8 | 10,2 | 384,3 |
| 3 | Output of dry coal tar | ths. tons | 17,5 | 16,6 | 17,5 | 16,8 | 18,0 | 16,8 | 15,5 | 16,2 | 17,3 | 12,8 | 7,5 | 5,6 | 178,2 |
| | Carbon content in dry coal tar | % by mass | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 |
| | | ths. tons C | 15,0 | 14,3 | 15,1 | 14,4 | 15,5 | 14,4 | 13,3 | 14,0 | 14,9 | 11,0 | 6,4 | 4,8 | 153,2 |
| 4 | Production of crude benzol | ths. tons | 5,5 | 5,2 | 5,4 | 5,1 | 5,4 | 5,2 | 4,9 | 5,1 | 5,5 | 4,0 | 2,0 | 1,8 | 55,0 |
| | Carbon content in crude benzol | % | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 |

*Specific $CO_2$ emissions from metallurgical conversions, same for project and baseline. Production of metallurgical coke*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ths. tons C | 4,9 | 4,7 | 4,8 | 4,6 | 4,9 | 4,7 | 4,4 | 4,5 | 4,9 | 3,6 | 1,8 | 2 | **49,5** |
| 5 | **Total mass of carbon in the output flow from production of metallurgical coke** | **ths. tons C** | **412,9** | **395,0** | **416,3** | **395,3** | **422,9** | **392,6** | **343,3** | **383,8** | **408,1** | **303,7** | **149,7** | **128,9** | **4152,3** |

CO2 emissions from production of metallurgical coke

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during production of metallurgical coke | ths. tons C | 115,3 | 108,7 | 115,5 | 112,3 | 117,1 | 112,0 | 97,3 | 104,8 | 111,3 | 82,8 | 43,2 | 38,6 | **1159,0** |
| 2 | CO2 emissions from production of metallurgical coke in BPCP | ths. tons CO2 | 422,9 | 398,7 | 423,7 | 411,6 | 429,3 | 410,8 | 356,6 | 384,4 | 408,3 | 303,7 | 158,2 | 141,5 | **4249,8** |
| 3 | **Specific CO2 emissions per ton of produced metallurgical coke** | **ton CO2/ton** | **1,000** | **0,982** | **0,989** | **1,014** | **0,991** | **1,020** | **1,013** | **0,972** | **0,969** | **0,971** | **1,028** | **1,053** | **1,000** |

## *12 months of 2009*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of coal charge in BPCP (on dry mass) | ths. tons | 277,3 | 406,8 | 429,5 | 441,4 | 436,6 | 484,4 | 495,3 | 503,3 | 493,3 | 501,0 | 456,6 | 527,0 | **5452,4** |
| | Carbon content in dry coal charge | % by mass | 80,35 | 80,26 | 80,23 | 79,73 | 79,72 | 80,48 | 80,51 | 80,30 | 80,67 | 80,83 | 80,72 | 80,39 | **80,35** |
| | | ths. tons C | 222,8 | 326,5 | 344,6 | 351,9 | 348,1 | 389,8 | 398,7 | 404,1 | 397,9 | 404,9 | 368,6 | 423,7 | **4381,7** |
| 2 | Consumption of COG in BPCP | mln. m3 | 34,1 | 42,9 | 42,6 | 43,4 | 41,6 | 51,4 | 49,9 | 49,4 | 49,5 | 49,4 | 46,4 | 53,4 | **553,9** |
| | Carbon content in COG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | **0,18** |
| | | ths. tons C | 6,2 | 7,7 | 7,7 | 7,8 | 7,7 | 9,4 | 9,4 | 8,8 | 9,2 | 9,5 | 8,6 | 9,7 | **101,6** |
| | Consumption of BFG in BPCP | mln. m3 | 47,5 | 88,0 | 92,5 | 95,2 | 101,4 | 93,0 | 104,6 | 107,7 | 105,5 | 109,7 | 103,6 | 114,0 | **1162,6** |
| | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | **0,21** |
| | | ths. tons C | 8,8 | 18,2 | 18,9 | 20,0 | 21,2 | 19,9 | 22,6 | 22,4 | 22,6 | 23,4 | 22,1 | 23,9 | **243,9** |
| | Consumption of NG in BPCP | mln. m3 | 1,5 | 2,1 | 2,3 | 1,50 | 0,69 | 0,64 | 0,70 | 0,58 | 0,74 | 1,44 | 2,21 | 3,0 | **17** |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 0,7 | 1,0 | 1,1 | 0,7 | 0,3 | 0,3 | 0,3 | 0,3 | 0,4 | 0,7 | 1,1 | 1,5 | **8,6** |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | **Total mass of carbon in the input flow for production of metallurgical coke** | **ths. tons C** | **238,5** | **353,4** | **372,3** | **380,4** | **377,3** | **419,4** | **431,1** | **435,5** | **430,1** | **438,6** | **400,5** | **458,7** | **4735,8** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Production of dry metallurgical coke | ths. tons | 193,5 | 282,4 | 301,5 | 309,9 | 308,2 | 342,1 | 350,9 | 353,7 | 347,1 | 352,9 | 322,1 | 372,6 | **3836,9** |
| | Carbon content in dry metallurgical coke | % by mass | 83,51 | 83,39 | 84,02 | 83,39 | 83,41 | 83,31 | 83,43 | 83,64 | 83,40 | 83,84 | 83,63 | 83,10 | **83,51** |
| | | ths. tons C | 161,6 | 235,5 | 253,3 | 258,4 | 257,1 | 285,0 | 292,7 | 295,8 | 289,4 | 295,9 | 269,4 | 309,6 | **3203,8** |
| 2 | Output of COG in BPCP | mln. m3 | 86,7 | 131,1 | 140,8 | 145,4 | 146,0 | 158,1 | 166,0 | 167,6 | 163,7 | 166,5 | 148,0 | 171,4 | **1791,4** |
| | Carbon content in COG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | **0,18** |
| | | ths. tons C | 15,7 | 23,6 | 25,4 | 26,3 | 26,9 | 28,9 | 31,3 | 29,7 | 30,5 | 31,9 | 27,6 | 31,0 | **328,8** |
| 3 | Output of dry coal tar | ths. tons | 6,9 | 13,9 | 12,8 | 13,9 | 14,6 | 16,5 | 16,3 | 15,9 | 15,8 | 14,5 | 13,2 | 15,4 | **169,6** |
| | Carbon content in dry coal tar | % by mass | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | 86,00 | **86,00** |
| | | ths. tons C | 6,0 | 12,0 | 11,0 | 12,0 | 12,5 | 14,2 | 14,0 | 13,6 | 13,6 | 12,5 | 11,4 | 13,2 | **145,9** |
| 4 | Production of crude benzol | ths. tons | 2,7 | 4,2 | 4,0 | 4,6 | 4,2 | 4,6 | 4,8 | 5,0 | 4,8 | 4,9 | 4,2 | 4,8 | **52,9** |
| | Carbon content in crude benzol | % | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | 90,00 | **90,00** |
| | | ths. tons C | 2,4 | 3,8 | 3,6 | 4,1 | 3,8 | 4,2 | 4,3 | 4,5 | 4,4 | 4,5 | 3,8 | 4 | **47,6** |
| 5 | **Total mass of carbon in the output flow from production of metallurgical coke** | **ths. tons C** | **185,7** | **274,8** | **293,4** | **300,8** | **300,3** | **332,2** | **342,3** | **343,7** | **337,9** | **344,7** | **312,1** | **358,2** | **3726,2** |

CO2 emissions from production of metallurgical coke

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during production of metallurgical coke | ths. tons C | 52,8 | 78,6 | 79,0 | 79,6 | 77,0 | 87,2 | 88,8 | 91,9 | 92,2 | 93,8 | 88,4 | 100,6 | **1009,7** |
| 2 | CO2 emissions from production of metallurgical coke in BPCP | ths. tons CO2 | 193,7 | 288,0 | 289,6 | 291,8 | 282,2 | 319,6 | 325,5 | 336,9 | 338,1 | 344,1 | 324,0 | 368,7 | **3702,2** |
| 3 | **Specific CO2 emissions per ton of produced metallurgical coke** | **ton CO2/ton** | **1,001** | **1,020** | **0,960** | **0,942** | **0,916** | **0,934** | **0,928** | **0,952** | **0,974** | **0,975** | **1,006** | **0,990** | **0,966** |

*Specific $CO_2$ emissions from metallurgical conversions, same for project and baseline. Production of metallurgical coke*

**Production of pig iron**

$$PE_{pig\_iron} = [(M_{skip\_metallurgical\ coke\_BF\_PJ} * \%C_{metallurgical\ coke\_PJ}) + (FC_{COG\_BF\_PJ} * C_{COG\_PJ}) + (FC_{NG\_BF\_PJ} * C_{NG\_PJ}) + (FC_{BFG\_BF\_PJ} * C_{BFG\_.PJ}) - (P_{pig\ iron\_BF\_PJ} * \%C_{pig\ iron}) - (P_{BFG\_BF\_PJ} * C_{BFG\_PJ})] * 44/12$$

**(PDD formula D1.1.2.-3)**

***Specific CO2 emissions per ton of pig iron produced***

$$SPE_{pig\ iron} = PE_{pig\_iron} / P_{pig\ iron\_BF\_PJ}$$

**(PDD formula D.1.1.2.-4)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $M_{skip\_metallurgical\ coke\_BF\_PJ}$ | Consumption of skip metallurgical coke in BFP | ths. tons | $P_{pig\ iron\_BF\_PJ}$ | Production of pig iron in BFP | ths. tons |
| $FC_{COG\_BF\_PJ}$ | Consumption of COG in BFP | mln. $m^3$ | $P_{BFG\_BF\_PJ}$ | Output of BFG in BFP | mln. $m^3$ |
| $FC_{NG\_BF\_PJ}$ | Consumption of NG in BFP | mln. $m^3$ | $C_{NG\_PJ}$ | carbon content in NG | kg $C/m^3$ |
| $FC_{BFG\_BF\_PJ}$ | Consumption of BFG in BFP | mln. $m^3$ | $C_{BFG\_.PJ}$ | Carbon content in BFG | kg $C/m^3$ |
| $C_{COG\_PJ}$ | Carbon content in COG | kg $C/m^3$ | $PE_{pig\ iron}$ | Project emissions from production of pig iron in the blast furnace plant | ths. tons $CO_2$ |
| $\%C_{pig\ iron}$ | Carbon content in pig iron | % by mass | $SPE_{pig\ iron}$ | Specific $CO_2$ emissions per ton of produced pig iron | ton $CO_2$/ton |
| $\%C_{metallurgical\ coke\_PJ}$ | Carbon content in metallurgical coke | % by mass | | | |

## *12 months of 2008*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of skip metallurgical coke in BFP | ths. tons | 390,5 | 374,6 | 397,3 | 375,4 | 408,0 | 361,3 | 323,5 | 371,4 | 381,5 | 283,3 | 144,6 | 127,8 | 3939,2 |
| | Carbon content in dry metallurgical coke | %by mass | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 | 83,51 |
| | | ths. tons C | 326,1 | 312,8 | 331,8 | 313,5 | 340,7 | 301,7 | 270,2 | 310,1 | 318,6 | 236,6 | 120,8 | 106,7 | 3289,6 |
| 2 | Consumption of COG in BFP | mln. m3 | 6,4 | 7,1 | 5,9 | 4,9 | 7,9 | 8,9 | 7,4 | 8,5 | 8,3 | 4,9 | 3,3 | 0,0 | 73,7 |
| | Carbon content in COG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | 0,19 |

*Specific $CO_2$ emissions form metallurgical conversions same for project and baseline. Production of pig iron*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ths. tons C | 1,26 | 1,39 | 1,13 | 0,96 | 1,55 | 1,73 | 1,39 | 1,61 | 1,54 | 0,93 | 0,61 | 0,00 | **14,1** |
| | Consumption of NG in BFP | mln. m3 | 86,3 | 83,0 | 89,6 | 81,9 | 82,9 | 71,4 | 63,9 | 71,8 | 79,1 | 67,3 | 31,4 | 20,2 | **828,8** |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 42,7 | 41,1 | 44,4 | 40,5 | 41,0 | 35,3 | 31,3 | 35,5 | 39,1 | 33,3 | 15,5 | 10,0 | **409,8** |
| | Consumption of BFG in BFP | mln. m3 | 422,3 | 400,8 | 438,9 | 390,4 | 404,0 | 328,9 | 302,7 | 362,5 | 371,6 | 291,6 | 164,2 | 153,76 | **4031,8** |
| | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | **0,20** |
| | | ths. tons C | 85,4 | 82,1 | 90,1 | 79,7 | 78,5 | 67,2 | 60,4 | 70,8 | 72,5 | 57,3 | 28,3 | 26,1 | **798,4** |
| 3 | **Total mass of carbon in the input flow for production of pig iron** | **ths. tons C** | **455,5** | **437,4** | **467,4** | **434,7** | **461,7** | **405,8** | **363,3** | **418,0** | **431,8** | **328,1** | **165,2** | **142,8** | **4511,9** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Production of pig iron in BFP | ths. tons | 874,5 | 843,1 | 895,4 | 820,8 | 872,3 | 754,4 | 679,4 | 785,3 | 811,0 | 621,8 | 315,3 | 268,2 | **8541,4** |
| | Carbon content in pig iron | % by mass | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | **4,70** |
| | | ths. tons C | 41 | 40 | 42 | 39 | 41 | 35 | 32 | 37 | 38 | 29 | 15 | 13 | **401** |
| 2 | Output of BFG in BFP | mln. m3 | 1176,9 | 1140,2 | 1200,5 | 1107,7 | 1180,0 | 1037,6 | 925,1 | 1062,6 | 1103,6 | 835,7 | 392,8 | 312,4 | **11475,0** |
| | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | **0,20** |
| | | ths. tons C | 238,0 | 233,5 | 246,4 | 226,2 | 229,2 | 211,9 | 184,7 | 207,4 | 215,4 | 164,4 | 67,6 | 53,0 | **2277,7** |
| 3 | **Total mass of carbon in the output flow from production of pig iron** | **ths. tons C** | **279,1** | **273,1** | **288,5** | **264,8** | **270,2** | **247,3** | **216,6** | **244,3** | **253,5** | **193,6** | **82,4** | **65,6** | **2679,1** |

CO2 emissions from production of pig iron

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning during production of pig iron | ths. tons | 176,4 | 164,3 | 178,9 | 169,9 | 191,6 | 158,5 | 146,6 | 173,7 | 178,3 | 134,6 | 82,7 | 77,2 | **1832,8** |
| 2 | CO2 emissions from production of pig iron in the blast furnace plant | ths. tons CO2 | 647,0 | 602,4 | 655,9 | 623,0 | 702,4 | 581,2 | 537,6 | 637,0 | 653,8 | 493,4 | 303,4 | 283,1 | **6720,2** |
| 3 | **Specific CO2 emissions per ton of pig iron produced** | **ton CO2/ton** | **0,740** | **0,715** | **0,733** | **0,759** | **0,805** | **0,770** | **0,791** | **0,811** | **0,806** | **0,794** | **0,962** | **1,056** | **0,812** |

*Specific $CO_2$ emissions form metallurgical conversions same for project and baseline. Production of pig iron*

## *12 months of 2009*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of skip metallurgical coke in BFP | ths. tons | 183,2 | 247,8 | 280,8 | 291,0 | 279,2 | 305,6 | 337,9 | 336,7 | 336,1 | 341,1 | 298,6 | 334,0 | 3572,2 |
| | Carbon content in dry metallurgical coke | % by mass | 83,51 | 83,39 | 84,02 | 83,39 | 83,41 | 83,31 | 83,43 | 83,64 | 83,40 | 83,84 | 83,63 | 83,10 | 83,51 |
| | | ths. tons C | 153,0 | 206,7 | 235,9 | 242,7 | 232,9 | 254,6 | 281,9 | 281,6 | 280,3 | 286,0 | 249,7 | 277,6 | 2982,9 |
| 2 | Consumption of COG in BFP | mln. m3 | 0,27 | 2,69 | 2,43 | 2,18 | 3,67 | 4,19 | 3,94 | 4,37 | 3,59 | 3,09 | 1,95 | 2,11 | 34,5 |
| | Carbon content in COG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | 0,18 |
| | | ths. tons C | 0,05 | 0,48 | 0,44 | 0,39 | 0,68 | 0,77 | 0,74 | 0,78 | 0,67 | 0,59 | 0,36 | 0,38 | 6,3 |
| | Consumption of NG in BFP) | mln. m3 | 86,3 | 83,0 | 89,6 | 81,9 | 82,9 | 71,4 | 63,9 | 71,8 | 79,1 | 67,3 | 31,4 | 20,2 | 828,8 |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | 0,50 |
| | | ths. tons C | 42,8 | 41,1 | 44,4 | 40,5 | 41,0 | 35,3 | 31,6 | 35,5 | 39,1 | 33,3 | 15,5 | 10,0 | 410,3 |
| | Consumption of BFG in BFP | mln. m3 | 188,8 | 249,7 | 289,0 | 292,2 | 286,4 | 310,9 | 346,9 | 350,9 | 361,2 | 382,4 | 340,9 | 379,55 | 3778,8 |
| | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 |
| | | ths. tons C | 35,0 | 51,6 | 59,2 | 61,3 | 59,9 | 66,4 | 74,8 | 72,9 | 77,2 | 81,7 | 72,8 | 79,6 | 792,5 |
| 3 | **Total mass of carbon in the input flow for production of pig iron** | **ths. tons C** | **230,8** | **299,9** | **339,9** | **344,8** | **334,5** | **357,2** | **389,1** | **390,9** | **397,3** | **401,6** | **338,4** | **367,6** | **4192,0** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Production of pig iron in BFP | ths. tons | 400,5 | 551,4 | 639,7 | 668,9 | 640,5 | 696,9 | 777,5 | 775,2 | 773,0 | 788,4 | 685,0 | 766 | 8162,8 |
| | Carbon content in pig iron | % by mass | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 |
| | | ths. tons C | 19 | 26 | 30 | 31 | 30 | 33 | 37 | 36 | 36 | 37 | 32 | 36 | 384 |
| 2 | Output of BFG in BFP | mln. m3 | 458,4 | 732,8 | 865,5 | 907,3 | 888,0 | 954,6 | 1077,7 | 1077,1 | 1070,0 | 1090,0 | 964,0 | 1082,1 | 11168 |
| | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 |
| | | ths. tons C | 84,9 | 151,5 | 177,2 | 190,3 | 185,8 | 204,0 | 232,5 | 223,7 | 228,7 | 233,0 | 206,0 | 227,0 | 2344,5 |
| 3 | **Total mass of carbon in the output flow from production of pig iron** | **ths. tons C** | **103,7** | **177,4** | **207,3** | **221,7** | **215,9** | **236,8** | **269,0** | **260,2** | **265,0** | **270,1** | **238,2** | **262,9** | **2728,2** |

*Specific $CO_2$ emissions form metallurgical conversions same for project and baseline. Production of pig iron*

CO2 emissions from production of pig iron

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning during production of pig iron | ths. tons | 127,0 | 122,5 | 132,7 | 123,1 | 118,6 | 120,4 | 120,1 | 130,7 | 132,3 | 131,6 | 100,2 | 104,7 | **1463,8** |
| 2 | CO2 emissions from production of pig iron in the blast furnace plant | ths. tons CO2 | 465,8 | 449,1 | 486,4 | 451,5 | 435,0 | 441,5 | 440,4 | 479,2 | 485,0 | 482,4 | 367,4 | 383,8 | **5367,4** |
| 3 | **Specific CO2 emissions per ton of pig iron produced** | **ton CO2/ton** | **1,163** | **0,814** | **0,760** | **0,675** | **0,679** | **0,634** | **0,566** | **0,618** | **0,627** | **0,612** | **0,536** | **0,501** | **0,682** |

*Specific $CO_2$ emissions form metallurgical conversions same for project and baseline. Production of pig iron*

**<u>Production of profiled steel billet in EAFP (project only)</u>**

$$PE_{EAFP} = [(M_{pig\ iron\_EAFP} * \%C_{pig\ iron}) + (M_{carbon\ powder\_EAFP} * \%C_{carbon\ powder\_EAFP}) + (M_{scrap\_EAFP} * \%C_{scrap}) + (M_{electrodes\_EAFP} * \%C_{electrodes\_EAFP}) + (FC_{NG\_EAFP} * C_{NG\_PJ}) - (\sum P_{profiled\&slab\ steel\_EAFP} * \%C_{steel})] * 44/12$$

**(PDD formula D.1.1.2-5)**

***Specific CO2 emissions per ton of profiled steel billet produced in EAFP***

$$SPE_{EAFP} = PE_{EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$$

**(PDD formula D.1.1.2-6)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $M_{pig\ iron\_EAFP}$ | Consumption of pig iron in EAFP | ths. tons | $FC_{NG\_EAFP}$ | Consumption of NG in EAFP | mln. $m^3$ |
| $M_{carbon\ powder\_EAFP}$ | Consumption of carbon-containing powder in EAFP | ths. tons | $\sum P_{profiled\&slab\ steel\_EAFP}$ | Total production of slab and profiled steel billet in EAFP | ths. tons |
| $M_{scrap\_EAFP}$ | Consumption of scrap metal in EAFP | ths. tons | $PE_{EAFP}$ | Project $CO_2$ emissions from production of profiled steel billet in EAFP | ths.tons $CO_2$ |
| $M_{electrodes\_EAFP}$ | Consumption of electrodes in EAFP | ths. tons | $SPE_{EAFP}$ | Specific $CO_2$ emissions per ton of steel billet produced in EAFP | ton $CO_2$/ton |
| $\%C_{pig\ iron}$ | Carbon content in pig iron | % by mass | $\%C_{electrodes\_EAFP}$ | Carbon content in electrodes | % by mass |
| $\%C_{carbon\ powder\_EAFP}$ | Carbon content in carbon-containing powder | % by mass | $C_{NG\_PJ}$ | Carbon content in NG | kg $C/m^3$ |
| $\%C_{scrap}$ | Carbon content in scrap metal | % by mass | $\%C_{steel}$ | Carbon content in steel | % by mass |

*Specific $CO_2$ emissions from metallurgical conversions in the project only. Production of profiled steel billet in EAFP*

## *12 months of 2008*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of pig iron in EAFP | ths. tons | 110,2 | 113,0 | 116,6 | 98,7 | 104,0 | 91,2 | 77,2 | 85,2 | 94,3 | 48,9 | 34,7 | 38,9 | **1012,8** |
| | Carbon content in pig iron | % by mass | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | **4,70** |
| | | ths. tons C | 5,2 | 5,3 | 5,5 | 4,6 | 4,9 | 4,3 | 3,6 | 4,0 | 4,4 | 2,3 | 1,6 | 1,8 | **47,6** |
| 2 | Consumption of carbon-containing powder in EAFP | ths. tons | 0,95 | 0,75 | 1,24 | 0,95 | 0,90 | 1,31 | 1,08 | 0,92 | 0,95 | 0,62 | 0,54 | 0,47 | **10,7** |
| | Carbon content in carbon-containing powder | % by mass | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | **95,00** |
| | | ths. tons C | 0,9 | 0,7 | 1,2 | 0,9 | 0,9 | 1,2 | 1,0 | 0,9 | 0,9 | 0,6 | 0,5 | 0,4 | **10,1** |
| 3 | Consumption of scrap metal in EAFP | ths. tons | 255,5 | 223,9 | 244,8 | 237,3 | 228,0 | 236,4 | 248,8 | 253,3 | 244,4 | 111,4 | 75,9 | 136,6 | **2496,3** |
| | Carbon content in scrap metal | % by mass | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | **0,18** |
| | | ths. tons C | 0,46 | 0,40 | 0,44 | 0,43 | 0,41 | 0,43 | 0,45 | 0,46 | 0,44 | 0,20 | 0,14 | 0,25 | **4,5** |
| 4 | Consumption of electrodes in EAFP | ths. tons | 0,41 | 0,36 | 0,45 | 0,37 | 0,38 | 0,40 | 0,43 | 0,44 | 0,44 | 0,21 | 0,14 | 0,25 | **4,3** |
| | Carbon content in electrodes | % by mass | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | **99,00** |
| | | ths. tons C | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,4 | 0,2 | 0,1 | 0,3 | **4,3** |
| 5 | Consumption of NG in EAFP | mln. m3 | 7,4 | 6,2 | 6,2 | 5,4 | 5,6 | 5,3 | 5,8 | 5,9 | 5,5 | 4,4 | 3,3 | 4,3 | **65,4** |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 3,7 | 3,1 | 3,1 | 2,7 | 2,8 | 2,6 | 2,8 | 2,9 | 2,7 | 2,2 | 1,6 | 2,1 | **32,4** |
| **6** | **Total mass of carbon in the input flow in EAFP** | **ths. tons C** | **10,6** | **9,9** | **10,6** | **9,0** | **9,3** | **9,0** | **8,4** | **8,7** | **9,0** | **5,5** | **4,0** | **4,9** | **98,8** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total production of slab and profiled steel billet in EAFP | ths. tons | 322,6 | 298,0 | 320,4 | 300,5 | 297,0 | 291,0 | 289,3 | 305,5 | 301,5 | 142,0 | 97,9 | 152,7 | **3118,3** |
| | Carbon content in steel | % by mass | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | **0,18** |
| | | ths. tons C | 0,6 | 0,5 | 0,6 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,3 | 0,2 | 0,3 | **5,6** |
| **2** | **Total mass of carbon in the output flow from EAFP** | **ths. tons C** | **0,6** | **0,5** | **0,6** | **0,5** | **0,5** | **0,5** | **0,5** | **0,5** | **0,5** | **0,3** | **0,2** | **0,3** | **5,6** |

*Specific $CO_2$ emissions from metallurgical conversions in the project only. Production of profiled steel billet in EAFP*

CO2 emissions from production of steel

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during production of profiled steel billet in EAFP | ths. tons C | 10,0 | 9,3 | 10,1 | 8,5 | 8,8 | 8,5 | 7,8 | 8,1 | 8,4 | 5,2 | 3,9 | 4,6 | **93,2** |
| 2 | CO2 emissions from production of profiled steel billet in EAFP | ths. tons CO2 | 36,7 | 34,2 | 36,9 | 31,1 | 32,2 | 31,0 | 28,7 | 29,8 | 30,8 | 19,2 | 14,2 | 16,9 | **341,8** |
| **3** | **Specific CO2 emissions per ton of profiled steel billet produced in EAFP** | **tons CO2/ton** | **0,114** | **0,115** | **0,115** | **0,104** | **0,108** | **0,107** | **0,099** | **0,098** | **0,102** | **0,135** | **0,145** | **0,111** | **0,113** |

## *12 months of 2009*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of pig iron in EAFP | ths. tons | 31,8 | 55,8 | 83,8 | 87,0 | 67,4 | 94,6 | 92,5 | 96,4 | 95,3 | 79,2 | 72,1 | 73,8 | **929,6** |
| | Carbon content in pig iron | % by mass | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | **4,70** |
| | | ths. tons C | 1,5 | 2,6 | 3,9 | 4,1 | 3,2 | 4,4 | 4,3 | 4,5 | 4,5 | 3,7 | 3,4 | 3,5 | **43,7** |
| 2 | Consumption of carbon-containing powder in EAFP | ths. tons | 0,6 | 0,7 | 0,2 | 0,2 | 0,1 | 0,2 | 0,2 | 0,3 | 0,5 | 0,2 | 0,1 | 0,2 | **3,4** |
| | Carbon content in carbon-containing powder | % by mass | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | 95,00 | **95,00** |
| | | ths. tons C | 0,5 | 0,7 | 0,2 | 0,2 | 0,1 | 0,2 | 0,2 | 0,3 | 0,5 | 0,1 | 0,1 | 0,1 | **3,2** |
| 3 | Consumption of scrap metal in EAFP | ths. tons | 129,4 | 183,4 | 26,0 | 18,3 | 13,8 | 30,2 | 33,4 | 78,5 | 72,4 | 28,4 | 24,8 | 17,8 | **656,5** |
| | Carbon content in scrap metal | % by mass | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | **0,18** |
| | | ths. tons C | 0,23 | 0,33 | 0,05 | 0,03 | 0,02 | 0,05 | 0,06 | 0,14 | 0,13 | 0,05 | 0,04 | 0,03 | **1,2** |
| 4 | Consumption of electrodes in EAFP | ths. tons | 0,23 | 0,37 | 0,04 | 0,03 | 0,03 | 0,05 | 0,04 | 0,14 | 0,12 | 0,05 | 0,04 | 0,02 | **1,2** |
| | Carbon content in electrodes | % by mass | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | 99,00 | **99,00** |
| | | ths. tons C | 0,2 | 0,4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,1 | 0,1 | 0,0 | 0,0 | 0,0 | **1,1** |
| 5 | Consumption of NG in EAFP | mln. m3 | 4,7 | 5,2 | 4,1 | 3,9 | 3,4 | 3,1 | 3,0 | 4,0 | 4,1 | 3,8 | 4,2 | 4,8 | **48,3** |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 2,3 | 2,6 | 2,0 | 1,9 | 1,7 | 1,5 | 1,5 | 2,0 | 2,0 | 1,9 | 2,1 | 2,4 | **23,9** |
| **6** | **Total mass of carbon in the input flow in EAFP** | **ths. tons C** | **4,8** | **6,6** | **6,2** | **6,2** | **5,0** | **6,2** | **6,1** | **7,1** | **7,2** | **5,8** | **5,7** | **6,1** | 73,1 |

*Specific $CO_2$ emissions from metallurgical conversions in the project only. Production of profiled steel billet in EAFP*

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total production of slab and profiled steel billet in EAFP | ths. tons | 140,7 | 211,5 | 95,9 | 92,8 | 72,4 | 110,5 | 111,4 | 155,0 | 148,0 | 95,0 | 85,9 | 81,2 | 1400 |
| | Carbon content in steel | % by mass | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 |
| | | ths. tons C | 0,3 | 0,4 | 0,2 | 0,2 | 0,1 | 0,2 | 0,2 | 0,3 | 0,3 | 0,2 | 0,2 | 0,1 | 2,5 |
| 2 | **Total mass of carbon in the output flow from EAFP** | **ths. tons C** | **0,3** | **0,4** | **0,2** | **0,2** | **0,1** | **0,2** | **0,2** | **0,3** | **0,3** | **0,2** | **0,2** | **0,1** | **2,5** |

CO2 emissions from production of steel

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during production of profiled steel billet in EAFP | ths. tons C | 4,6 | 6,2 | 6,0 | 6,1 | 4,9 | 6,0 | 5,9 | 6,8 | 6,9 | 5,7 | 5,5 | 5,9 | 70,6 |
| 2 | CO2 emissions from production of profiled steel billet in EAFP | ths. tons CO2 | 16,8 | 22,8 | 22,2 | 22,3 | 18,0 | 22,1 | 21,6 | 25,0 | 25,5 | 20,8 | 20,3 | 21,7 | 258,9 |
| 3 | **Specific CO2 emissions per ton of profiled steel billet produced in EAFP** | **tons CO2/ton** | **0,119** | **0,108** | **0,231** | **0,240** | **0,248** | **0,200** | **0,194** | **0,161** | **0,172** | **0,219** | **0,236** | **0,267** | **0,200** |

*Specific $CO_2$ emissions from metallurgical conversions in the project only. Production of profiled steel billet in EAFP*

**Steel smelting in Open-Hearth Furnace Plant (baseline only)**

$$BE_{OHFP} = [(M_{pig\ iron\_OHFP} * \%C_{pig\ iron}) + (M_{scrap\_OHFP} * \%C_{scrap}) + (SC_{NG\_OHFP} * P_{steel\_OHFP} * C_{NG\_PJ}) - (P_{steel\_OHFP} * \%C_{steel})] * 44/12$$

**(PDD formula D.1.1.4-1)**

***Specific CO2 emissions per ton of steel smelted in OHFP***

$$SBE_{OHFP} = BE_{OHFP} / P_{steel\_OHFP}$$

**(PDD formula D.1.1.4.-2)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$M_{pig\ iron\_OHFP}$** | Annual average consumption of pig iron in OHFP | ths. tons | **$C_{NG\_PJ}$** | Carbon content in NG | kg $C/m^3$ |
| **$\%C_{pig\ iron}$** | Carbon content in pig iron | % by mass | **$P_{steel\_OHFP}$** | Annual average smelting of steel in OHFP | ths. tons |
| **$M_{scrap\_OHFP}$** | Annual average consumption of scrap metal in OHFP | ths. tons | **$\%C_{steel}$** | Carbon content in steel | % by mass |
| **$\%C_{scrap}$** | Carbon content in scrap metal | % by mass | **$BE_{OHFP}$** | $CO_2$ emissions from steel smelting in OHFP | ths. tons $CO_2$ |
| **$SC_{NG\_OHFP}$** | Annual average consumption of NG in OHFP | mln. $m^3$ | **$SBE_{OHFP}$** | Specific $CO_2$ emissions per ton of steel smelted in OHFP | ton $CO_2$/ton |

## *12 months of 2008*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average consumption of pig iron in OHFP | ths. tons | 1941,1 | | | | | | | | | | | | **1941,1** |
| | Carbon content in pig iron | % by mass | 4,70 | | | | | | | | | | | | **4,70** |
| | | ths. tons C | 91,2 | | | | | | | | | | | | **91,2** |
| 2 | Annual average consumption of scrap metal in OHFP | ths. tons | 715,3 | | | | | | | | | | | | **715,3** |
| | Carbon content in scrap metal | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 1,3 | | | | | | | | | | | | **1,3** |
| 3 | Annual average consumption of NG in OHFP | mln. m3 | 54,4 | | | | | | | | | | | | **54,4** |

*Specific CO2 emissions for metallurgical conversions in the baseline only. Steel smelting in the OHFP*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 26,9 | | | | | | | | | | | | **26,9** |
| **4** | **Total mass of carbon in the input flow in the OHFP** | **ths. tons C** | **119,4** | | | | | | | | | | | | **119,4** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average smelting of steel in OHFP | ths. tons | 2335,7 | | | | | | | | | | | | **2335,7** |
| | Carbon content in steel | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 4,2 | | | | | | | | | | | | **4,2** |
| **2** | **Total mass of carbon in the output flow from OHFP** | **ths. tons C** | **4,2** | | | | | | | | | | | | **4,2** |

CO2 emissions from steel smelting in OHFP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during steel smelting in OHFP | ths. tons C | 115,2 | | | | | | | | | | | | **115,2** |
| 2 | CO2 emissions from steel smelting in OHFP | ths. tons CO2 | 422,5 | | | | | | | | | | | | **422,5** |
| **3** | **Specific CO2 emissions per ton of steel smelted in OHFP** | **tons CO2/ton** | **0,181** | | | | | | | | | | | | 0,181 |

## ***12 months of 2009***

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average consumption of pig iron in OHFP | ths. tons | 1941,1 | | | | | | | | | | | | **1941,1** |
| | Carbon content in pig iron | % by mass | 4,70 | | | | | | | | | | | | **4,70** |
| | | ths. tons C | 91,2 | | | | | | | | | | | | **91,2** |
| 2 | Annual average consumption of scrap metal in OHFP | ths. tons | 715,3 | | | | | | | | | | | | **715,3** |
| | Carbon content in scrap metal | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 1,3 | | | | | | | | | | | | **1,3** |
| 3 | Annual average consumption of NG in | mln. m3 | 54,4 | | | | | | | | | | | | **54,4** |

*Specific CO2 emissions for metallurgical conversions in the baseline only. Steel smelting in the OHFP*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OHFP | | | | | | | | | | | | | | |
| | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 26,9 | | | | | | | | | | | | **26,9** |
| 4 | **Total mass of carbon in the input flow in the OHFP** | **ths. tons C** | **119,5** | | | | | | | | | | | | **119,5** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average smelting of steel in OHFP | ths. tons | 2335,7 | | | | | | | | | | | | **2335,7** |
| | Carbon content in steel | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 4,2 | | | | | | | | | | | | **4,2** |
| 2 | **Total mass of carbon in the output flow from OHFP** | **ths. tons C** | **4,2** | | | | | | | | | | | | **4,2** |

CO2 emissions from steel smelting in OHFP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | **Total for year** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Burning of carbon during steel smelting in OHFP | ths. tons C | 115,3 | | | | | | | | | | | | **115,3** |
| 2 | CO2 emissions from steel smelting in OHFP | ths. tons CO2 | 422,6 | | | | | | | | | | | | **422,6** |
| 3 | **Specific CO2 emissions per ton of steel smelted in OHFP** | **tons CO2/ton** | 0,181 | | | | | | | | | | | | **0,181** |

*Specific CO2 emissions for metallurgical conversions in the baseline only. Steel smelting in the OHFP*

**Production of profiled steel billet in the Blooming Mill Plant (baseline only)**

$$BE_{BM} = [(M_{steel\_BM} * \%C_{steel}) + (SC_{BFG\_BM} * P_{profiled\ steel\_BM} * C_{BFG\_PJ}) + (SC_{COG\_BM} * P_{profiled\ steel\_BM} * C_{COG\_PJ}) - (P_{profiled\ steel\_BM} * \%C_{steel})] * 44/12$$

**(PDD formula D.1.1.4-3)**

***Specific CO2 emissions per ton of profiled steel billet produced in BMP***

$$SBE_{BM} = BE_{BM} / P_{profiled\ steel\_BM}$$

**(PDD formula D.1.1.4.-4)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $M_{steel\_BM}$ | Annual average consumption of steel in BMP | ths. tons | $SC_{COG\_BM}$ | Annual average consumption of COG in BMP | mln. $m^3$ |
| $\%C_{steel}$ | Carbon content in steel | % by mass | $C_{COG\_PJ}$ | Carbon content in COG | kg $C/m^3$ |
| $SC_{BFG\_BM}$ | Annual average consumption of BFG in BMP | mln. $m^3$ | $P_{profiled\ steel\_BM}$ | Annual average production of profiled steel billet in BMP | ths. tons |
| $C_{BFG\_PJ}$ | Carbon content in BFG | kg $C/m^3$ | $BE_{BM}$ | $CO_2$ emissions from production of profiled steel billet in BMP | ths. tons $CO_2$ |
| | | | $SBE_{BM}$ | Specific $CO_2$ emissions per ton of profiled steel billet produced in BMP | ton $CO_2$/ton |

*Specific CO2 emissions for metallurgical conversions fin the baseline only. Production of profiled steel billet in the Blooming Mill Plant*

## *12 months of 2008*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average consumption of steel in BMP | ths. tons | 2335,7 | | | | | | | | | | | | **2335,7** |
| | Carbon content in steel | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 4,2 | | | | | | | | | | | | **4,2** |
| 2 | Annual average consumption of BFG in BMP | mln. m3 | 542,3 | | | | | | | | | | | | **542,3** |
| | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | **0,20** |
| | | ths. tons C | 105,9 | | | | | | | | | | | | **105,9** |
| 3 | Annual average consumption of COG in BMP | mln. m3 | 15,6 | | | | | | | | | | | | **15,6** |
| | Carbon content in COG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | **0,19** |
| | | ths. tons C | 2,9 | | | | | | | | | | | | **2,9** |
| **4** | **Total mass of carbon in the input flow in BMP** | **ths. tons C** | 113,0 | | | | | | | | | | | | **113,0** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average production of profiled steel billet in BMP | ths. tons | 2029,9 | | | | | | | | | | | | **2029,9** |
| | Carbon content in steel | % | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 3,7 | | | | | | | | | | | | **3,7** |
| **2** | **Total mass of carbon in the output flow from BMP** | **ths. tons C** | 3,7 | | | | | | | | | | | | **3,7** |

CO2 emissions from production of profiled steel billet in BMP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning during production of profiled steel billet in BMP | ths. tons C | 109,4 | | | | | | | | | | | | **109,4** |
| 2 | CO2 emissions from production of profiled steel billet in BMP | **ths. tons CO2** | 401,1 | | | | | | | | | | | | **401,1** |
| 3 | **Specific CO2 emissions from production of profiled steel billet in BMP** | **tons CO2/ton** | **0,198** | | | | | | | | | | | | **0,198** |

*Specific CO2 emissions for metallurgical conversions fin the baseline only. Production of profiled steel billet in the Blooming Mill Plant*

# *12 months of 2009*

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average consumption of steel in BMP | ths. tons | 2335,7 | | | | | | | | | | | | **2335,7** |
| | Carbon content in steel | % by mass | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 4,2 | | | | | | | | | | | | **4,2** |
| 2 | Annual average consumption of BFG in BMP | mln. m3 | 542,3 | | | | | | | | | | | | **542,3** |
| | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | **0,21** |
| | | ths. tons C | 113,1 | | | | | | | | | | | | **113,1** |
| 3 | Annual average consumption of COG in BMP | mln. m3 | 15,6 | | | | | | | | | | | | **15,6** |
| | Carbon content in COG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | **0,18** |
| | | ths. tons C | 2,9 | | | | | | | | | | | | **2,9** |
| **4** | **Total mass of carbon in the input flow in BMP** | **ths. tons C** | 120,2 | | | | | | | | | | | | **120,2** |

Output carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average production of profiled steel billet in BMP | ths. tons C | 2029,9 | | | | | | | | | | | | **2029,9** |
| | Carbon content in steel | % | 0,18 | | | | | | | | | | | | **0,18** |
| | | ths. tons C | 3,7 | | | | | | | | | | | | **3,7** |
| **2** | **Total mass of carbon in the output flow from BMP** | **ths. tons C** | 3,7 | | | | | | | | | | | | **3,7** |

CO2 emissions from production of profiled steel billet in BMP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning in the production of profiled steel billet in BMP | ths. tons C | 116,5 | | | | | | | | | | | | **116,5** |
| 2 | CO2 emissions from production of profiled steel billet in BMP | **ths. tons CO2** | 427,3 | | | | | | | | | | | | **427,3** |
| **3** | **Specific CO2 emissions from production of profiled steel billet in BMP** | **tons CO2/ton** | **0,211** | | | | | | | | | | | | **0,211** |

*Specific CO2 emissions for metallurgical conversions fin the baseline only. Production of profiled steel billet in the Blooming Mill Plant*

## *D.2 Coefficients of consumption for metallurgical conversions*

**<u>Coefficients of consumption for metallurgical conversions in the project</u>**

**Specific consumption of pig iron per ton of steel billet produced in EAFP**

$$SC_{pig\ iron\_EAFP} = M_{pig\ iron\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$$ **(PDD formula D.1.1.2.-7)**

**Specific consumption of scrap metal per ton of steel billet produced in EAFP**

$$SC_{scrap\_EAFP} = M_{scrap\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$$ **(PDD formula D.1.1.2.-8)**

**Specific consumption of dry skip metallurgical coke per ton of produced pig iron**

$$SC_{skip\_metallurgical\_coke\_PJ} = M_{skip\_metallurgical\ coke\_BF\_PJ} / P_{pig\ iron\_BF\_PJ}$$ **(PDD formuila D.1.1.2.-9)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $SC_{pig\ iron\_EAFP}$ | Specific consumption of pig iron per ton of steel billet produced in EAFP | ton/ton | $M_{scrap\_EAFP}$ | Consumption of scrap metal in EAFP | ths. tons |
| $M_{pig\ iron\_EAFP}$ | Consumption of pig iron in EAFP | ths. tons | $SC_{skip\_metallurgical\_coke\_PJ}$ | Specific consumption of dry skip metallurgical coke per ton of pig iron produced in BFP | tons/ton |
| $\sum P_{profiled\&slab\ steel\_EAFP}$ | Total production of slab and profiled steel billet in EAFP | ths. tons | $M_{skip\_metallurgical\ coke\_BF\_PJ}$ | Consumption of dry skip metallurgical coke in BFP | ton/ton |
| $SC_{scrap\_EAFP}$ | Specific consumption of pig iron per ton of steel billet produced in EAFP | ton/ton | $P_{pig\ iron\_BF\_PJ}$ | Production of pig iron in BFP | ton/ton |

*Coefficients of consumption of materials for metallurgical conversions in the project*

## *12 months of 2008*

Project factors

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total production of slab and profiled steel billet in EAFP | ths. tons | 322,6 | 298,0 | 320,4 | 300,5 | 297,0 | 291,0 | 289,3 | 305,5 | 301,5 | 142,0 | 97,9 | 152,7 | **3118,3** |
| 2 | **Output of profiled steel billet in EAFP** | ths. tons | **176,1** | **164,7** | **171,7** | **168,3** | **146,2** | **156,8** | **154,7** | **159,1** | **159,2** | **118,3** | **44,0** | **55,6** | **1674,7** |
| 3 | Total smelting of steel in EAF-180 | ths. tons | 279,3 | 247,5 | 279,5 | 275,4 | 256,7 | 264,3 | 280,0 | 295,6 | 280,2 | 114,4 | 85,0 | 152,3 | **2810,2** |
| 4 | Consumption of pig iron in EAFP | ths. tons | 110,2 | 113,0 | 116,6 | 98,7 | 104,0 | 91,2 | 77,2 | 85,2 | 94,3 | 48,9 | 34,7 | 38,9 | **1012,8** |
| 5 | Consumption of scrap metal in EAFP | ths. tons | 255,5 | 223,9 | 244,8 | 237,3 | 228,0 | 236,4 | 248,8 | 253,3 | 244,4 | 111,4 | 75,9 | 136,6 | **2496** |
| 6 | Specific consumption of pig iron per ton of steel billet produced in EAFP | ton/ton | 0,341 | 0,379 | 0,364 | 0,328 | 0,350 | 0,314 | 0,267 | 0,279 | 0,313 | 0,344 | 0,355 | 0,255 | **0,324** |
| 7 | Specific consumption of scrap metal per ton of steel billet produced in EAFP | ton/ton | 0,792 | 0,751 | 0,764 | 0,790 | 0,768 | 0,812 | 0,860 | 0,829 | 0,811 | 0,784 | 0,776 | 0,895 | **0,803** |
| 8 | Specific consumption of dry skip metallurgical coke per ton of produced pig iron | ton/ton | 0,447 | 0,444 | 0,444 | 0,457 | 0,468 | 0,479 | 0,476 | 0,473 | 0,470 | 0,456 | 0,459 | 0,477 | **0,462** |

Note: in this case, the calculation model operates with data including the data from cells previously submitted (*Specific consumption of coke per ton of iron*), and also contains indicators (*actual production of profiled steel billet in the EAFP* and *production of steel in EAF-180*), which will be used to calculate project emissions further.

*Coefficients of consumption of materials for metallurgical conversions in the project*

## *12 months of 2009*

Project factors

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total production of slab and profiled steel billet in EAFP | ths. tons | 140,7 | 211,5 | 95,9 | 92,8 | 72,4 | 110,5 | 111,4 | 155,0 | 148,0 | 95,0 | 85,9 | 81,2 | **1400,3** |
| 2 | **Output of profiled steel billet in EAFP** | ths. tons | **67,3** | **93,2** | **96,4** | **92,2** | **72,6** | **110,5** | **112,2** | **112,0** | **90,8** | **77,4** | **47,9** | **56,2** | **1028,7** |
| 3 | Total smelting of steel in EAF-180 | ths. tons | 140,7 | 210,6 | 0,4 | 0,0 | 0,0 | 0,0 | 0,0 | 59,2 | 50,3 | 6,7 | 0,0 | 0,0 | **467,9** |
| 4 | Consumption of pig iron in EAFP | ths. tons | 31,8 | 55,8 | 83,8 | 87,0 | 67,4 | 94,6 | 92,5 | 96,4 | 95,3 | 79,2 | 72,1 | 73,8 | **929,6** |
| 5 | Consumption of scrap metal in EAFP | ths. tons | 129,4 | 183,4 | 26,0 | 18,3 | 13,8 | 30,2 | 33,4 | 78,5 | 72,4 | 28,4 | 24,8 | 17,8 | **657** |
| 6 | Specific consumption of pig iron per ton of steel billet produced in EAFP | ton/ton | 0,226 | 0,264 | 0,874 | 0,938 | 0,932 | 0,856 | 0,830 | 0,622 | 0,644 | 0,833 | 0,839 | 0,909 | **0,731** |
| 7 | Specific consumption of scrap metal per ton of steel billet produced in EAFP | ton/ton | 0,920 | 0,867 | 0,271 | 0,198 | 0,190 | 0,274 | 0,300 | 0,507 | 0,489 | 0,299 | 0,289 | 0,219 | **0,402** |
| 8 | Specific consumption of dry skip metallurgical coke per ton of produced pig iron | ton/ton | 0,457 | 0,449 | 0,439 | 0,435 | 0,436 | 0,439 | 0,435 | 0,434 | 0,435 | 0,433 | 0,436 | 0,436 | **0,439** |

Note: in this case, the calculation model operates with data including the data from cells previously submitted (*Specific consumption of coke per ton of iron*), and also contains indicators (*actual production of profiled steel billet in the EAFP* and *production of steel in EAF-180*), which will be used to calculate project emissions further.

*Coefficients of consumption of materials for metallurgical conversions in the project*

<u>**Coefficients of consumption of materials for metallurgical conversions in the baseline**</u>

**Consumption of pig iron per ton of smelted steel in the baseline**

$$SC_{pig\ iron\_OHFP} = M_{pig\ iron\_OHFP} / P_{steel\_OHFP} \quad \textbf{(PDD formula D.1.1.4.-5)}$$

**Consumption of scrap metal per ton of smelted steel in the baseline**

$$SC_{scrap\_OHFP} = M_{scrap\_OHFP} / P_{steel\_OHFP} \quad \textbf{(PDD formula D.1.1.4.-6)}$$

**Consumption of steel per ton of profiled steel billet produced in BMP**

$$SC_{steel\_profiled\_steel\_BM} = M_{steel\_BM} / P_{profiled\ steel\_BM} \quad \textbf{(PDD formula D.1.1.4.-7)}$$

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $SC_{pig\ iron\_OHFP}$ | Consumption of pig iron per ton of steel smelted in OHFP | ton/ton | $M_{scrap\_OHFP}$ | Consumption of scrap metal per ton of steel smelted in OHFP | ths. tons |
| $M_{pig\ iron\_OHFP}$ | Consumption of pig iron in OHFP | ths. tons | $SC_{steel\_profiled\_steel\_BM}$ | Specific consumption of steel per ton of profiled steel billet produced in BMP | ton/ton |
| $P_{steel\_OHFP}$ | Annual average output of steel in OHFP | ths. tons | $M_{steel\_BM}$ | Annual average consumption of steel in BMP | ths. tons |
| $SC_{scrap\_OHFP}$ | Specific consumption of scrap metal per ton of steel smelted in OHFP, | ton/ton | $P_{profiled\ steel\_BM}$ | Annual average output of profiled steel billet in BMP | ths. tons |

*Coefficients of consumption of materials for metallurgical conversions in the baseline*

## *12 months of 2008*

Baseline factors

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average production of profiled steel billet in BMP | ths. tons | 2 029,9 | | | | | | | | | | | | **2 029,9** |
| 2 | **Output of profiled steel billet in EAFP** | **ths. tons** | **176,1** | **164,7** | **171,7** | **168,3** | **146,2** | **156,8** | **154,7** | **159,1** | **159,2** | **118,3** | **44,0** | **55,6** | **1674,7** |
| 3 | Annual average smelting of steel in OHFP | ths. tons | 2 335,7 | | | | | | | | | | | | **2 335,7** |
| 4 | Annual average consumption of pig iron in OHFP | ths. tons | 1 941,1 | | | | | | | | | | | | **1 941,1** |
| 5 | Annual average consumption of scrap metal in OHFP | ths. tons | 715,3 | | | | | | | | | | | | **715,3** |
| 6 | Specific consumption of pig iron per ton of steel smelted in OHFP | ton/ton | 0,831 | | | | | | | | | | | | **0,831** |
| 7 | Specific consumption of scrap metal per ton of steel smelted in OHFP | ton/ton | 0,306 | | | | | | | | | | | | **0,306** |
| 8 | Specific consumption of steel per ton of profiled steel billet produced in BMP | ton/ton | 1,151 | | | | | | | | | | | | **1,151** |
| 9 | Specific consumption of dry skip metallurgical coke per ton of produced pig iron | ton/ton | 0,447 | 0,444 | 0,444 | 0,457 | 0,468 | 0,479 | 0,476 | 0,473 | 0,470 | 0,456 | 0,459 | 0,477 | **0,462** |

Note: for this case the calculation mode in general operates with the values obtained from calculations in the PDD for the baseline (in figures, fixed ex-ante). Monitoring indicators are: *Actual production of profiled steel billet in the EAFP*, and *Specific consumption of metallurgical coke per ton of iron* (the same for the project and the baseline).

*Coefficients of consumption of materials for metallurgical conversions in the baseline*

### *12 months of 2009*

Baseline factors

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Annual average production of profiled steel billet in BMP | ths. tons | 2 029,9 | | | | | | | | | | | | **2 029,9** |
| 2 | **Output of profiled steel billet in EAFP** | **ths. tons** | **67,3** | **93,2** | **96,4** | **92,2** | **72,6** | **110,5** | **112,2** | **112,0** | **90,8** | **77,4** | **47,9** | **56,2** | **1028,7** |
| 3 | Annual average smelting of steel in OHFP | ths. tons | 2 335,7 | | | | | | | | | | | | **2 335,7** |
| 4 | Annual average consumption of pig iron in OHFP | ths. tons | 1 941,1 | | | | | | | | | | | | **1 941,1** |
| 5 | Annual average consumption of scrap metal in OHFP | ths. tons | 715,3 | | | | | | | | | | | | **715,3** |
| 6 | Specific consumption of pig iron per ton of steel smelted in OHFP | ton/ton | 0,831 | | | | | | | | | | | | **0,831** |
| 7 | Specific consumption of scrap metal per ton of steel smelted in OHFP | ton/ton | 0,306 | | | | | | | | | | | | **0,306** |
| 8 | Specific consumption of steel per ton of profiled steel billet produced in BMP | ton/ton | 1,151 | | | | | | | | | | | | **1,151** |
| 9 | Specific consumption of dry skip metallurgical coke per ton of produced pig iron | ton/ton | 0,457 | 0,449 | 0,439 | 0,435 | 0,436 | 0,439 | 0,435 | 0,434 | 0,435 | 0,433 | 0,436 | 0,436 | **0,439** |

Note: for this case the calculation mode in general operates with the values obtained from calculations in the PDD for the baseline (in figures, fixed ex-ante). Monitoring indicators are: *Actual production of profiled steel billet in the EAFP*, and *Specific consumption of metallurgical coke per ton of iron* (the same for the project and the baseline).

*Coefficients of consumption of materials for metallurgical conversions in the baseline*

### *D.3 Project $CO_2$ emissions from metallurgical conversions associated with production of profiled steel billet*

**Project $CO_2$ emissions from consumption of metallurgical coke for production of profiled steel billet**

$$PE_{metallurgical\_coke\_profiled\_steel} = SC_{skip\_metallurgical\_coke\_PJ} * SC_{pig\ iron\_\ EAFP} * P_{profiled\ steel\_EAFP} * SPE_{coke\ production}$$ **(PDD formula D.1.1.2.-10)**

**Project $CO_2$ emissions from consumption of pig iron for production of profiled steel billet**

$$PE_{pig\ iron\_profiled\_steel} = SC_{pig\ iron\_\ EAFP} * P_{profiled\ steel\_EAFP} * SPE_{pig\ iron}$$ **(PDD formula D.1.1.2.-11)**

**Project $CO_2$ emissions in EAFP from production of profiled steel billet**

$$PE_{profiled\ steel\_\ EAFP} = P_{profiled\ steel\_\ EAFP} * SPE_{EAFP}$$ **(PDD formula D.1.1.2.-12)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $PE_{metallurgical\_coke\_profiled\_steel}$ | Project $CO_2$ emissions from consumption of metallurgical coke for production of profiled steel billet | ths. tons $CO_2$ | $P_{profiled\ steel\_EAFP}$ | Output of profiled steel billet in EAFP | ths. tons |
| $SC_{skip\_metallurgical\_coke\_PJ}$ | Specific consumption of dry skip metallurgical coke per ton of pig iron smelted in BFP | ton/ton | $PE_{pig\ iron\_\ profiled\_steel}$ | Project $CO_2$ emissions from consumption of pig iron for production of profiled steel billet | ths. tons $CO_2$ |
| $SC_{pig\ iron\_\ EAFP}$ | Specific consumption of pig iron per ton of steel billet produced in EAFP | ton/ton | $SPE_{pig\ iron}$ | Specific $CO_2$ emissions per ton of produced pig iron | ton $CO_2$/ton |
| $SPE_{metallurgical\_coke}$ | Specific $CO_2$ emissions per ton of dry metallurgical coke produced in BPCP | ton $CO_2$/ton | $SPE_{EAFP}$ | Specific $CO_2$ emissions per ton of profiled steel billet produced in EAFP | ton $CO_2$/ton |

*Project $CO_2$ emissions from metallurgical conversions associated with production of profiled steel billet*

## *12 months of 2008*

Project CO2 emissions from metallurgical conversions during production of profiled steel billet

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from consumption of metallurgical coke for production of profiled steel billet** | ths. tons CO2 | 26,859 | 27,749 | 27,732 | 25,268 | 23,939 | 23,549 | 19,663 | 20,986 | 23,442 | 18,541 | 7,160 | 6,751 | 251,637 |
| 2 | **CO2 emissions from consumption of pig iron for production of profiled steel billet** | ths. tons CO2 | 48,813 | 50,694 | 50,731 | 44,844 | 41,543 | 39,916 | 33,520 | 36,019 | 40,445 | 33,033 | 12,670 | 11,499 | 443,729 |
| 3 | **CO2 emissions in EAFP from production of profiled steel billet** | ths. tons CO2 | 19,845 | 18,559 | 19,345 | 18,962 | 16,476 | 17,672 | 17,439 | 17,931 | 17,945 | 13,326 | 4,958 | 6,266 | 188,723 |

## *12 months of 2009*

Project CO2 emissions from metallurgical conversions during production of profiled steel billet

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from consumption of metallurgical coke for production of profiled steel billet** | ths. tons CO2 | 6,723 | 10,676 | 35,733 | 36,341 | 28,491 | 40,069 | 39,110 | 29,242 | 24,573 | 26,956 | 16,950 | 21,560 | 316,426 |
| 2 | **CO2 emissions from consumption of pig iron for production of profiled steel billet** | ths. tons CO2 | 10,374 | 16,770 | 57,461 | 58,976 | 46,143 | 64,490 | 63,521 | 47,523 | 39,896 | 43,980 | 27,453 | 34,884 | 511,471 |
| 3 | **CO2 emissions in EAFP from production of profiled steel billet** | ths. tons CO2 | 13,436 | 18,599 | 19,242 | 18,407 | 14,492 | 22,054 | 22,409 | 22,358 | 18,132 | 15,447 | 9,570 | 11,228 | 205,375 |

Note: To decrease the error in the calculation of annual $CO_2$ emissions, monthly emissions from the metallurgical conversions calculated by multiplying the actual production of profiled steel billet per month (and consumption of metallurgical coke/ iron) with the corresponding specific values of $CO_2$ emissions from conversions, averaged over the year as accrual sum.

*Project $CO_2$ emissions from metallurgical conversions associated with production of profiled steel billet*

### *D.4 $CO_2$ emissions from production of profiled steel billet in the baseline*

**$CO_2$ emissions from consumption of metallurgical coke for production of profiled steel billet in the baseline**

$$BE_{metallurgical\ coke\_profiled\_steel} = SC_{skip\_metallurgical\_coke\_PJ} * SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * SPE_{metallurgical\_coke}$$ **(PDD formula D.1.1.4.-8)**

**$CO_2$ emissions from consumption of pig iron in the baseline**

$$BE_{pig\ iron\_profiled\_steel} = SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * SPE_{pig\ iron}$$ **(PDD formula D.1.1.4.-9)**

**$CO_2$ emissions from steel smelting in OHFP**

$$BE_{steel\_OHFP} = SC_{steel\_profiled\_steel\_BM} * P_{profiled\ steel\_EAFP} * SBE_{OHFP}$$ **(PDD formula D.1.1.4.-10)**

**$CO_2$ emissions from production of profiled steel billet in BMP**

$$BE_{profiled\ steel\_BM} = SBE_{BM} * P_{profiled\ steel\_EAFP}$$ **(PDD formula D.1.1.4.-11)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$BE_{metallurgical\ coke\_profiled\_steel}$** | $CO_2$ emissions from consumption of metallurgical coke in BFP for production of profiled steel billet in the baseline | ths. tons $CO_2$ | **$BE_{steel\_OHFP}$** | $CO_2$ emissions from steel smelting in OHFP | ths. tons $CO_2$ |
| **$BE_{pig\ iron\_profiled\_steel}$** | $CO_2$ emissions from consumption of pig iron in OHFP | ths. tons $CO_2$ | **$BE_{profiled\ steel\_BM}$** | $CO_2$ emissions from production of profiled steel billet in BMP | ths. tons $CO_2$ |
| **$SC_{skip\_metallurgical\_coke\_PJ}$** | Specific consumption of dry skip metallurgical coke per ton of pig iron smelted in BFP | ton/ton | **$SBE_{OHFP}$** | Specific $CO_2$ emissions per ton of steel smelted in OHFP | tons $CO_2$/ton |
| **$P_{profiled\ steel\_EAFP}$** | Output of profiled steel billet in EAFP | ths. tons | **$SPE_{metallurgical\_coke}$** | Specific $CO_2$ emissions per ton of dry metallurgical coke produced in BPCP | tons $CO_2$/ton |
| **$SC_{steel\_profiled\_steel\_BM}$** | Consumption of steel per ton of profiled steel billet produced in BMP | ton/ton | **$SBE_{BM}$** | Specific $CO_2$ emissions per ton of production of profiled steel billet in BMP | tons $CO_2$/ton |
| **$SC_{pig\ iron\_OHFP}$** | Consumption of pig iron per ton of steel smelted in OHFP | ton/ton | **$SPE_{pig\ iron}$** | Specific $CO_2$ emissions per ton of produced pig iron | tons $CO_2$/ton |

*CO2 emissions from production of profiled steel billet in the baseline*

## *12 months of 2008*

CO2 emissions from  metallurgical conversions form steel making in OHFP and production of profilled steel billet in BMP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from consumption of metallurgical coke in BFP for production of profiled steel billet (baseline)** | **ths.tons CO2** | 75,242 | 69,999 | 72,867 | 73,623 | 65,421 | 71,839 | 70,491 | 71,986 | 71,668 | 51,540 | 19,305 | 25,348 | **739,329** |
| 2 | **CO2 emissions from consumption of pig iron in BFP in the baseline** | **ths.tons CO2** | 136,745 | 127,882 | 133,299 | 130,661 | 113,531 | 121,771 | 120,165 | 123,555 | 123,650 | 91,827 | 34,162 | 43,177 | **1300,424** |
| 3 | **CO2 emissions from steel smelting in OHFP** | **ths.tons CO2** | 36,664 | 34,287 | 35,740 | 35,032 | 30,439 | 32,649 | 32,218 | 33,127 | 33,153 | 24,620 | 9,159 | 11,576 | **348,665** |
| 4 | **CO2 emissions from production of profiled steel billet in BMP** | **ths.tons CO2** | 34,798 | 32,542 | 33,921 | 33,249 | 28,890 | 30,987 | 30,578 | 31,441 | 31,465 | 23,367 | 8,693 | 10,987 | **330,920** |

## *12 months of 2009*

CO2 emissions from  metallurgical conversions form steel making in OHFP and production of profilled steel billet in BMP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from consumption of metallurgical coke in BFP for production of profiled steel billet (baseline)** | **ths.tons CO2** | 28,462 | 38,703 | 39,112 | 37,076 | 29,248 | 44,789 | 45,099 | 44,969 | 36,504 | 30,946 | 19,314 | 22,684 | **416,908** |
| 2 | **CO2 emissions from consumption of pig iron in BFP in the baseline** | **ths.tons CO2** | 43,917 | 60,794 | 62,895 | 60,168 | 47,370 | 72,086 | 73,248 | 73,081 | 59,268 | 50,490 | 31,282 | 36,702 | **671,302** |
| 3 | **CO2 emissions from steel smelting in OHFP** | **ths.tons CO2** | 14,015 | 19,401 | 20,071 | 19,201 | 15,117 | 23,004 | 23,375 | 23,322 | 18,913 | 16,112 | 9,983 | 11,712 | **214,224** |
| 4 | **CO2 emissions from production of profiled steel billet in BMP** | **ths.tons CO2** | 14,166 | 19,611 | 20,288 | 19,409 | 15,280 | 23,253 | 23,628 | 23,574 | 19,118 | 16,287 | 10,091 | 11,839 | **216,544** |

*CO2 emissions from production of profiled steel billet in the baseline*

### *D.5 $CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

**$CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades**

$$PE_{EC\_grid\_profiled\_steel\_EAF} = SEC_{grid\_steel\_EAF} * P_{profiled\ steel\_EAFP} * \sum P_{steel\_EAF} / \sum P_{profiled\ \&slab\ steel\_EAFP} * EF_{grid} * (1+TDL)$$ **(PDD formula D.1.1.2.-14)**

**Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades**

$$SEC_{grid\_steel\_EAF} = EC_{grid\_steel\_EAF} / \sum P_{steel\_EAF}$$ **(PDD formula D.1.1.2.-15)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$EC_{grid\_steel\_EAF}$** | Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | GW-h | **$SEC_{grid\_steel\_EAF}$** | Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation per ton of all smelted steel | MW-h/ton |
| **$\sum P_{steel\_EAF}$** | Total smelting of steel in EAF-180 | ths. tons | **$EF_{grid}$** | $CO_2$ emission factor for grid electricity from Unified Energy Systems of Urals (EF grid = 0.541 t CO2/MW-h) | tons CO2/MW-h |
| **$P_{profiled\ steel\_EAFP}$** | Output of profiled steel billet in EAFP | ths. tons | **TDL** | Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals | % |
| **$\sum P_{profiled\&slab\ steel\_EAFP}$** | Total production of slab and profiled steel billet in EAFP | ths. tons | **$PE_{EC\_grid\_profiled\_steel\_EAF}$** | $CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades | ths. tons $CO_2$ |

**$CO_2$ emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet**

$$PE_{EC\_profiled\_steel\_other\ EAFP} = (SEC_{steel\ refinement\ and\ casting\ EAFP} * P_{profiled\ steel\_EAFP} + SEC_{steel\_OHFP} * P_{profiled\ steel\_EAFP} * (\sum P_{profiled\&slab\ steel\_EAFP} - \sum P_{steel\_EAF}) / \sum P_{profiled\&slab\ steel\_EAFP})) * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL)) / (EC_{gross\_PJ} - EC_{grid\_steel\_EAF}))$$

**(PDD formula D.1.1.2.-16)**

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

**Specific electricity consumption in EAFP for steel refining and casting**

$$SEC_{\text{steel refinement and casting EAFP}} = (EC_{EAFP} - EC_{\text{grid\_steel\_EAF}} - SEC_{\text{steel\_OHFP}} * (\sum P_{\text{profiled\&slab steel\_EAFP}} - \sum P_{\text{steel\_EAF}})) / \sum P_{\text{profiled\&slab steel\_EAFP}}$$

**(PDD formula D.1.1.2.-17)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **PE** $_{\text{EC\_other equipment\_EAFP\_PJ}}$ | CO2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet | ths. tons $CO_2$ | **EF** $_{\text{own generation\_PJ}}$ | $CO_2$ emission factor for electricity produced by own generating capacities of MMK | tons $CO_2$/MW-h |
| **SEC** $_{\text{steel refinement and casting EAFP}}$ | Specific electricity consumption in EAFP for steel refining and casting, | MW-h/ton | **EC** $_{\text{gross\_PJ}}$ | Total electricity consumption by MMK | GW-h |
| **P** $_{\text{profiled steel\_EAFP}}$ | Output of profiled steel billet in EAFP | ths. tons | **EC** $_{\text{import\_PJ}}$ | Electricity purchases from Unified Energy Systems of Urals grid | GW-h |
| **∑P** $_{\text{profiled\&slab steel\_EAFP}}$ | Total production of slab and profiled steel billet in EAFP | ths. tons | **EC** $_{\text{grid\_steel\_EAF}}$ | Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | GW-h |
| **∑P** $_{\text{steel\_EAF}}$ | Total smelting of steel in EAF-180 | ths. tons | **EC** $_{\text{EAFP}}$ | Total electricity consumption in EAFP | GW-h |
| **SEC** $_{\text{steel\_OHFP}}$ | Specific electricity consumption in OHFP per ton of steel | MW-h/ton | **TDL** | Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals[3] | % |
| **EF** $_{\text{grid}}$ | CO2 emission factor for grid electricity from Unified Energy Systems of Urals (EF grid = 0.541 t CO2/MW-h) | tons $CO_2$/MW-h | | | |

[3] http://www.mrsk-ural.ru/ru/460

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

**$CO_2$ emissions from consumption of electricity from corporate grid of MMK, for production of nitrogen, pure nitrogen and argon needed for production of profiled steel billet**

$$PE_{EC\_Ar\_N2\_profiled\_steel} = (EC_{N2\_profiled\_steel} + EC_{pure\ N2\_profiled\_steel} + EC_{Ar\_profiled\_steel}) * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF})$$ **(PDD formula D.1.1.2.-18)**

**Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP**

$$EC_{N2\_profiled\_steel} = SEC_{N2\_PJ} * V_{N2\_EAFP} * P_{profiled\_steel\_EAFP} / \sum P_{profiled\&slab\ steel\_EAFP}$$ **(PDD formula D.1.1.2.-19)**

**Electricity consumption for production of pure nitrogen, which is used during production of profiled steel billet in EAFP**

$$EC_{pure\_N2\_profiled\_steel} = SEC_{pure\_N2\_PJ} * V_{pure\_N2\_EAFP} * P_{profiled\_steel\_EAFP\_} / \sum P_{profiled\&slab\ steel\_EAFP}$$ **(PDD formulaD.1.1.2.-20)**

**Electricity consumption for production of argon, which is used during production of profiled steel billet in EAFP**

$$EC_{Ar\_profiled\_steel} = SEC_{Ar\_PJ} * V_{Ar\_EAFP} * P_{profiled\_steel\_EAFP} /\_\sum P_{profiled\&slab\ steel\_EAFP}$$ **(PDD formula D.1.1.2.-21)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$PE_{EC\_Ar\_N2\_profiled\_steel}$** | $CO_2$ emissions from consumption of electricity from corporate grid of MMK for production of nitrogen, pure nitrogen and argon needed for production of profiled steel billet | ths. tons $CO_2$ | **$EC_{gross\_PJ}$** | Total electricity consumption by MMK | GW-h |
| **$EC_{N2\_profiled\_steel}$** | Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP | GW-h | **$EC_{import\_PJ}$** | Electricity purchases from Unified Energy Systems of Urals grid | GW-h |
| **$EC_{pure\ N2\_profiled\_steel}$** | Electricity consumption for production of pure nitrogen, which is used during production of profiled steel billet in EAFP | GW-h | **$EC_{grid\_steel\_EAF}$** | Consumption of grid electricity by EAFP-180, via 220/35 kV step-down substation | GW-h |
| **$EC_{Ar\_profiled\_steel}$** | Electricity consumption for production of argon, which is used during production of profiled steel billet in EAFP | GW-h | **$EF_{grid}$** | $CO_2$ emission factor for grid electricity from Unified Energy Systems of Urals (EF grid = 0.541 | tons $CO_2$/ MW-h |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

| | | | | | |
|---|---|---|---|---|---|
| | | | | t CO2/MW-h) | |
| **EF** $_{own\ generation\_PJ}$ | CO2 emission factor for electricity produced by own generating capacities of MMK | tons $CO_2$/ MW-h | **TDL** | Technological losses during transportation and distribution of grid electricity in Unified Energy System of Urals | % |
| **SEC** $_{N2\_PJ}$ | Specific electricity consumption for production of nitrogen at MMK | MW-h/1000 $m^3$ | **V** $_{N2\_EAFP}$ | Consumption of nitrogen in EAFP | mln. $m^3$ |
| **SEC** $_{pure\_N2\_PJ}$ | Specific electricity consumption for production of pure nitrogen at MMK | MW-h/1000 $m^3$ | **V** $_{pure\_N2\_EAFP}$ | Consumption of pure nitrogen in EAFP | mln. $m^3$ |
| **SEC** $_{Ar\_PJ}$ | Specific electricity consumption for production of argon at MMK | MW-h/1000 $m^3$ | **V** $_{Ar\_EAFP}$ | Consumption of argon in EAFP | mln. $m^3$ |
| **P** $_{profiled\ steel\_EAFP}$ | Output of profiled steel billet in EAFP | ths. tons | **∑P** $_{profiled\&slab\ steel\_EAFP}$ | Total production of slab and profiled steel billet in EAFP | ths. tons |

## *12 months of 2008*

Electricity balance in project

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total electricity consumption in EAFP | GWh | 98,3 | 86,3 | 96,9 | 93,0 | 89,6 | 93,9 | 97,2 | 103,3 | 98,3 | 48,5 | 34,1 | 60,3 | **999,6** |
| 2 | Specific electricity consumption in EAFP for steel refining and casting | MWh/ton | *0,046* | *0,046* | *0,046* | *0,045* | *0,047* | *0,049* | *0,054* | *0,061* | *0,059* | *0,078* | *0,092* | *0,091* | **0,060** |
| 3 | Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | GWh | 83,1 | 72,2 | 81,9 | 79,3 | 75,3 | 79,4 | 81,5 | 84,5 | 80,3 | 37,3 | 25,0 | 46,5 | **826,3** |
| 4 | Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades | MWh/ton | *0,298* | *0,292* | *0,293* | *0,288* | *0,293* | *0,301* | *0,291* | *0,286* | *0,287* | *0,326* | *0,294* | *0,305* | **0,296** |
| 5 | Total electricity consumption by MMK | GWh | 655,9 | 610,9 | 640,5 | 618,2 | 617,7 | 610,8 | 613,5 | 645,0 | 624,9 | 533,8 | 398,3 | 403,2 | **6972,9** |
| 6 | Electricity purchases from Unified Energy Systems of Urals grid | GWh | 175,3 | 166,0 | 183,7 | 184,0 | 179,0 | 162,0 | 201,5 | 227,4 | 222,4 | 102,0 | 25,0 | 46,5 | **1874,7** |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Electricity purchases from Unified Energy Systems of Urals grid except EAF-180 demand | GWh | 92,1 | 93,7 | 101,8 | 104,7 | 103,7 | 82,6 | 120,0 | 142,9 | 142,0 | 64,7 | 0,0 | 0,0 | **1048,3** |
| 8 | Electricity, generated by MMK | GWh | 480,7 | 445,0 | 456,9 | 434,3 | 438,7 | 448,8 | 412,0 | 417,6 | 402,5 | 431,8 | 373,3 | 356,7 | **5098,2** |

Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Consumption of nitrogen in EAFP* | mln. m3 | 3,2 | 2,5 | 2,6 | 2,5 | 2,6 | 2,6 | 2,6 | 2,9 | 2,3 | 1,9 | 1,1 | 1,3 | **28** |
| 2 | Specific electricity consumption for production of nitrogen at MMK | MWh/ths. m3 | *0,200* | *0,209* | *0,216* | *0,217* | *0,202* | *0,201* | *0,216* | *0,206* | *0,209* | *0,215* | *0,275* | *0,175* | **0,212** |
| 3 | Specific consumption of nitrogen for production of steel in EAFP | ths. m3/ton | 0,010 | 0,008 | 0,008 | 0,008 | 0,009 | 0,009 | 0,009 | 0,009 | 0,008 | 0,013 | 0,011 | 0,009 | **0,009** |
| 4 | Electricity consumption for production of nitrogen | GWh | 0,35 | 0,29 | 0,30 | 0,31 | 0,26 | 0,28 | 0,30 | 0,31 | 0,26 | 0,34 | 0,14 | 0,08 | **3,2** |
| 5 | *Consumption of pure nitrogen in EAFP* | mln. m3 | 0,73 | 0,15 | 0,25 | 0,10 | 0,016 | 0,21 | 0,13 | 0,12 | 0,12 | 0,17 | 0,17 | 0,33 | **2,5** |
| 6 | Specific electricity consumption for production of pure nitrogen at MMK | MWh/ths. m3 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | **0,826** |
| 7 | Specific consumption of pure nitrogen for production of steel in EAFP | ths. m3/ton | 0,0023 | 0,0005 | 0,0008 | 0,0003 | 0,0001 | 0,0007 | 0,0005 | 0,0004 | 0,0004 | 0,0012 | 0,0017 | 0,0022 | **0,0009** |
| 8 | Electricity consumption for production of pure nitrogen | GWh | 0,3 | 0,1 | 0,1 | 0,0 | 0,0 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | **1,1** |
| 9 | *Consumption of argon in EAFP* | mln. m3 | 0,28 | 0,27 | 0,26 | 0,22 | 0,26 | 0,23 | 0,22 | 0,26 | 0,28 | 0,15 | 0,111 | 0,184 | **2,7** |
| 10 | Specific electricity consumption for production of argon at MMK | MWh/ths. m3 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | **0,055** |
| 11 | Specific consumption of argon for production of steel in EAFP | ths. m3/ton | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | **0,001** |
| 12 | Electricity consumption fo production of argon | GWh | 0,008 | 0,008 | 0,008 | 0,007 | 0,007 | 0,007 | 0,007 | 0,007 | 0,008 | 0,007 | 0,003 | 0,004 | **0,08** |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

## *12 months of 2009*

Electricity balance in project

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total electricity consumption in EAFP | GWh | 60,8 | 79,4 | 10,2 | 9,0 | 7,7 | 10,2 | 10,7 | 29,1 | 26,9 | 11,4 | 9,1 | 9,9 | **274,4** |
| 2 | Specific electricity consumption in EAFP for steel refining and casting | MWh/ton | *0,090* | *0,070* | *0,092* | *0,087* | *0,094* | *0,082* | *0,083* | *0,079* | *0,082* | *0,098* | *0,094* | *0,109* | **0,088** |
| 3 | Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | GWh | 48,1 | 64,6 | 0,6 | 0,3 | 0,3 | 0,4 | 0,7 | 16,3 | 14,1 | 1,5 | 0,43 | 0,43 | **147,8** |
| 4 | Specific consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades | MWh/ton | *0,342* | *0,307* | *1,791* | *0,000* | *0,000* | *0,000* | *0,000* | *0,274* | *0,280* | *0,227* | *0,000* | *0,000* | **0,268** |
| 5 | Total electricity consumption by MMK | GWh | 463,0 | 536,5 | 494,5 | 464,8 | 461,1 | 492,8 | 530,7 | 553,9 | 536,1 | 545,4 | 514,2 | 557,4 | **6150,4** |
| 6 | Electricity purchases from Unified Energy Systems of Urals grid | GWh | 48,1 | 121,2 | 41,6 | 26,0 | 48,0 | 97,8 | 138,1 | 149,7 | 122,7 | 102,9 | 75,6 | 88,0 | **1059,7** |
| 7 | Electricity purchases from Unified Energy Systems of Urals grid except EAF-180 demand | GWh | 0,0 | 56,6 | 41,0 | 25,6 | 47,7 | 97,4 | 137,4 | 133,4 | 108,6 | 101,4 | 75,2 | 87,6 | **911,9** |
| 8 | Electricity generated by MMK | GWh | 414,9 | 415,3 | 452,9 | 438,8 | 413,1 | 395,0 | 392,7 | 404,2 | 413,4 | 442,5 | 438,6 | 469,3 | **5090,8** |

Electricity consumption for production of nitrogen, which is used during production of profiled steel billet in EAFP

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Consumption of nitrogen in EAFP* | mln. m3 | 1,67 | 1,75 | 0,937 | 0,903 | 0,932 | 0,903 | 0,935 | 1,162 | 1,072 | 0,597 | 0,00024 | 0,00009 | **11** |
| 2 | Specific electricity consumption for production of nitrogen at MMK | MWh/ths. m3 | 0,176 | 0,164 | 0,189 | 0,197 | 0,196 | 0,189 | 0,226 | 0,225 | 0,169 | 0,198 | 0,257 | 0,268 | **0,204** |
| 3 | Specific consumption of nitrogen for production of steel in EAFP | ths. m3/ton | 0,012 | 0,008 | 0,010 | 0,010 | 0,013 | 0,008 | 0,008 | 0,007 | 0,007 | 0,006 | 0,000 | 0,000 | **0,008** |
| 4 | Electricity consumption for production of nitrogen | GWh | 0,14 | 0,13 | 0,18 | 0,18 | 0,18 | 0,17 | 0,21 | 0,19 | 0,11 | 0,10 | 0,00 | 0,00 | **1,6** |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | *Consumption of pure nitrogen in EAFP* | mln. m3 | 0,130 | 0,135 | 0,141 | 0,133 | 0,136 | 0,128 | 0,116 | 0,126 | 0,140 | 0,083 | 0,0012 | 0,00096 | **1,3** |
| 6 | Specific electricity consumption for production of pure nitrogen at MMK | MWh/ths. m3 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 | 0,826 |
| 7 | Specific consumption of pure nitrogen for production of steel in EAFP | ths. m3/ton | 0,0009 | 0,0006 | 0,0015 | 0,0014 | 0,0019 | 0,0012 | 0,0010 | 0,0008 | 0,0009 | 0,0009 | 0,0000 | 0,0000 | 0,0009 |
| 8 | Electricity consumption for production of pure nitrogen | GWh | 0,1 | 0,0 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,0 | 0,0 | **0,8** |
| 9 | *Consumption of argon in EAFP* | mln. m3 | 0,185 | 0,250 | 0,102 | 0,086 | 0,069 | 0,076 | 0,109 | 0,133 | 0,116 | 0,072 | 0,073 | 0,082 | **1,4** |
| 10 | Specific electricity consumption for production of argon at MMK | MWh/ths. m3 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | 0,055 | **0,055** |
| 11 | Specific consumption of argon for production of steel in EAFP | ths. m3/ton | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 | 0,001 |
| 12 | Electricity consumption for production of argon | GWh | 0,005 | 0,006 | 0,006 | 0,005 | 0,004 | 0,004 | 0,006 | 0,005 | 0,004 | 0,003 | 0,002 | 0,003 | 0,05 |

**Total $CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP**

**PE** $_{electricity\_profiled\_steel\_EAFP}$ = **PE** $_{EC\_grid\_profiled\_steel\_EAF}$ + **PE** $_{EC\_profiled\_steel\_other\ EAFP}$ + **PE** $_{EC\_Ar\_N2\_profiled\_steel}$ **(PDD formula D.1.1.2.-13)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **PE** $_{electricity\_profiled\_steel\_EAFP}$ | Total $CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP | ths. tons $CO_2$ | **PE** $_{EC\_profiled\_steel\_other\ EAFP}$ | $CO_2$ emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) during production of profiled steel billet | ths. tons $CO_2$ |
| **PE** $_{EC\_grid\_profiled\_steel\_EAF}$ | $CO_2$ emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation during smelting of profiled steel grades in EAFP | ths. tons $CO_2$ | **PE** $_{EC\_Ar\_N2\_profiled\_steel}$ | $CO_2$ emissions from consumption of electricity from corporate MMK grid for production of nitrogen, pure nitrogen, and argon needed for production of profiled steel billet in EAFP | ths. tons $CO_2$ |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

## *12 months of 2008*

CO2 emissions from electricity consumption associated with production of profiled steel billet in EAFP

| № | Data variable | Unit | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | ths. tons CO2 | 26,352 | 23,187 | 25,479 | 25,796 | 21,523 | 24,864 | 25,328 | 25,555 | 24,648 | 18,034 | 6,519 | 9,830 | **257,114** |
| 2 | CO2 emissions from consumption of electricity from corporate MMK grid in for production of nitrogen, pure nitrogen, and argon | ths. tons CO2 | 0,511 | 0,280 | 0,326 | 0,283 | 0,244 | 0,347 | 0,318 | 0,311 | 0,277 | 0,353 | 0,123 | 0,114 | **3,487** |
| 3 | CO2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) | ths. tons CO2 | 6,162 | 5,934 | 6,251 | 6,006 | 6,225 | 7,114 | 7,267 | 8,330 | 8,277 | 7,094 | 2,464 | 3,062 | **74,186** |
| 4 | **Total CO2 emissions from electricity consumption associated with production of profiled steel billet in EAFP** | **ths. tons CO2** | **33,025** | **29,401** | **32,056** | **32,084** | **27,992** | **32,324** | **32,913** | **34,196** | **33,202** | **25,481** | **9,106** | **13,005** | **334,787** |

## *12 months of 2009*

CO2 emissions from electricity consumption associated with production of profiled steel billet in EAFP

| № | Data variable | Unit | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | ths. tons CO2 | 13,511 | 16,704 | 0,377 | 0,188 | 0,185 | 0,231 | 0,388 | 6,896 | 5,068 | 0,724 | 0,254 | 0,253 | **44,779** |
| 2 | CO2 emissions from consumption of electricity from corporate MMK grid in for production of nitrogen, pure nitrogen, and argon | ths. tons CO2 | 0,142 | 0,128 | 0,224 | 0,245 | 0,275 | 0,265 | 0,300 | 0,257 | 0,176 | 0,130 | 0,002 | 0,003 | **2,146** |
| 3 | CO2 emissions from consumption of electricity from corporate MMK grid by other equipment of EAFP (including DBSU) | ths. tons CO2 | 4,364 | 4,592 | 7,138 | 7,268 | 6,751 | 9,274 | 9,673 | 8,904 | 7,439 | 6,734 | 3,755 | 5,008 | **80,901** |
| 4 | **Total CO2 emissions from electricity consumption associated with production of profiled steel billet in EAFP** | **ths. tons CO2** | **18,016** | **21,424** | **7,739** | **7,701** | **7,210** | **9,770** | **10,362** | **16,057** | **12,683** | **7,588** | **4,011** | **5,264** | **127,827** |

*$CO_2$ emissions from electricity consumption associated with production of profiled steel billet in EAFP*

**<u>$CO_2$ emission factor for electricity produced at MMK</u>**

**$EF_{own\ generation\_PJ} = PE_{total\ electricity\ generation} / (EC_{gross\_PJ} - EC_{import\_PJ})$** **(PDD formula D.1.1.2.-22)**

**CO2 emissions from electricity generation at MMK**

**$PE_{total\ electricity\ generation} = PE_{combustion\ gases\_electricity} + PE_{combustion\ coal\_electricity}$** **(PDD formula D.1.1.2.-23)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$EF_{own\ generation\_PJ}$** | $CO_2$ emission factor for electricity produced at MMK | tons $CO_2$/MW-h | **$EC_{gross\_PJ}$** | Total electricity generation at MMK | GW-h |
| **$PE_{total\ electricity\ generation}$** | Total $CO_2$ emissions from electricity generation at MMK | ths. tons $CO_2$ | **$EC_{import\_PJ}$** | Electricity purchases from Unified Energy Systems of Urals grid | GW-h |
| **$PE_{combustion\ gases\_electricity}$** | $CO_2$ emissions from combustion of gases for electricity generation at MMK | ths. tons $CO_2$ | **$PE_{combustion\ coal\_electricity}$** | $CO_2$ emissions from combustion of power station coal | ths. tons $CO_2$ |

**$CO_2$ emissions from combustion of gases for electricity generation at MMK**

**$PE_{combustion\ gases\_electricity} = (FC_{BFG\_CPP\_PJ} * C_{BFG\_PJ} + FC_{NG\_CPP\_PJ} * C_{NG\_.PJ} + FC_{NG\_CHPP\_PJ} * C_{NG\_PJ} + FC_{BFG\_SABPP\_PJ} * C_{BFG\_PJ} + FC_{COG\_SABPP\_PJ} * C_{COG\_PJ} + FC_{NG\_SABPP\_PJ} * C_{NG\_PJ} + FC_{NG\_turbine\ section\ of\ SP\ \_PJ} * C_{NG\_.PJ} + FC_{NG\_gas\ recovery\ unit\text{-}2\ of\ SP\ \_PJ} * C_{NG\_PJ})/100 * 44/1$** **(PDD formula D.1.1.2.-24)**

**CO2 emissions from combustion of power station coal for electricity generation at MMK**

**$PE_{combustion\ coal\_electricity} = (FC_{energy\ coal\_CHPP\_PJ} * \%C_{energy\ coal})/100 * 44/12$** **(PDD formula D.1.1.2.-25)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$PE_{combustion\ gases\_electricity}$** | $CO_2$ emissions from combustion of gases for electricity generation at MMK | ths. tons $CO_2$ | **$PE_{combustion\ coal\_electricity}$** | $CO_2$ emissions from combustion of power station coal | ths. tons $CO_2$ |
| **$FC_{BFG\_CPP\_PJ}$** | Consumption of BFG in CPP | mln. $m^3$ | **$FC_{COG\_SABPP\_PJ}$** | Consumption of COG in SABPP | mln. $m^3$ |
| **$FC_{NG\_CPP\_PJ}$** | Consumption of NG in CPP | mln. $m^3$ | **$FC_{NG\_SABPP\_PJ}$** | Consumption of NG in SABPP | mln. $m^3$ |

*$CO_2$ emission factor for electricity produced at MMK*

| | | | | | |
|---|---|---|---|---|---|
| **FC** $_{NG\_CHPP\_PJ}$ | Consumption of NG in CHPP | mln. $m^3$ | **FC** $_{NG\_turbine\ section\ of\ SP\ \_PJ}$ | Consumption of NG in turbine section of SP | mln. $m^3$ |
| **FC** $_{BFG\_SABPP\_PJ}$ | Consumption of BFG in SABPP | mln. $m^3$ | **FC** $_{NG\_gas\ recovery\ unit-2\ of\ SP\ \_PJ}$ | Consumption of NG in gas recovery unit of SP | mln. $m^3$ |
| **C** $_{BFG\_PJ}$ | Carbon content in BFG | kg C/$m^3$ | **C** $_{NG\_PJ}$ | Carbon content in NG | kg C/$m^3$ |
| **C** $_{COG\_PJ}$ | Carbon content in COG | kg C/$m^3$ | **%C** $_{energy\ coal}$ | Carbon content in power station coal | % by mass |
| **FC** $_{energy\ coal\_CHPP\_PJ}$ | Consumption of power station coal by CHPP | ths. tons | | | |

## *12 months of 2008*

Input carbon flows, burning of gases

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of BFG in CPP | mln. m3 | 163,3 | 172,8 | 181,5 | 182,3 | 252,8 | 239,7 | 209,4 | 220,9 | 241,5 | 146,8 | 41,6 | 34,2 | 2086,8 |
| 2 | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | 0,20 |
| | | ths. tons C | 33,0 | 35,4 | 37,3 | 37,2 | 49,1 | 48,9 | 41,8 | 43,1 | 47,1 | 28,9 | 7,2 | 5,8 | 414,8 |
| 3 | Consumption of NG in CPP | mln. m3 | 27,7 | 23,4 | 25,6 | 24,8 | 26,3 | 29,7 | 35,5 | 33,8 | 27,9 | 34,7 | 35,9 | 35,1 | 360,5 |
| 4 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 |
| | | ths. tons C | 13,7 | 11,6 | 12,7 | 12,3 | 13,0 | 14,7 | 17,4 | 16,7 | 13,8 | 17,2 | 17,8 | 17,4 | 178,2 |
| 5 | Consumption of NG in CHPP | mln. m3 | 54,7 | 49,4 | 51,2 | 61,6 | 66,4 | 74,0 | 62,9 | 60,7 | 55,8 | 53,5 | 50,4 | 48,1 | 688,6 |
| 6 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 |
| | | ths. tons C | 27,1 | 24,5 | 25,3 | 30,5 | 32,9 | 36,6 | 30,8 | 30,0 | 27,6 | 26,5 | 24,9 | 23,8 | 340,5 |
| 7 | Consumption of COG in SABPP | mln. m3 | 76,2 | 62,1 | 74,4 | 64,6 | 71,8 | 69,3 | 59,2 | 64,4 | 68,4 | 63,1 | 22,2 | 10,8 | 707 |
| 8 | Carbon content in COG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | 0,20 |
| | | ths. tons C | 15,4 | 12,7 | 15,3 | 13,2 | 14,0 | 14,2 | 11,8 | 12,6 | 13,4 | 12,4 | 3,8 | 1,8 | 140,5 |
| 9 | Consumption of BFG in SABPP | mln. m3 | 17,0 | 11,4 | 14,5 | 13,2 | 14,8 | 14,8 | 12,1 | 12,5 | 12,1 | 12,1 | 3,1 | 2,6 | 140,2 |
| 10 | Carbon content in BFG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | 0,19 |
| | | ths. tons C | 3,3 | 2,2 | 2,8 | 2,6 | 2,9 | 2,9 | 2,3 | 2,4 | 2,2 | 2,3 | 0,6 | 0,5 | 26,9 |

*$CO_2$ emission factor for electricity produced at MMK*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Consumption of NG in SABPP | mln. m3 | 5,6 | 5,7 | 6,4 | 4,6 | 4,9 | 4,3 | 5,8 | 5,1 | 6,0 | 8,7 | 9,7 | 11,2 | **78** |
| 12 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 2,8 | 2,8 | 3,2 | 2,3 | 2,4 | 2,1 | 2,9 | 2,5 | 3,0 | 4,3 | 4,8 | 5,5 | **38,6** |
| 13 | Consumption of NG in turbine section of SP | mln. m3 | 0,519 | 0,387 | 0,408 | 0,348 | 0,342 | 0,263 | 0,148 | 0,190 | 0,181 | 0,275 | 0,245 | 0,118 | **3,4** |
| 14 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 0,26 | 0,19 | 0,20 | 0,17 | 0,17 | 0,13 | 0,07 | 0,09 | 0,09 | 0,14 | 0,12 | 0,06 | **1,7** |
| 15 | Consumption of NG in gas recovery unit of SP | mln. m3 | 0,21 | 0,17 | 0,21 | 0,19 | 0,10 | 0 | 0,03 | 0,15 | 0,16 | 0,13 | 0,19 | 0,12 | **1,6** |
| 16 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 0,10 | 0,08 | 0,10 | 0,09 | 0,05 | 0,00 | 0,01 | 0,08 | 0,08 | 0,06 | 0,10 | 0,06 | **0,8** |
| 17 | **Total carbon input stream with gases** | **ths. tons C** | **95,7** | **89,5** | **96,8** | **98,3** | **114,5** | **119,4** | **107,0** | **107,5** | **107,3** | **91,7** | **59,3** | **54,9** | **1142,0** |

Input carbon flows, burning of coal

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of power station coal by CHPP | ths. tons | 7,8 | 10,9 | 6,7 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,9 | 2,9 | 5,8 | **34,9** |
| 2 | Carbon content in power station coal | % by mass | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 |
| | | ths. tons C | 5,7 | 7,9 | 4,9 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,6 | 2,1 | 4,2 | **25,5** |
| **3** | **Total ouput carbon flow** | **ths. tons C** | **5,7** | **7,9** | **4,9** | **0,0** | **0,0** | **0,0** | **0,0** | **0,0** | **0,0** | **0,6** | **2,1** | **4,2** | **25,5** |

CO2 emissions from electricity generation

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning in the gas-burning processes | ths. tons C | 95,7 | 89,5 | 96,8 | 98,3 | 114,5 | 119,4 | 107,0 | 107,5 | 107,3 | 91,7 | 59,3 | 54,9 | **1142,0** |
| 2 | CO2 emissions from burning of gases | ths. tons CO2 | 350,9 | 328,2 | 355,0 | 360,5 | 419,7 | 437,9 | 392,5 | 394,2 | 393,4 | 336,4 | 217,3 | 201,3 | **4187,2** |
| 3 | Carbon burning in the coal burning process | ths. tons C | 5,7 | 7,9 | 4,9 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,6 | 2,1 | 4,2 | **25,5** |
| 4 | CO2 emissions from coal burning | ths. tons CO2 | 20,9 | 29,1 | 18,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 2,3 | 7,8 | 15,4 | **93,5** |

*$CO_2$ emission factor for electricity produced at MMK*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | CO2 emission factor for electricity produced at MMK | ths. tons CO2 | 371,8 | 357,3 | 373,0 | 360,5 | 419,7 | 437,9 | 392,5 | 394,2 | 393,4 | 338,7 | 225,1 | 216,7 | 4280,7 |

Emission factors for electricity and power transmission/distribution losses

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emission factor for electricity generated at MMK | tons CO2/MWh | 0,774 | 0,803 | 0,816 | 0,830 | 0,957 | 0,976 | 0,953 | 0,944 | 0,977 | 0,784 | 0,603 | 0,607 | 0,835 |
| 2 | CO2 emissions factor for grid electricity purchased from Unified Energy System of Urals (fixed ex-ante, 2008-2012) | tons CO2/MWh | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 | 0,541 |
| 3 | Power transmission and distribution losses in Unified energy Systems of Urals grid | %/100 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 | 0,0736 |

## *12 months of 2009*

Input carbon flows, burning of gases

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of BFG in CPP | mln. m3 | 66,1 | 105,4 | 144,2 | 168,6 | 218,1 | 239,2 | 274,5 | 262,8 | 252,3 | 192,9 | 166,0 | 168,0 | 2258,2 |
| 2 | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 |
| | | ths. tons C | 12,2 | 21,8 | 29,5 | 35,4 | 45,6 | 51,1 | 59,2 | 54,6 | 53,9 | 41,2 | 35,5 | 35,2 | 475,3 |
| 3 | Consumption of NG in CPP | mln. m3 | 38,8 | 24,2 | 23,1 | 21,5 | 22,6 | 19,8 | 16,0 | 16,0 | 20,0 | 19,7 | 21,5 | 24,2 | 267,5 |
| 4 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | 0,50 |
| | | ths. tons C | 19,2 | 12,0 | 11,5 | 10,7 | 11,2 | 9,8 | 7,9 | 7,9 | 9,9 | 9,7 | 10,7 | 12,0 | 132,4 |
| 5 | Consumption of NG in CHPP | mln. m3 | 50,8 | 51,6 | 55,8 | 55,0 | 62,7 | 62,2 | 68,7 | 70,9 | 67,5 | 65,2 | 57,5 | 57,5 | 725,6 |
| 6 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | 0,50 |
| | | ths. tons C | 25,2 | 25,6 | 27,7 | 27,2 | 31,0 | 30,8 | 34,0 | 35,1 | 33,4 | 32,3 | 28,5 | 28,5 | 359,2 |
| 7 | Consumption of COG in SABPP | mln. m3 | 31,2 | 62,7 | 63,1 | 69,6 | 65,9 | 69,8 | 53,5 | 79,8 | 70,7 | 70,1 | 59,2 | 71,5 | 767 |
| 8 | Carbon content in COG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 |
| | | ths. tons C | 5,8 | 13,0 | 12,9 | 14,6 | 13,8 | 14,9 | 11,6 | 16,6 | 15,1 | 15,0 | 12,7 | 15,0 | 160,8 |

*$CO_2$ emission factor for electricity produced at MMK*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Consumption of BFG in SABPP | mln. m3 | 5,4 | 11,9 | 10,2 | 15,1 | 15,1 | 12,7 | 9,2 | 11,1 | 8,5 | 10,0 | 11,2 | 12,3 | **133** |
| 10 | Carbon content in BFG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | **0,18** |
| | | ths. tons C | 1,0 | 2,1 | 1,8 | 2,7 | 2,8 | 2,3 | 1,7 | 2,0 | 1,6 | 1,9 | 2,1 | 2,2 | **24,3** |
| 11 | Consumption of NG in SABPP | mln. m3 | 13,5 | 7,0 | 8,6 | 6,0 | 6,3 | 5,2 | 2,5 | 4,8 | 5,8 | 5,9 | 7,5 | 8,0 | **81** |
| 12 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 6,7 | 3,5 | 4,2 | 3,0 | 3,1 | 2,6 | 1,2 | 2,4 | 2,9 | 2,9 | 3,7 | 4,0 | **40,1** |
| 13 | Consumption of NG in turbine section of SP | mln. m3 | 0,2 | 0,3 | 0,4 | 0,3 | 0,2 | 0,2 | 0,2 | 0,3 | 0,3 | 0,2 | 0,5 | 0,3 | **3,3** |
| 14 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 0,10 | 0,15 | 0,20 | 0,13 | 0,10 | 0,09 | 0,09 | 0,16 | 0,14 | 0,09 | 0,23 | 0,15 | **1,6** |
| 15 | Consumption of NG in gas recovery unit of SP | mln. m3 | 0,16 | 0,11 | 0,12 | 0,16 | 0,06 | 0,06 | 0,08 | 0,15 | 0,15 | 0,16 | 0,21 | 0,15 | **1,6** |
| 16 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 0,08 | 0,05 | 0,06 | 0,08 | 0,03 | 0,03 | 0,04 | 0,07 | 0,07 | 0,08 | 0,10 | 0,07 | **0,8** |
| **17** | **Total carbon input stream with gases** | **ths. tons C** | **70,2** | **78,1** | **87,9** | **93,8** | **107,6** | **111,7** | **115,8** | **118,7** | **117,0** | **103,2** | **93,4** | **97,1** | **1194,6** |

Input carbon flows, burning of coal

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of power station coal by CHPP | ths. tons | 15,5 | 4,7 | 8,2 | 12,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 5,9 | 3,9 | 7,4 | **57,6** |
| 2 | Carbon content in power station coal | % by mass | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 | 73,00 |
| | | ths. tons C | 11,3 | 3,4 | 6,0 | 8,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 4,3 | 2,9 | 5,4 | **42,0** |
| **3** | **Total ouput carbon flow** | **ths. tons C** | **11,3** | **3,4** | **6,0** | **8,8** | **0,0** | **0,0** | **0,0** | **0,0** | **0,0** | **4,3** | **2,9** | **5,4** | **42,0** |

CO2 emissions from electricity generation

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Carbon burning in the gas-burning processes | ths. tons C | 70,2 | 78,1 | 87,9 | 93,8 | 107,6 | 111,7 | 115,8 | 118,7 | 117,0 | 103,2 | 93,4 | 97,1 | **1194,6** |
| 2 | CO2 emissions from burning of gases | ths. tons CO2 | 257,5 | 286,4 | 322,3 | 343,8 | 394,7 | 409,5 | 424,7 | 435,4 | 429,1 | 378,6 | 342,3 | 355,9 | **4380,1** |

*$CO_2$ emission factor for electricity produced at MMK*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Carbon burning in the coal burning process | ths. tons C | 11,3 | 3,4 | 6,0 | 8,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 4,3 | 2,9 | 5,4 | **42,0** |
| 4 | CO2 emissions from coal burning | ths. tons CO2 | 41,4 | 12,5 | 21,9 | 32,2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 15,7 | 10,5 | 19,9 | **154,1** |
| 5 | **CO2 emission factor for electricity produced at MMK** | **ths. tons CO2** | **298,9** | **298,9** | **344,2** | **376,0** | **394,7** | **409,5** | **424,7** | **435,4** | **429,1** | **394,3** | **352,8** | **375,8** | **4534,2** |

Emission factors for electricity and power transmission/distribution losses

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emission factor for electricity generated at MMK** | **tons CO2/MWh** | **0,720** | **0,720** | **0,760** | **0,857** | **0,955** | **1,037** | **1,082** | **1,077** | **1,038** | **0,891** | **0,804** | **0,801** | **0,895** |
| 2 | **CO2 emissions factor for grid electricity purchased from Unified Energy System of Urals** (fixed ex-ante, 2008-2012) | **tons CO2/MWh** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** | **0,541** |
| 3 | Power transmission and distribution losses in Unified energy Systems of Urals grid | %/100 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | 0,0851 | **0,0851** |

*$CO_2$ emission factor for electricity produced at MMK*

### *D.6 $CO_2$ emissions from electricity consumption in the baseline*

**$CO_2$ emissions from electricity consumption in OHFP**

$$BE_{electricity\_OHFP} = SEC_{steel\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} *((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/(EC_{gross\_PJ} - EC_{grid\_steel\_EAF})$$ **(PDD formula D.1.1.4.-12)**

**$CO_2$ emissions from consumption of electricity in BMP**

$$BE_{electricity\_BM} = SEC_{profiled\ steel\_BM\_} * P_{profiled\ steel\_EAFP} * ((EF_{own\ generation\_PJ} * (EC_{gross\_PJ} - EC_{import\_PJ}) + EF_{grid} * (EC_{import\_PJ} - EC_{grid\_steel\_EAF}) * (1+TDL))/ (EC_{gross\_PJ} - EC_{grid\_steel\_EAF})$$ **(PDD formula D.1.1.4.-14)**

**Total $CO_2$ emissions from electricity consumption**

$$BE_{total\ electricity\ consumption} = BE_{electricity\_OHFP} + BE_{electricity\_BM}$$ **(PDD formula D.1.1.4.-16)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$BE_{electricity\_OHFP}$** | $CO_2$ emissions from electricity consumption in OHFP | ths. tons $CO_2$ | **$EC_{gross\_PJ}$** | Total electricity consumption by MMK | GW-h |
| **$BE_{electricity\_BM}$** | $CO_2$ emissions from consumption of electricity in BMP | ths. tons $CO_2$ | **$EC_{import\_PJ}$** | Electricity purchases from Unified Energy Systems of Urals grid | GW-h |
| **$BE_{total\ electricity\ consumption}$** | Total $CO_2$ emissions from electricity consumption in the baseline | ths. tons $CO_2$ | **$EC_{grid\_steel\_EAF}$** | Consumption of grid electricity by EAF-180 via 220/35 kV step-down substation | GW-h |
| **$SEC_{steel\_OHFP}$** | Specific consumption of electricity in OHFP per ton of smelted steel | MW-h/ton | **$EF_{grid}$** | $CO_2$ emission factor for grid electricity from Unified Energy Systems of Urals (EF grid = 0.541 t CO2/MW-h) | tons $CO_2$/MW-h |
| **$SC_{steel\_profiled\_steel\_BM}$** | Specific consumption of steel per ton of profiled steel billet produced in BMP | tons $CO_2$/MW-h | **$EF_{own\ generation\_PJ}$** | $CO_2$ emission factor for electricity produced by own generating capacities of MMK | tons $CO_2$/MW-h |
| **$P_{profiled\ steel\_EAFP}$** | Output of profiled steel billet in EAFP | ths. tons | **TDL** | Technological losses during | % |

*$CO_2$ emissions from electricity consumption in the baseline*

| | | | | | |
|---|---|---|---|---|---|
| | | | | transportation and distribution of grid electricity in Unified Energy System of Urals | |
| **SEC** $_{profiled\ steel\_BM}$ | Specific consumption of electricity in BMP per ton of profiled steel billet | MW-h/ton | | | |

## *12 months of 2008*

Electricity balance in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Specific consumption of electricity in OHFP per ton of smelted steel | MWh/ton | 0,007 | | | | | | | | | | | | **0,007** |
| 2 | Specific consumption of electricity in BMP per ton of profiled steel billet | MWh/ton | 0,041 | | | | | | | | | | | | **0,041** |
| 3 | Total electricity consumption by MMK | GWh | 655,9 | 610,9 | 640,5 | 618,2 | 617,7 | 610,8 | 613,5 | 645,0 | 624,9 | 533,8 | 398,3 | 403,2 | **6972,9** |
| 4 | Electricity purchases from Unified Energy Systems of Urals grid | GWh | 175,3 | 166,0 | 183,7 | 184,0 | 179,0 | 162,0 | 201,5 | 227,4 | 222,4 | 102,0 | 25,0 | 46,5 | **1874,7** |
| 5 | Electricity purchases from Unified Energy Systems of Urals grid except EAF-180 demand | GWh | 92,1 | 93,7 | 101,8 | 104,7 | 103,7 | 82,6 | 120,0 | 142,9 | 142,0 | 64,7 | 0,0 | 0,0 | **1048,3** |
| 6 | Electricity, generated by MMK | GWh | 480,7 | 445,0 | 456,9 | 434,3 | 438,7 | 448,8 | 412,0 | 417,6 | 402,5 | 431,8 | 373,3 | 356,7 | **5098,2** |

CO2 emissions from electricity demand in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from electricity demand in OHFP | ths. tons CO2 | 1,046 | 1,007 | 1,062 | 1,052 | 1,035 | 1,147 | 1,075 | 1,084 | 1,113 | 0,717 | 0,212 | 0,270 | **10,821** |
| 2 | CO2 emissions from electricity demand in BMP | ths. tons CO2 | 5,399 | 5,197 | 5,482 | 5,431 | 5,341 | 5,920 | 5,551 | 5,593 | 5,746 | 3,701 | 1,095 | 1,395 | **55,852** |
| 3 | **Total CO2 emissions from electricity denamd** | **ths. tons CO2** | **6,445** | **6,204** | **6,544** | **6,483** | **6,376** | **7,067** | **6,627** | **6,677** | **6,859** | **4,418** | **1,307** | **1,665** | **66,673** |

*$CO_2$ emissions from electricity consumption in the baseline*

## *12 months of 2009*

Electricity balance in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Specific consumption of electricity in OHFP per ton of smelted steel | MWh/ton | 0,007 | | | | | | | | | | | | **0,007** |
| 2 | Specific consumption of electricity in BMP per ton of profiled steel billet | MWh/ton | 0,041 | | | | | | | | | | | | **0,041** |
| 3 | Total electricity consumption by MMK | GWh | 463,0 | 536,5 | 494,5 | 464,8 | 461,1 | 492,8 | 530,7 | 553,9 | 536,1 | 545,4 | 514,2 | 557,4 | **6150,4** |
| 4 | Electricity purchases from Unified Energy Systems of Urals grid | GWh | 48,1 | 121,2 | 41,6 | 26,0 | 48,0 | 97,8 | 138,1 | 149,7 | 122,7 | 102,9 | 75,6 | 88,0 | **1059,7** |
| 5 | Electricity purchases from Unified Energy Systems of Urals grid except EAF-180 demand | GWh | 0,0 | 56,6 | 41,0 | 25,6 | 47,7 | 97,4 | 137,4 | 133,4 | 108,6 | 101,4 | 75,2 | 87,6 | **911,9** |
| 6 | Electricity, generated by MMK | GWh | 414,9 | 415,3 | 452,9 | 438,8 | 413,1 | 395,0 | 392,7 | 404,2 | 413,4 | 442,5 | 438,6 | 469,3 | **5090,8** |

CO2 emissions from electricity consumption in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from electricity consumption in OHFP | ths. tons CO2 | 0,388 | 0,524 | 0,575 | 0,621 | 0,533 | 0,838 | 0,856 | 0,856 | 0,686 | 0,516 | 0,296 | 0,345 | **7,034** |
| 2 | CO2 emissions from electricity consumption in BMP | ths. tons CO2 | 2,002 | 2,707 | 2,967 | 3,205 | 2,749 | 4,323 | 4,419 | 4,418 | 3,540 | 2,665 | 1,529 | 1,781 | **36,307** |
| **3** | **Total CO2 emissions from electricity consumption in the baseline** | **ths. tons CO2** | **2,390** | **3,231** | **3,542** | **3,826** | **3,282** | **5,161** | **5,275** | **5,274** | **4,226** | **3,182** | **1,825** | **2,126** | **43,341** |

*$CO_2$ emissions from electricity consumption in the baseline*

### *D.6 $CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet*

**$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the project**

$PE_{air\ blast\_for\_pig\_iron} = P_{profiled\ steel\_\ EAFP} * SC_{pig\ iron\_\ EAFP} * SC_{air\ blast\ generation\_PJ} * EF_{air\ blast\ generation\_PJ}$ **(PDD formula D.1.1.2.-26)**

$EF_{air\ blast\ generation\_PJ} = PE_{air\ blast\ generation} / OC_{air\ blast\ generation\_PJ}$ **(PDD formula D.1.1.2.-27)**

$PE_{air\ blast\ generation} = (FC_{BFG\_SABPP\_\ air\ blast\ generation\ \_PJ} * C_{BFG\_PJ} + FC_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ} * C_{COG.PJ} + FC_{NG\_SABPP\_\ air\ blast\ generation\_PJ} * C_{NG\_.PJ})/100 * 44/12$

**(PDD formula D.1.1.2.-28)**

***Specific consumption of air blast per ton of pig iron produced***

$SC_{air\ blast\ generation\_PJ} = OC_{air\ blast\ generation\_PJ} / P_{pig\ iron\_BF\_PJ}$ **(PDD formula D.1.1.2.-29)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $PE_{air\ blast\_for\_pig\_iron}$ | $CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet | ths. tons $CO_2$ | $OC_{air\ blast\ generation\_PJ}$ | Generation of air blast at MMK | mln. $m^3$ |
| $P_{profiled\ steel\_\ EAFP}$ | Output of profiled steel billet in EAFP | ths. tons | $FC_{BFG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ | Consumption of BFG in SABPP for generation of air blast | mln. $m^3$ |
| $SC_{pig\ iron\_\ EAFP}$ | Specific consumption of pig iron per ton of profiled steel billet produced in EAFP | ton/ton | $C_{BFG\_PJ}$ | Carbon content in BFG | kg $C/m^3$ |
| $SC_{air\ blast\ generation}$ | Specific consumption of air blast per ton of pig iron produced | ths. $m^3$/ton | $FC_{COG\_SABPP\_\ air\ blast\ generation\ \_PJ}$ | Consumption of COG in SABPP for generation of air blast | mln. $m^3$ |
| $EF_{air\ blast\ generation\_PJ}$ | $CO_2$ emission factor for air blast generation | ths. tons $CO_2$/ths. $m^3$ | $C_{COG.PJ}$ | Carbon content in COG | % by mass |
| $PE_{air\ blast\ generation}$ | $CO_2$ emissions from combustion of fuel for generation of air blast | ths. tons $CO_2$ | $FC_{NG\_SABPP\_\ air\ blast\ generation\_PJ}$ | Consumption of NG in SABPP for generation of air blast | mln. $m^3$ |
| $P_{pig\ iron\_BF\_PJ}$ | Production of pig iron in BFP | ths. tons | $C_{NG\_.PJ}$ | Carbon content in NG | kg $C/m^3$ |

*$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet*

# *12 months of 2008*

Generation of air blast at MMK

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Generation of air blast at MMK | mln. m3 | 1960,9 | 1943,8 | 2166,8 | 2083,6 | 2236,6 | 1991,0 | 1827,6 | 2131,6 | 1972,0 | 1503,5 | 838,4 | 821,4 | **21477,3** |
| 2 | **Specific consumption of air blast in BFP per ton of produced pig iron** | **ths. m3 of air blast/ton** | *2,242* | *2,306* | *2,420* | *2,538* | *2,564* | *2,639* | *2,690* | *2,714* | *2,432* | *2,418* | *2,659* | *3,063* | **2,557** |

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of BFG in SABPP for generation of air blast | mln. m3 | 106,5 | 104,9 | 118,0 | 117,3 | 124,7 | 111,8 | 91,8 | 115,4 | 108,8 | 68,9 | 22,1 | 10,6 | **1100,7** |
| 2 | Carbon content in BFG | kg C/m3 | 0,20 | 0,20 | 0,21 | 0,20 | 0,19 | 0,20 | 0,20 | 0,20 | 0,20 | 0,20 | 0,17 | 0,17 | **0,20** |
| | | ths. tons C | 21,5 | 21,5 | 24,2 | 24,0 | 24,2 | 22,8 | 18,3 | 22,5 | 21,2 | 13,5 | 3,8 | 1,8 | **219,5** |
| 3 | Consumption of COG in SABPP for generation of air blast | mln. m3 | 23,7 | 19,4 | 23,0 | 23,9 | 25,7 | 23,8 | 18,7 | 22,5 | 19,3 | 13,2 | 3,1 | 2,5 | **218,8** |
| 4 | Carbon content in COG | kg C/m3 | 0,20 | 0,19 | 0,19 | 0,19 | 0,20 | 0,19 | 0,19 | 0,19 | 0,18 | 0,19 | 0,18 | 0,17 | **0,19** |
| | | ths. tons C | 4,7 | 3,8 | 4,4 | 4,6 | 5,0 | 4,6 | 3,5 | 4,3 | 3,6 | 2,5 | 0,6 | 0,4 | **42,0** |
| 5 | Consumption of NG in SABPP for generation of air blast | mln. m3 | 7,8 | 9,7 | 10,2 | 8,3 | 8,5 | 6,9 | 9,0 | 9,1 | 9,5 | 9,5 | 9,6 | 10,9 | **109,2** |
| 6 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | **0,49** |
| | | ths. tons C | 3,9 | 4,8 | 5,0 | 4,1 | 4,2 | 3,4 | 4,4 | 4,5 | 4,7 | 4,7 | 4,8 | 5,4 | **54,0** |
| 7 | **Total carbon content in input gaseos flow** | **ths. tons C** | **30,0** | **30,1** | **33,6** | **32,7** | **33,5** | **30,8** | **26,3** | **31,3** | **29,5** | **20,8** | **9,1** | **7,6** | **315,4** |

CO2 emissions from generation of air blast

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from generation of air blast** | **ths. tons CO2** | **110,2** | **110,2** | **123,4** | **120,0** | **122,7** | **113,0** | **96,4** | **114,8** | **108,2** | **76,2** | **33,5** | **28,0** | **1156,5** |

*$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet*

CO2 emission factor for generation of air blast

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emission factor for generation of air blast at MMK | tons CO2/ ths. m3 of air blast | 0,056 | 0,057 | 0,057 | 0,058 | 0,055 | 0,057 | 0,053 | 0,054 | 0,055 | 0,051 | 0,040 | 0,034 | 0,052 |

CO2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the project

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from generation of air blast for production of pig iron | ths. tons CO2 | 7,576 | 8,165 | 8,611 | 8,073 | 7,201 | 7,368 | 5,857 | 6,486 | 6,644 | 4,986 | 1,658 | 1,479 | 74,103 |

## *12 months of 2009*

Generation of air blast at MMK

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Generation of air blast at MMK | mln. m3 | 1038,7 | 1256,7 | 1464,8 | 1513,5 | 1547,6 | 1747,6 | 1898,5 | 1925,0 | 1845,7 | 1841,5 | 1699,7 | 1709,8 | 19489,0 |
| 2 | Specific consumption of air blast in BFP per ton of produced pig iron | ths. m3 of air blast/ton | *2,593* | *2,279* | *2,290* | *2,263* | *2,416* | *2,508* | *2,442* | *2,483* | *2,388* | *2,336* | *2,481* | *2,233* | 2,393 |

Input carbon flows

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Consumption of BFG in SABPP for generation of air blast | mln. m3 | 26,5 | 62,3 | 70,3 | 78,0 | 76,5 | 96,1 | 119,5 | 123,7 | 112,5 | 108,5 | 82,8 | 91,3 | 1048,0 |
| 2 | Carbon content in BFG | kg C/m3 | 0,19 | 0,21 | 0,20 | 0,21 | 0,21 | 0,21 | 0,22 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 |
| | | ths. tons C | 4,9 | 12,9 | 14,4 | 16,3 | 16,0 | 20,5 | 25,8 | 25,7 | 24,0 | 23,2 | 17,7 | 19,1 | 220,6 |
| 3 | Consumption of COG in SABPP for generation of air blast | mln. m3 | 4,6 | 11,9 | 11,4 | 16,9 | 17,6 | 17,5 | 20,5 | 17,3 | 13,6 | 15,5 | 15,6 | 15,7 | 178,0 |

*$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Carbon content in COG | kg C/m3 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,18 | 0,19 | 0,18 | 0,19 | 0,19 | 0,19 | 0,18 | **0,18** |
| | | ths. tons C | 0,8 | 2,1 | 2,1 | 3,1 | 3,2 | 3,2 | 3,9 | 3,1 | 2,5 | 3,0 | 2,9 | 2,8 | **32,7** |
| 5 | Consumption of NG in SABPP for generation of air blast | mln. m3 | 11,5 | 7,0 | 9,6 | 6,8 | 7,3 | 7,2 | 5,6 | 7,4 | 9,2 | 9,0 | 10,4 | 10,2 | **101,1** |
| 6 | Carbon content in NG | kg C/m3 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,50 | 0,49 | 0,49 | 0,49 | 0,49 | 0,49 | 0,50 | **0,50** |
| | | ths. tons C | 5,7 | 3,4 | 4,7 | 3,3 | 3,6 | 3,6 | 2,8 | 3,6 | 4,6 | 4,5 | 5,2 | 5,1 | **50,0** |
| 7 | **Total carbon content in input gaseos flow** | **ths. tons C** | **11,4** | **18,5** | **21,2** | **22,8** | **22,8** | **27,3** | **32,4** | **32,4** | **31,1** | **30,6** | **25,7** | **27,0** | **303,4** |

CO2 emissions from generation of air blast

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from generation of air blast** | **ths. tons CO2** | **41,9** | **67,7** | **77,7** | **83,5** | **83,7** | **100,1** | **118,8** | **118,9** | **114,2** | **112,3** | **94,4** | **99,1** | **1112,3** |

CO2 emission factor for generation of air blast

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emission factor for generation of air blast at MMK** | **tons CO2/ ths. m3 of air blast** | 0,040 | 0,054 | 0,053 | 0,055 | 0,054 | 0,057 | 0,063 | 0,062 | 0,062 | 0,061 | 0,056 | 0,058 | 0,056 |

CO2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the project

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **CO2 emissions from generation of air blast for production of pig iron** | **ths. tons CO2** | 1,591 | 3,017 | 10,229 | 10,785 | 8,842 | 13,584 | 14,229 | 10,679 | 8,637 | 9,183 | 5,546 | 6,621 | 102,943 |

*$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet*

## <u>$CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the baseline</u>

$$BE_{air\ blast\_for\_pig\_iron} = SC_{air\ blast\ generation\_PJ} * SC_{pig\ iron\_OHFP} * P_{profiled\ steel\_EAFP} * SC_{steel\_profiled\_steel\_BM} * EF_{air\ blast\ generation\_PJ}$$

**(PDD formula D.1.1.4.-17)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| $BE_{air\ blast\_for\_pig\_iron}$ | $CO_2$ emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the baseline | ths. tons $CO_2$ | $P_{profiled\ steel\_EAFP}$ | Output of profiled steel billet in EAFP | ths. tons |
| $SC_{air\ blast\ generation\_PJ}$ | Specific consumption of air blast in BFP per ton of pig iron | ths. $m^3$/ton | $SC_{steel\_profiled\_steel\_BM}$ | Specific consumption of steel per ton of profiled steel billet produced in BMP | ton/ton |
| $SC_{pig\ iron\_OHFP}$ | Specific consumption of pig iron per ton of steel produced in OHFP | ton/ton | $EF_{air\ blast\ generation\_PJ}$ | $CO_2$ emission factor for air blast generation | ths. tons $CO_2$/ths. $m^3$ |

### *12 months of 2008*

CO2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from generation of air blast for production of pig iron | ths. tons CO2 | 21,222 | 20,596 | 22,626 | 23,522 | 19,681 | 22,478 | 20,995 | 22,248 | 20,313 | 13,859 | 4,470 | 5,555 | 217,564 |

### *12 months of 2009*

CO2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the baseline

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CO2 emissions from generation of air blast for production of pig iron | ths. tons CO2 | 6,736 | 10,936 | 11,197 | 11,002 | 9,077 | 15,184 | 16,408 | 16,423 | 12,831 | 10,542 | 6,320 | 6,966 | 133,622 |

*CO2 emissions from generation of air blast for production of pig iron used for production of profiled steel billet in the baseline*

## *D.7 Emissions reduction calculation from project activity*

**Total project emissions from production of profiled steel billet**

$$PE = PE_{metallurgical\ coke\_profiled\_steel} + PE_{pig\ iron\_\ profiled\_steel} + PE_{profiled\ steel\_\ EAFP} + PE_{electricity\_profiled\_steel\_EAFP} + PE_{air\ blast\_for\_pig\_iron}$$

**(PDD formula D.1.1.2.-30)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **PE** | Total project $CO_2$ emissions from production of profiled steel billet | ths. tons $CO_2$ | $PE_{profiled\ steel\_\ EAFP}$ | $CO_2$ emissions in EAFP from production of profiled steel billet | ths. tons $CO_2$ |
| $PE_{metallurgical\ coke\_profiled\_steel}$ | $CO_2$ emissions from consumption of metallurgical coke for production of profiled steel billet | ths. tons $CO_2$ | $PE_{electricity\_profiled\_steel\_EAFP}$ | $CO_2$ emissions from consumption of electricity for production of profiled steel billet in EAFP | ths. tons $CO_2$ |
| $PE_{pig\ iron\_\ profiled\_steel}$ | $CO_2$ emissions from consumption of pig iron for production of profiled steel billet | ths. tons $CO_2$ | $PE_{air\ blast\_for\_pig\_iron}$ | $CO_2$ emissions from consumption of air blast for production of pig iron for production of profiled steel billet | ths. tons $CO_2$ |

**Total $CO_2$ emissions in the baseline**

$$BE = BE_{metallurgical\ coke\_profiled\_steel} + BE_{pig\ iron\_profiled\_steel} + BE_{steel\_OHFP} + BE_{profiled\ steel\_BM} + BE_{total\ electricity\ consumption} + BE_{air\ blast\_for\_pig\_iron}$$

**(PDD formula D.1.1.4.-18)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **BE** | Total $CO_2$ emissions in the baseline | ths. tons $CO_2$ | $BE_{steel\_OHFP}$ | $CO_2$ emissions from steel smelting in OHFP | ths. tons $CO_2$ |
| $BE_{metallurgical\ coke\_profiled\_steel}$ | $CO_2$ emissions from consumption of metallurgical coke in BFP for production of profiled steel billet in the baseline | ths. tons $CO_2$ | $BE_{profiled\ steel\_BM}$ | $CO_2$ emissions from production of profiled steel billet in BMP | ths. tons $CO_2$ |
| $BE_{pig\ iron\_profiled\_steel}$ | $CO_2$ emissions from consumption of pig iron in BFP in the baseline | ths. tons $CO_2$ | $BE_{total\ electricity\ consumption}$ | Total $CO_2$ emissions from electricity consumption in the baseline | ths. tons $CO_2$ |
| | | | $BE_{air\ blast\_for\_pig\_iron}$ | $CO_2$ emissions from generation of air blast in the baseline | ths. tons $CO_2$ |

**Utilization of blast furnace dust at the cement factory outside MMK**

$$LE_y = M_{dust\ utilization\_PJ} * \%C_{dust\_BF\_PJ} * 44/12$$ **(PDD formula D.1.3.2.-1)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$LE_y$** | $CO_2$ emissions from utilization of blast furnace dust at the cement factory outside MMK | ths. tons $CO_2$ | **$\%C_{dust\_BF\_PJ}$** | Carbon content in blast furnace dust, | % by mass |
| **$M_{dust\ utilization\_PJ}$** | Supply of blast furnace dust at the cement factory outside MMK | ths. tons | | | |

**GHG emission reduction from the project activity**

$$ER_y = BE_y - PE_y - LE_y$$ **(PDD formula D.1.4.-1)**

| Symbol | Data variable | Unit | Symbol | Data variable | Unit |
|---|---|---|---|---|---|
| **$ER_y$** | Emission reduction in the period y | tons $CO_{2eq}$ | **$PE_y$** | Project emissions in the period y | ths. tons $CO_2$ |
| **$BE_y$** | Baseline emissions in the period y | ths. tons $CO_2$ | **$LE_y$** | $CO_2$ emissions from utilization of blast furnace dust at the cement factory outside MMK | ths. tons $CO_2$ |

## *12 months of 2008*

Leakages - utilization of blast furnace dust outside MMK

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Supply of blast furnace dust to the cement factory outside MMK | ths. tons | 1,5 | 1,5 | 1,5 | 0,9 | 1,0 | 1,3 | 2,1 | 1,8 | 2,5 | 1,7 | 1,8 | 0,4 | 17,9 |
| | Carbon content in blast furnace dust | % by mass | 14,2 | 13,3 | 13,2 | 14,7 | 14,7 | 19,0 | 19,8 | 18,2 | 15,1 | 15,7 | 20,6 | 32,2 | 17,6 |
| | | ths. tons C | 0,21 | 0,20 | 0,20 | 0,13 | 0,15 | 0,25 | 0,42 | 0,33 | 0,38 | 0,26 | 0,37 | 0,11 | 3,0 |
| 2 | CO2 emissions from utilization of blast furnace dust at the cement factory outside MMK | ths. tons CO2 | 0,781 | 0,732 | 0,726 | 0,475 | 0,537 | 0,906 | 1,525 | 1,201 | 1,384 | 0,968 | 1,360 | 0,420 | 11,015 |

ERUs generated in 2008 in accordance with monitoring results

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Total project CO2 emissions from production of profiled steel billet | ths. tons CO2 | 136,119 | 134,567 | 138,475 | 129,232 | 117,152 | 120,830 | 109,392 | 115,617 | 121,678 | 95,367 | 35,551 | 39,000 | 1292,979 |
| 2 | Total CO2 emissions in the baseline | ths. tons CO2 | 311,116 | 291,510 | 304,997 | 302,571 | 264,339 | 286,790 | 281,074 | 289,034 | 287,108 | 209,633 | 77,096 | 98,307 | 3003,574 |
| 3 | CO2 emissions from leakages | ths. tons CO2 | 0,781 | 0,732 | 0,726 | 0,475 | 0,537 | 0,906 | 1,525 | 1,201 | 1,384 | 0,968 | 1,360 | 0,420 | 11,015 |
| 4 | ERUs generated in 2008 | tons CO2eq | 174 216 | 156 211 | 165 796 | 172 864 | 146 650 | 165 055 | 170 158 | 172 215 | 164 046 | 113 298 | 40 185 | 58 887 | 1 699 581 |

## *12 months of 2009*

Leakages - utilization of blast furnace dust outside MMK

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Supply of blast furnace dust to the cement factory outside MMK | ths. tons | 0,2 | 0,9 | 1,0 | 1,5 | 1,2 | 0,9 | 1,6 | 1,5 | 2,0 | 2,2 | 1,0 | 1,2 | **15,2** |
| | Carbon content in blast furnace dust | % by mass | 27,8 | 22,0 | 22,0 | 22,6 | 19,8 | 22,6 | 19,5 | 14,2 | 16,8 | 16,8 | 20,0 | 17,9 | **20,2** |
| | | ths. tons C | 0,05 | 0,21 | 0,21 | 0,33 | 0,24 | 0,21 | 0,31 | 0,22 | 0,34 | 0,37 | 0,20 | 0,21 | **2,9** |
| 2 | **CO2 emissions from utilization of blast furnace dust at the cement factory outside MMK** | **ths. tons CO2** | **0,199** | **0,762** | **0,766** | **1,202** | **0,871** | **0,777** | **1,153** | **0,799** | **1,232** | **1,345** | **0,733** | **0,788** | **10,626** |

ERUs generated in 2009 in accordance with monitoring results

| № | Data variable | Unit | Jan | Feb | March | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec | Total for year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Total project CO2 emissions from production of profiled steel billet** | **ths. tons CO2** | 50,140 | 70,486 | 130,404 | 132,211 | 105,179 | 149,967 | 149,631 | 125,860 | 103,921 | 103,154 | 63,530 | 79,558 | **1264,040** |
| 2 | **Total CO2 emissions in the baseline** | **ths. tons CO2** | 109,686 | 152,677 | 157,105 | 150,681 | 119,375 | 183,478 | 187,032 | 186,644 | 150,861 | 127,559 | 78,815 | 92,030 | **1695,941** |
| 3 | **CO2 emissions from leakages** | **ths. tons CO2** | 0,199 | 0,762 | 0,766 | 1,202 | 0,871 | 0,777 | 1,153 | 0,799 | 1,232 | 1,345 | 0,733 | 0,788 | 10,626 |
| 4 | **ERUs generated in 2009** | **tons CO2eq** | 59 347 | 81 429 | 25 935 | 17 269 | 13 324 | 32 733 | 36 249 | 59 984 | 45 708 | 23 060 | 14 552 | 11 685 | 421 275 |

# Appendix 1

| | Color legend for calculation tables |
|---|---|
| | carbon containing flow |
| | data input from MMK reports |
| | carbon mass |
| 0,19 | carbon conent |
| | specific CO2 emissions |
| | CO2 emissions, associated with production of profiled steel billet |
| | value fixed ex-ante |
| | value which requires a special note in the monitoring report (section C) |

# Appendix 2

## List of abbreviations

| | |
|---|---|
| BFG | Blast-Furnace Gas |
| BFP | Blast-Furnace Plant |
| BMP | Blooming Mill Plant |
| BOFP | Basic Oxygen Furnace Plant |
| BPCP | By-Product Coke Plant |
| CCM | Continuous Casting Machine |
| CEST | Center for Energy Saving Technologies |
| CHPP | Combined Heat Power Plant |
| CL | Central Lab |
| COG | Coke Oven Gas |
| CPP | Central Power Plant |
| DBSU | Double-Bath Steelmaking Unit |
| EAF | Electric Arc Furnace |
| EAFP | Electric Arc-Furnace Plant |
| EF | Emission Factor |
| EIA | Environmental Impact Assessment |
| ERU | Emission Reduction Unit |
| GHG | Greenhouse Gas |
| IMP and LDW | Integrated Mining-and-Processing, Limestone and Dolomite Works |
| IPCC | Intergovernmental Panel on Climate Change |
| JI | Joint Implementation |
| KP | The Kyoto Protocol |
| LFA | Ladle-Furnace Aggregate |
| MEC | Magnitogorsk Energy Company |
| MMK | Magnitogorsk iron and steel works |
| MNR | Ministry of Natural Resources |
| MPC | Maximum Permissible Concentration |
| MPE | Maximum Permissible Emissions |
| OHFP | Open-Hearth Furnace Plant |
| SABPP | Steam-Air Blowing Power Plant |
| SP | Steam Plant |
| SRA | Steel Refining Aggregate |
| TEE | Turbine Expansion Engine |
| QMS | Quality Management System |