**Climate care**

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# DPM Krumovgrad

# Preliminary GHG Emission Inventory

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# Content

# 1. Introduction

DPM Krumovgrad project provisions the construction of an open pit mining operation comprised of a process plant, employing conventional crushing, grinding and flotation processing for gold extraction, with an expected ore treatment rate of about 0.84 mln. t per year and expected gold/silver concentrate production of about 10 000 t.

DPM Krumovgrad is negotiating a funding from EBRD for the Krumovgrad mine project. According to EBRD's Environmental and social policy, all financed projects that are expected to produce post-investment more than 25 000 t of $CO_2$-eq. annually, shall quantify these emissions. The initial screening process allocates a project to an emission category reflecting the scale of future emissions from the facilities, where the investment is to be made. For projects of similar scopes the expected annual GHG emissions are estimated to about 40 000 t of $CO_2$ annually, which would qualify the Krumovgrad project in the medium-low category (20–100 kt $CO_2$ emissions per year).

Usually, under the loan terms is required to elaborate an Inventory of the Greenhouse gas (GHG) emissions resulting from the mine activities and to prepare a Carbon Management Plan if the project is expected to generate above 100 kt $CO_2$ emissions per year. The specific requirements of the EBRD include:

- The client should encourage the reduction of all GHG emission related to the project in a way, which is appropriate for the nature and the scale of the operation activities and impacts of the project
- During the development of projects that are expected to produce or already produce significant quantities of GHG emissions, the client should collect and report data, required for performing an assessment of base (pre-investment) GHG emissions, as well as to calculate the expected amount of GHG emissions after the investment realization. The GHG emission inventory should include direct emissions from installations and equipment that are owned or under control of the client within the physical boundaries of the project/site, together with the emissions from external operations, on which the project depends, including as well indirect emissions, related to the production of electricity outside the territory of the project's site. The qualitative determination and parameters observation, necessary for the GHG emission assessment, should be performed on a yearly basis during the whole life cycle of the project
- Furthermore, the client should assess the technical and financial feasibility and profitability of all options for carbon intensity reduction, during the design and operation phases of the project, and to adopt suitable options

According to the above requirements DPM Krumovgrad has assigned to denkstatt Bulgaria Ltd. the preparation of a preliminary inventory of greenhouse gas emissions expected to be generated from the company activities.

# 2. Baseline inventory of GHG emissions

## 2.1. Methodology

Since the project is a new mining operation, the pre-investment baseline emissions are accounted as zero, as it is required by the EBRD methodology.

The GHG emissions inventory has been prepared in accordance with the applicable guidelines and methodologies, including

- EBRD Methodology for Assessment of Greenhouse Gas Emissions (version 7 from 6th of July 2010)
- EBRD Electricity Emission Factors Review (November 2009)
- World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) Greenhouse Gas Protocol
- International Panel for Climate Change (IPCC) Guidelines for National GHG Inventories from 1996 and 2006, as well as Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories from 2000

Following these methodologies ensures that all relevant data is accurate and reported in the appropriate format, and can therefore be used for preparing reports at international level.

## 2.2. Organizational and Operational Boundaries

According to EBRD's methodology, GHG emissions are categorised as direct and indirect.

Direct emissions result from processes occurring in the physical boundaries of the project. Indirect emissions are emissions that are produced due to the existence of the project, but which occur outside of the project boundaries.

Indirect emissions are divided into upstream, which are related with the production of the delivered resources and materials used in the project, and downstream - associated with the use of products and services resulting from the project.

The EBRD's methodology refers to the WRI/WBCSD Greenhouse gas protocol regarding the classification of GHG emissions. This Protocol requires specific decisions regarding inventory boundaries in order to achieve comparability of results and to avoid double counting. GHG emissions are divided into 3 levels shown on the figure below (Figure 1).

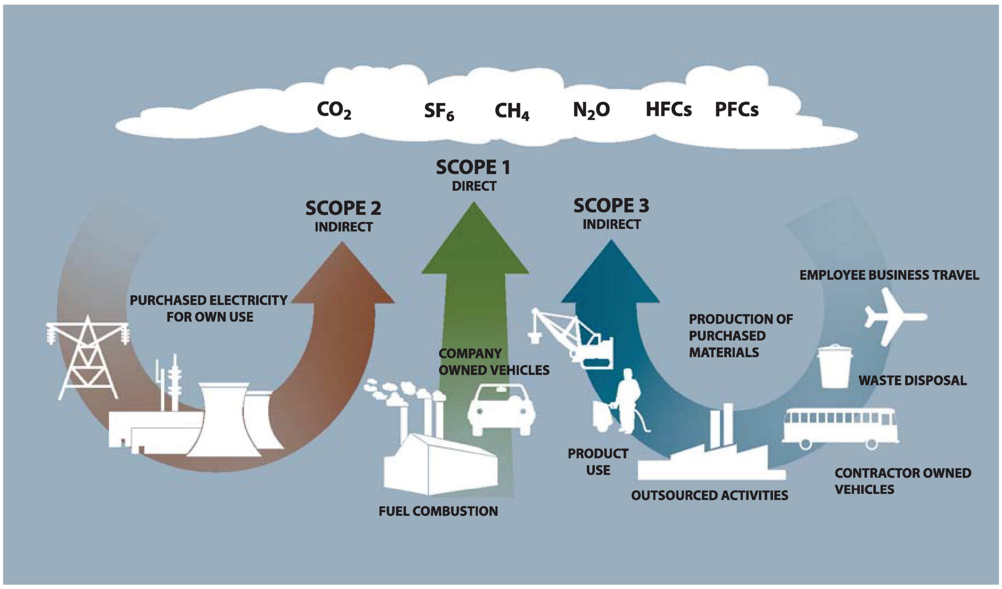


*Figure 1 Scope of GHG emissions according to GHG Protocol*

Emissions from Scope 1 and 2 are mandatory for reporting, so they fall within the inventory boundaries, but it is at the discretion of the company to decide which activities generating emissions from Scope 3 should be included.

Scope 1 coincides with the direct GHG emissions, as defined in the EBRD's methodology; Scope 2 coincides with the indirect GHG emissions from the production of the used electricity and heat; Scope 3 are other indirect emissions (upstream and downstream).

According to EBRD's guidelines, the assessor should consider whether any features of the project give rise to other significant indirect emissions which need to be evaluated. From all materials which are going to be used in the production, only steel balls and sodium silicate are expected to be used in significant quantities, and they could be associated with significant amounts of GHG emissions. The following rules are applied regarding the included indirect emissions from Scope 3:

- The quantities of the used resources or materials are more than 200 t per year
- GHG emissions resulting from the use of specific resources/materials (direct and indirect) exceed 200 t $CO_2$ per year
- Regarding the emissions from freight transport of the produced concentrate, only the activities within the country territory are considered. The transport of the used materials is included in the scope of the inventory only for the materials, for which the consumption is significant

The EBRD methodology does not set any requirements regarding the materiality of the assessment, neither do the ISO 14064 standard series. The EU Regulation 600/2012 on the verification of greenhouse gas emission report sets the materiality level at 5% for installations with annual emissions of less than 500 000 t $CO_2$. For the purposes of this report the limit values were chosen in such a way that all sources of GHG emissions, which could generate above 0.5% of the total emissions, are included in the scope of the inventory.

The adopted rules define the following sources of GHG emissions, for which primary data should be collected annually.

**Direct emissions (Scope 1)**

- $CO_2$ emissions from combustion of diesel fuel within the company boundaries (mining machinery)
- $CO_2$ emissions from combustion of fuel for the company passenger car and light duty vehicle fleet
- $CO_2$ emissions from use of explosives

Outside the inventory boundaries are GHG emissions resulting from the use of sulphur hexafluoride in high voltage switchgear equipment ($CO_2$ equivalent) and fluorinated greenhouse gases in air-conditioning equipment ($CO_2$ equivalent) as they are insignificant.

**Indirect emissions (Scope 2)**

- $CO_2$ emissions due to the production of used electricity

**Indirect emissions (Scope 3)**

- $CO_2$ emissions due to losses in transformation and transmission of electricity
- $CO_2$ emissions from fuel and electricity consumption related to transport of concentrate, performed by subcontractors: truck and rail transport
- $CO_2$ emissions from materials production, including steel balls and sodium silicate
- $CO_2$ emissions from fuel consumption, related to transport of used materials

Outside the inventory boundaries are $CO_2$ emissions resulting from fuel consumption related to passenger transport of employees, performed by subcontractors as well as the emissions due to the production of other materials used (e.g. frother, flocculant, copper sulfate penthahydrate, dithiophosphate, potassium amyl xanthate), as they are not significant. International flights of the management team are also excluded because they cannot be unambiguously assigned to the activity of DPM Krumovgrad.

All the conversion and emission factors and assumptions are described in Annex 1.

## 2.3. Results

Scope 1 emissions (direct emissions) mostly originate from the used fuels from the mining machinery (around 834 t $CO_2$ per year). The use of explosives generates around 119 t $CO_2$ per year. Passenger transport emissions are very small (around 16 t $CO_2$ per year).

Scope 2 emissions (indirect emissions from the production of used electricity) are estimated to be around 44 569 t $CO_2$ per year.

Scope 3 emissions result from three main sources – production of used materials, transport of concentrate and transformation and distribution losses in the electricity network. Emissions from the production of used materials are mainly due to use of explosives, steel balls and sodium silicate. Emissions from transport of concentrate are relatively low due to the small distances within the project boundary (only on country's territory).

According to the preliminary assessment of the GHG emissions, the DPM Krumovgrad project qualifies in the medium-low category (20–100 kt $CO_2$ emissions per year).

The final GHG emission inventory results are represented in the Table 1:

*Table 1 Results from the GHG emission inventory*

| Emission source | GHG emissions [t $CO_2$ per year] |
|---|---|
| **Scope 1** | |
| Diesel fuel for production | 699 |
| Car fleet | 16 |
| Explosives | 119 |
| **Total Scope 1** | **834** |
| **Per ton of production (Scope 1)** | **0.083** |
| **Per ton of extracted ore (Scope 1)** | **0.001** |
| | |
| **Scope 2** | |
| Electricity consumption | 44 569 |
| **Total Scope 2** | **44 569** |
| **Per ton of production (Scope 2)** | **4.457** |
| **Per ton of extracted ore (Scope 2)** | **0.053** |
| | |
| **Scope 3** | |
| Production transport | 126 |
| Materials production | 3 028 |
| Materials transport | 182 |
| Transformation and distribution losses | 4 457 |
| **Total Scope 3** | **7 793** |
| **Per ton of production (Scope 3)** | **0.779** |
| **Per ton of extracted ore (Scope 3)** | **0.009** |
| | |
| **Total Scope 1+2** | **45 402** |
| **Per ton of production (Scope 1+2)** | **4.540** |
| **Per ton of extracted ore (Scope 1+2)** | **0.054** |
| | |
| **Total emissions** | **53 195** |
| **Per ton of production** | **5.320** |
| **Per ton of extracted ore** | **0.063** |

The distribution of GHG emissions by scopes (Figure 2) clearly shows that emissions from Scope 2 (electricity consumption) are the most significant source - they form about 84% of the total GHG emissions of the company.

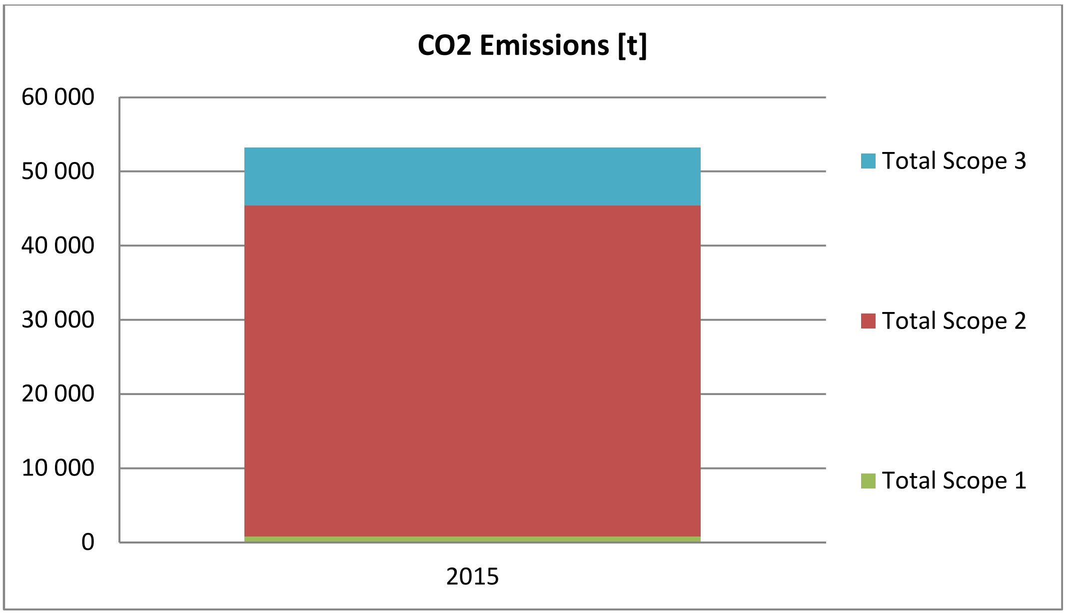


*Figure 2 GHG emissions by scope*

Figure 3 represents the main sources graphically. As it could be seen, Scope 1 (direct emissions from used explosives, fuels for the mining machinery and car fleet) and Scope 3 (other indirect emissions from used materials production and concentrate transport) and very small compared to emissions from electricity consumption.

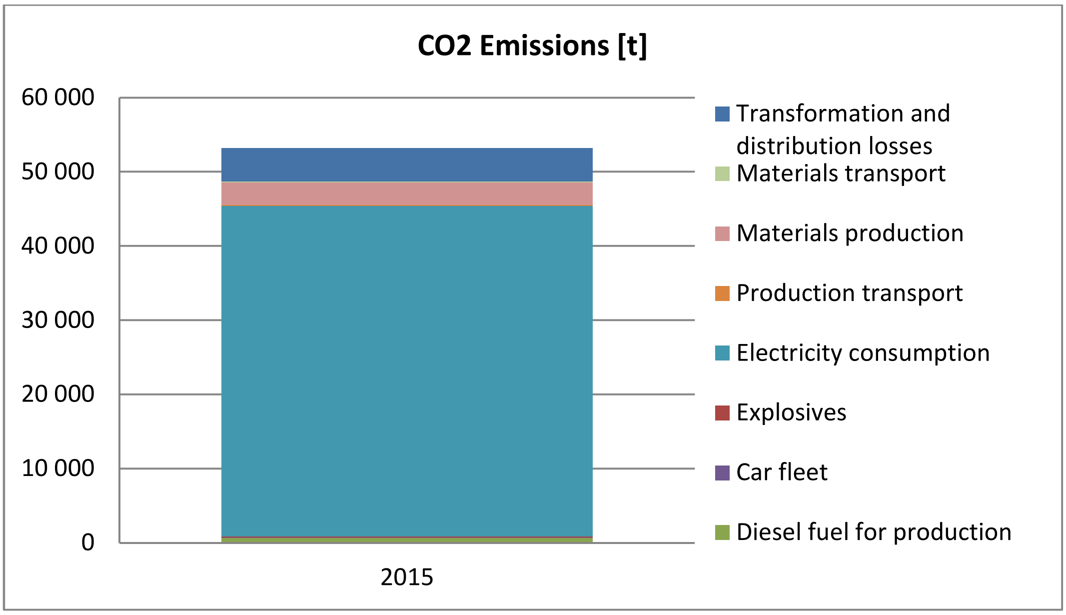


*Figure 3 GHG emissions by main sources*

# 3. Annex 1: Factors and assumptions

In the three tables below are listed all conversion and emission factors, as well as assumptions made during the calculation of GHG emissions. They are mainly divided into three levels, as recommended in the methodology of EBRD:

*Table 2 Parameters for calculating emissions in Scope 1*

| Parameter | Value | Source |
|---|---|---|
| **Mining machinery – diesel fuel** | | |
| Fuel density | 0.840 kg/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014)[1] |
| Emission factor | 3.186 kg $CO_2$/kg<br>2.676 kg $CO_2$/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) |
| **Car fleet – gasoline** | | |
| Fuel density | 0.740 kg/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) |
| Emission factor | 3.070 kg $CO_2$/kg<br>2.272 kg $CO_2$/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) |
| **Car fleet – diesel fuel** | | |
| Fuel density | 0.840 kg/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) |
| Emission factor | 3.186 kg $CO_2$/kg<br>2.676 kg $CO_2$/l | GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) |
| **Explosives** | | |
| Emission factor | 0.169 kg $CO_2$/kg | Based on Krumovgrad project EIA:<br>0.0857 m3 $CO_2$/kg explosives |

*Table 3 Parameters for calculating emissions in Scope 2*

| Parameter | Value | Source |
|---|---|---|
| Electricity emission factor | 0.591 kg $CO_2$ per kWh | IEA[2]. The EF concerns the supplied electricity, since the project does not envision on-site electricity generation by fuel combustion or by renewable sources. For the calculation of GHG emissions, the annual EF is shifted with 2 years due to the delay of data publication, in order to avoid recalculation of emissions for previous years (e.g. for 2013 is used EF for 2011). There is some level of uncertainty regarding the future value of this emission factor, since on one hand it depends on the annual share of nuclear and renewable energy sources (which is growing) and on the other on the electricity demand, which determines the share of electricity produced from coal. The assessment of the values form the last 5 years does not show a stable trend and the level of uncertainty has been determined at 9%. |
| Transformation and distribution losses | 10% | Estimate is based on data provided in the National Energy Balance, which reports 9.9% distribution losses from the total net electricity production for 2012 and similar values for the latest years. The World Bank[3] estimates the losses at 8.8% for 2011. The losses are expected to be lower than the average value for the high and medium voltage grid (e.g. industrial sector) and higher for the low voltage grid (e.g. residential and commercial sectors), but there is some level of uncertainty projecting this data forward. A conservative approach has been followed regarding the transformation and distribution losses and in order to avoid potential underestimation of the emissions, an average value of 10% is adopted for this report. |

[1] GHG Protocol's Emission Factors from Cross-Sector Tools (April 2014) http://www.ghgprotocol.org/calculation-tools/all-tools

[2] International Energy Agency, $CO_2$ Emissions From Fuel Combustion Highlights (2013 Edition)

[3] http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS/

*Table 4 Parameters for calculating emissions in Scope 3*

| Parameter | Value | Source |
|---|---|---|
| **Freight transportation** | | |
| Operation, lorry >16t, fleet average | 1.029 kg $CO_2$/km | Ecoinvent[4] database v.2.2 |
| Transport, lorry >16t, fleet average | 0.134 kg $CO_2$/tkm | Ecoinvent database v.2.2 |
| Operation, freight train, electricity | 0.028 kg $CO_2$/tkm | Ecoinvent database v.2.2 |
| Krumovgrad – Momchilgrad course length (concentrate transport) | 100 km | The value represents the two-way journey, since the trucks are not used for other transport purposes. |
| Panagyurishte-Krumovgrad (explosives transport) | 220 km | The value represents the one-way journey, since the trucks might be used for other transport purposes. |
| Momchilgrad-Burgas distance (concentrate transport) | 270 km | The value represents the one-way journey, since the train cars might be used for other transport purposes. |
| Pernik – Krumovgrad (steel balls transport) | 320 km | The value represents the one-way journey, since the trucks might be used for other transport purposes. |
| Central Europe – Krumovgrad (Sodium silicate transport) | 2000 km average | The value represents the one-way journey, since the trucks might be used for other transport purposes. |
| **Production of utilized materials EF [kg $CO_2$ / kg]** | | |
| Steel balls | 0.425 kg $CO_2$/kg | Ecoinvent database v.2.2 |
| Sodium silicate | 1.587 kg $CO_2$/kg | Ecoinvent database v.2.2 |
| Dynolite (explosive) | 2.510 kg $CO_2$/kg | Ecoinvent database v.2.2 |

[4] Ecoinvent Centre Life Cycle Inventory Database (http://www.ecoinvent.org/database/)