BENEŠ a LÁT a.s.
Továrni 463, 289 14 Poříčany

Calculation of the carbon footprint
Plant Z08 - Mimoň
(Scope 1 and 2)

Processed by authorized person according to Act No. 201/2012 Coll., on air protection	Ing. Zbyněk Krayzel Poupetova 13/1383, 170 00 Prague 7 Holesovice ID number - 71519475 Tel.: 602 829 112, 266 711 179 E-mail: zbynek.krayzel@seznam.cz
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Stamp and signature	Ing. Zbyněk Krayzel Poupětova 13/1383 170 00 Praha 7 - Holešovice IČO: 71519475

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1. Introduction and company introduction

The company BENES a LAT a.s., Tovarni 463, 289 14 Poricany, VAT nr. CZ 257 24 304 operates the Al smelter in Mimon. Aluminium ingots and parts of aluminium castings that are not suitable for further use (returnable material) are melted in the smelter.

The company consists of:

1) Aluminium smelting and casting technology (classification according to the annex to Act No. 201/2012 Coll. as point 4.10. – Smelting and casting of non-ferrous metals and their alloys). Smelting is carried out in 3 melting furnaces and 6 high-pressure casting presses. One of the melting furnaces is a shaft with direct natural gas heating, two melting furnaces are crucible furnaces with indirect heating. 6 high-pressure presses - of different capacity and operating pressure, heated by natural gas.

A. MELTING

Aluminium ingots and parts of aluminium castings that are not suitable for further use (returnable material) are melted in the smelter. Smelting takes place in two crucible furnaces and one shaft furnace.

Crucible melting furnace for indirect melting (ELSKLO)

The melting gas tilting furnace has a cylindrical frame located in the furnace stand. Hydraulic single- acting cylinders located on the sides allow the furnace to be tilted (maximum tilting angle is 100°). The interior of the gas furnace has a cylindrical shape, a crucible is inserted in the middle on a base. The crucible is heated by the flame of the burner, the burner is inserted tangentially into the furnace, the flame burns in a spiral around the crucible. During heating, the flue gas does not come into contact with the material or melt.

The melting process is discontinuous – after filling the crucible with aluminium ingots and returnable material, the charge is heated, after the metal melts, the contents of the crucible are kept at a given temperature and continuously poured into the distribution crucible.

The flue gas is vented into the chimney at the back of the furnace. Flue gases from natural gas are discharged from both furnaces into a common chimney led above the roof of the hall.

Emissions from the melting of Al alloys are discharged into the working area of the smelter. The production of these emissions is minimized, the crucible furnaces are provided with lids during the melting period, which are hinged only when the crucible is filled with the batch and when the melt is poured into the distribution crucible.

After the batch is melted, the melt is poured into the distribution crucible, the melt is treated with the addition of refining salts, the resulting aluminium smears are removed from the surface of the melt, and then the melt is transferred to the tempering reservoirs of individual pressure casting machines.

Continuous shaft melting furnace

A shaft furnace is a vertical furnace with a collection chamber, a burner system at the lower end and a setting system in the upper part. The metal is fed by a conveyor into the hopper, where the lower layer of the aluminium charge is melted by the flue gases from the burner in the lower part of the furnace. The melt flows into a pool measuring 1700 x 900 x 600 mm. Once it is filled, the temperature in the pool is maintained by a gas burner, and then, by tilting the entire furnace, it is poured into the distribution crucible through the pouring hole and the pouring gutter.

The flue gases from gas burners and emissions from smelting are vented by a joint chimney from the upper part of the furnace, which is led to the roof of the production hall.

Melt treatment

Treatment of the melt from the crucible furnaces and the shaft furnace is carried out after pouring into the distribution crucible in a common device for the treatment of the melt by the addition of refining salts while simultaneously bubbling with nitrogen gas.

B. CASTING

High pressure presses

The melt from the melting furnaces is delivered to individual high-pressure presses, located in the area of the production hall.

Each press is equipped with a tempered melt reservoir, from which the required amount of melt is dispensed, which is pushed into the mold by pressing the hydraulic piston. Surplus melt is forced out of the mold through drainage channels and, together with any defective pieces, is used as input raw material for the production of the next melt.

C. APRETATION

The casting taken out of the mold must be free of all excess risers, sharp edges, and burrs. Their removal is carried out mechanically with shearing presses or by hand sanding using files, small hand sanders, or a large belt sander. Manual sanding is performed on work benches with extraction through the grate on the top of the table or an extraction nozzle. All suction is further conducted through textile filters, where solid pollutants are captured. The output from the filters is fed back into the working environment.

2. Carbon footprint, introduction, and concepts

The carbon footprint is the sum of released greenhouse gases expressed in CO_2 equivalents. A carbon footprint can relate to an individual, a product or an event. However, it is most often used in connection with products and defines the sum of all greenhouse gases that were emitted during the production of the given product. Similar product characteristics serve to select the one whose production has the least impact on the environment.

This is an indicator of the environmental load, which is derived from the total ecological footprint. It is usually expressed in CO_2 equivalents. That is, not in the weight of carbon itself, but of the carbon dioxide produced from it and also other emitted greenhouse gases (e.g. methane, nitrous oxide, halogenated hydrocarbons), whose weight is recalculated to how much CO_2 would have the same warming effect. However, it is necessary to pay attention to the fact that sometimes the other gases are neglected in the data on the carbon footprint, which can mean a big difference (this is also a problem with the data in the following text). A term that clearly indicates their inclusion is the so-called **greenhouse footprint.**

Direct and indirect footprint

The carbon footprint can be divided into direct and indirect.

Direct (primary) footprint – the amount of greenhouse gases released directly during a given activity (during electricity generation, heating, fuel combustion, etc.).

Indirect (secondary) footprint – the amount of greenhouse gases released during the product's entire life cycle – from production to eventual disposal.

Carbon footprint levels

Carbon footprint can be measured at different levels – city level, business level, individual level, product level, etc.

Enterprise level

This includes all released emissions falling within the operation of the company. Currently, the Greenhouse Gas Protocol (GHG Protocol) is used to calculate a company's carbon footprint, which divides the carbon footprint into three categories: Category 1 emissions (Scope 1), Category 2 emissions (Scope 2) and Category 3 emissions (Scope 3).

Scopes

Scope 1 (direct emissions) – activities that fall under the given enterprise and are controlled by it, during which emissions are released directly into the air. These are direct emissions. They include, for example, emissions from boilers or generators burning fossil fuels in the company, emissions from mobile sources (e.g. cars) owned by the company or emissions from industrial processes, emissions from waste treatment or wastewater treatment in facilities operated by the company.

Scope 2 (indirect emissions from energy) – emissions associated with the consumption of purchased energy (electricity, heat, steam, or cooling), which do not occur directly in the company, but are a consequence of the company's activities. These are indirect emissions from sources that the company does not directly control, yet it has a fundamental influence on their size. If the company itself produces electricity/heat and sells it to other customers, or if it sells the purchased electricity/heat to other customers (for example, tenants) and the amount of this electricity is measured, it is deducted from the total Scope 2 emissions. The procedure for determining Scope 2 emissions (in terms of own energy production from renewable energy sources and other factors) was updated in January 2015, and detailed methodologies are available on the GHG Protocol website.

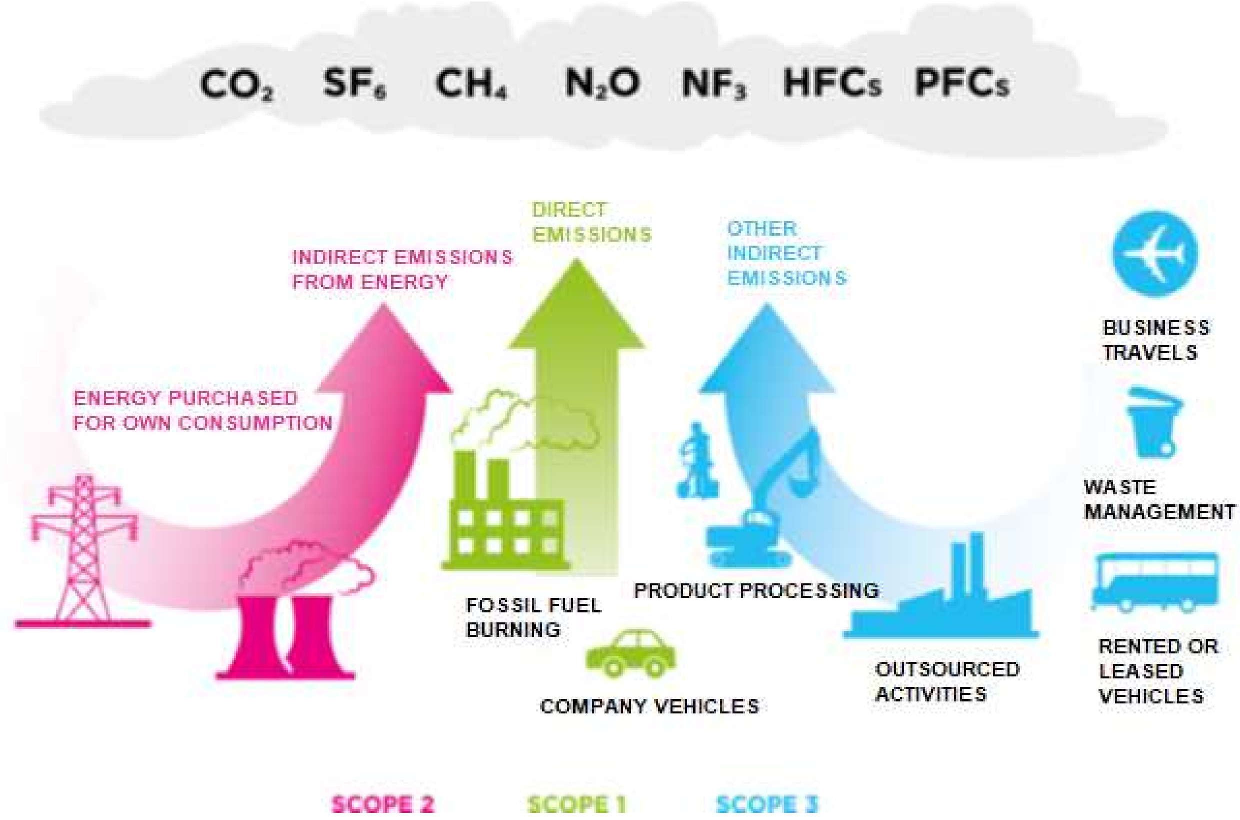
Scope 3 (other indirect emissions) – emissions that are a consequence of the company's activities and that arise from sources outside the control or ownership of the company but are not classified as Scope 2 (e.g. business travel by plane, landfilling, purchase, and transport of material by a third party etc.). It follows from the definition that it is the broadest and logically least precisely defined category. While Scope 1 and Scope 2 emissions are well comparable between companies, Scope 3 emissions are only comparable to a limited extent. Therefore, reporting of Scope 1 and Scope 2 emissions is mandatory in the GHG Protocol and in the CDP database, while Scope 3 is only recommended. In recent years, however, Scope 3 has become increasingly important, and companies report at least the most important items within Scope 3 as a standard. Here they can demonstrate innovative emissions reduction management. A detailed technical description of the calculation of the main types of Scope 3 emissions is provided by the GHG Protocol.

When determining a company's carbon footprint, it is necessary to correctly quantify all Scope 1 and Scope 2 emissions, which are mandatory from the point of view of the GHG Protocol and other standards. Scope 3 emissions are optional - we recommend selecting those items that are the most important from the point of view of management or the operation of the company, or which can be effectively reduced.

Carbon footprint of the company (Company Carbon footprint)

The carbon footprint of the company is therefore a measure of the impact of the company's functioning on the environment and especially on climate change. The carbon footprint is an indirect indicator of the consumption of energy, products, and services. It measures the amount of greenhouse gases that correspond to the company's activities or products. In addition to the enterprise level, the carbon footprint can be determined at other levels – national, municipal, individual.

COMPOSITION OF THE COMPANY'S CARBON FOOTPRINT



Greenhouse gases (GHG – Green House Gases)

These are gases that occur in the Earth's atmosphere and contribute to the greenhouse effect. On the one hand, they are of natural origin (such as water vapor, methane), and on the other hand, they are released by human activity (mainly by burning fossil fuels, but also by a number of other activities). In the context of human-induced climate change and the carbon footprint, we are interested in the second group of these gases.

The GHG Protocol registers a total of seven anthropogenic greenhouse gases that are relevant in terms of the company's carbon footprint. The table shows the main sources of these gases, their names, sources, and global warming coefficient. The most common of them is carbon dioxide - CO_2, which is formed every time a substance containing carbon (C) reacts with oxygen (O_2) in the atmosphere. Carbon dioxide covers all greenhouse gases, we can convert them to it, similar to how we convert Czech crowns to euros, for example. The exchange rate in this comparison is the so-called global warming potential (GWP).

GWP - Global Warming Potential

A measure of the potential contribution of a given gas to the greenhouse effect. The unit is the contribution to the greenhouse effect of one molecule of CO_2. Using these coefficients, it is possible to determine the so-called CO_2 equivalent (written as CO_2 equiv., CO_2 eq., CO_2e), i.e. the amount of CO_2 that would have an equivalent contribution to the greenhouse effect of the atmosphere equal to the given amount of the relevant gas. It usually refers to a time horizon of 100 years.

Table No. 1 - Greenhouse gases and GWP

Greenhouse gas	Chem. formula	Resources (from human activity)	GWP
Carbon dioxide	CO_2	Combustion of fossil fuels and biomass (80%); deforestation; aerobic decomposition of organic matter; erosion.	1
Methane	CH_4	Anaerobic decomposition of organic matter, biomass burning and landfill (5%); natural gas and oil processing, coal resources, gas leaks, cattle breeding, rice cultivation (25%).	25
Nitrous oxide	N_2O	Agricultural activity, production of nitric and adipic acid, combustion processes, rocket, and aviation technology.	298
Fluorinated hydrocarbons	HFC	Industrial processes, replacement of freons in refrigeration and air conditioning equipment, propellant gases - fire extinguishers, cleaning agents, foaming agents.	650 - 14,800
Perfluorocarbons	PFC	Refrigeration equipment, industrial processes, aluminium and semiconductor production, pharmaceuticals, cosmetics.	6,500 – 23,000
Sulphur fluoride	SF_6	Electrotechnical industry, magnesium, and aluminium smelting.	22,800 – 23,900
Nitrous fluoride	NF_3	Production of plasma screens, solar panels and liquid crystal displays, selective agent.	17,200

Note: The GWP values of specific HFCs, PFCs and other substances can be found on the GHG Protocol website: http://www.ghgprotocol.org/files/ghgp/tools/Global-Warming-Potential-Values.pdf.

Emission factors

Emission factors express the amount of greenhouse gases in tons of carbon dioxide or other greenhouse gases related to a unit of energy or use another unit expression (per mass or volume of the product). In the next step, these factors must be converted to the corresponding amount of greenhouse gases expressed in carbon dioxide equivalents (CO_2 eq.) using the GWP of the given gas. Some emission factors are country-specific – for example, electricity depends on the national energy mix, which is different for each country and also changes over time. Similarly, for specific products (for example a computer) it is advisable to obtain the emission factor directly from the manufacturer of the given product.

Units

A company's carbon footprint is usually expressed in tons of carbon dioxide equivalent (t CO_2 eq.). In the case of partial activities or the carbon footprint of the product, kilograms (kg) or grams (g) of CO_2 eq. can be used. The input data units for calculating the carbon footprint are much more varied. In the case of energy, it is most often kWh or MWh. Other used energy units (e.g. joules or calories) must be converted to this unit. Other inputs are most often weight (tons, kilograms) or volume (cubic meters, litres).

Carbon neutrality

Carbon neutrality means achieving a zero-carbon footprint. This is a somewhat misleading term. In the case of the vast majority of businesses, this is an unrealistic goal. Businesses must primarily focus on their activities, and in doing so, greenhouse gas emissions inevitably arise. Carbon neutrality therefore means achieving zero **net emissions**. This means offsetting the production of emissions and removing them from the atmosphere, for example through offsets. The key point is that the primary concern of each emitter should be **the reduction of** their gross (absolute) amount of emissions and only the second step of offsetting them.

Offsets

Offsets are defined as quantified reductions in greenhouse gas emissions used to offset (i.e. offset) greenhouse gas emissions emitted somewhere else (by another source), for example to meet a voluntary or mandatory greenhouse gas emission reduction target. Offsets are calculated relative to a default value that represents a hypothetical scenario for the original state (i.e. the level of emissions in the absence of an offset project).

Additionality

Additionality means the implementation of compensatory measures that would otherwise not be implemented. If, for example, replacement planting or reforestation of forest land is carried out by law, this is not additionality, as there will be no additional assimilation of CO_2 compared to *business-as-usual*. The following criteria can be applied to test whether an offset project meets the conditions of additionality:

- The measure is not required by current regulation.
- It is not common practice in the given sector or region.
- There is a guarantee that the project will be implemented within the necessary time horizon (e.g., the newly planted greenery will not be neglected in maintenance so that it binds the required amount of carbon dioxide from the atmosphere during its lifetime).

Basic standards

GHG Protocol (http://www.ghgprotocol.org)

A globally used corporate standard for carbon footprint measurement and reporting. It standardizes the procedure for measuring, managing, and reporting greenhouse gas emissions from the company. It was created by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). It is used as the basis for a large number of programs that inventory greenhouse gas emissions. Since its inception in 2001, more than 1,000 businesses and other types of organizations have used it. This methodology is based on the GHG Protocol standard.

CSN ISO 14064 standard – Greenhouse gases

The ISO 14064 standard consists of three complementary components. The ISO 14064-1 standard includes requirements for the planning, implementation, management, and administration, reporting and verification of greenhouse gas emission inventories for organizations. The second part of the standard (14064-2) regulates the requirements for monitoring and reporting achieved reductions in emissions or increases in greenhouse gas sinks through projects and/or project-oriented activities. The third part (14064-3) sets out the principles and requirements for the verification of greenhouse gas inventories and for the validation and verification of greenhouse gas projects. The GHG Protocol and ISO 14064 are mutually compatible.

CDP - Carbon Disclosure Project (https://www.cdp.net)

CDP is a voluntary scheme for disclosing information about the carbon footprint of businesses and the impact of businesses on the environment. It is a global initiative to which, on the one hand, companies report detailed data on their carbon footprint and energy and carbon management, and on the other hand, investors and other interested parties draw information from it. Thousands of companies, including the most important globally, are currently reporting to the scheme, and 822 institutional investors with a total asset volume of $95 trillion draw on it. In addition to the carbon footprint, CDP has a program focused on forests and the supply chain. The provision of data to the CDP is based on online questionnaires for companies.

3. Company data and technical description of greenhouse gas sources

Company data

Table No. 2 – Operator specifications

Operator identification number	257 24 304
Business name	BENES and LAT a.s.
Residence	Tovarni 463, 289 14 Poricany
Phone	+420 267 227 300
E-mail	info@benesalat.cz
Statutory representative of the operator	Svatopluk Runcik, director of the company
A person authorized to act on behalf of the operator	Ing. Frantisek Sulc, company ecologist

Table No. 3 – Establishment specifications

Establishment identification number (ICP)	695250033
Name of establishment	**BENES a LAT a. s. – Z08-Mimon**
Resource name	**Classification**
101 – **Al foundry** (shaft furnace ZPF, 2 x crucible melting furnace ELSKLO GLK 600, 6 x high-pressure casting presses)	Listed stationary source of air pollution according to Annex No. 2 of Act 201/2012 Coll., **4.10.** – Melting and casting of non-ferrous metals and their alloys with a total projected capacity of more than 50 kg per day
102 - Transport and handling (small hand sanders, large belt sanders, shearing presses)	Listed stationary source of air pollution according to Annex No. 2 of Act 201/2012 Coll., **4.8.1.** – Transport and handling of the batch or product
103 – Blasting machine	Listed stationary source of air pollution according to Annex No. 2 of Act 201/2012 Coll., **4.12** – Surface treatment of metals and plastics and other non-metallic objects with a total projected capacity of the spa volume up to 30 m^3 inclusive (excluding rinsing), processes without the use of spas
Region	Liberecky
Address of the establishment	Krizova 660, 471 24 Mimon

Cadastral territory	Except 695254
Municipality	Mimon 561835
Responsible person	Ing. Frantisek Sulc
Mobile phone	+ 420 606 611 519
E-mail	frantisek.sulc@benesalat.cz
Total capacity	1600 t Al / year

The following activities generate greenhouse gas emissions at the company:

Table No. 4

Z08 Mimoň		**2020**	**2021**	**2022**
	basic energy			
electrical energy	MWh	2,001.042	2,747.581	2,111.279
share of energy from renewable sources	%	24.0%	28.0%	72.6%
gas (consumption via main gas meter)	m^3	316,137	438,810	342,154
fuel based on utility oils	l	---	2,000	2,000
	other energy inputs			
motor vehicles (diesel)	l	3,177	4,341	3,035
diesel for the diesel generator	l	included in diesel for MV		
	CHS&C			
name				
CO_2 compressed	kg	70	125	110
acetylene	kg	20	20	10
Arsal 2125 (<20% Na_2CO_3)	kg	0	500	1,000

4. Carbon footprint calculation

Emission sources identification

The basic step in determining the total emissions of greenhouse gases from the company (i.e. its carbon footprint) is the identification of the main sources of these emissions within the company, or beyond its borders, if they are related to its activity (see Scope 1, Scope 2, and Scope 3). In practice, this means obtaining data from various departments of the company (e.g. *facility management, procurement, environmental management,* etc.) about **the consumption** of given items in a given period (most often it is a calendar year). The problem may be that the relevant departments have information in monetary (invoice) units, not physical units. For example, fuel consumption in company vehicles is expressed in crowns, not litres. In the vast majority of cases, however, it is possible to convert monetary units into physical units, which are necessary for calculating the carbon footprint.

Emissions calculation

The next step is the actual calculation of greenhouse gas emissions. In practice, it means **multiplying** the consumption/production data by the corresponding emission factors. Great care must be taken to use the correct unit and order. If the input data is given in units other than the emission factor, it is necessary to convert it to the corresponding unit and order. In the first phase, the calculation is performed separately for each relevant greenhouse gas (CO_2, CH_4, N_2O, HFC, PFC, SF_6 and NF_3). Subsequently, these emissions are converted according to their contribution to global climate change (GWP) into so-called equivalent emissions of carbon dioxide (CO_2 eq.). This parameter represents the resulting unit of the company's carbon footprint. Calculation formula and calculation procedure based on specific data:

EMISSION CALCULATION FORMULA

$$\mathbf{ADix \times EFix = CFix}$$

$$\mathbf{CFx \times GWPx = CF\ CO_2\ eq.}$$

- ADix – activity data for item "i" and greenhouse gas "x"
- EFix – emission factor for item "i" and greenhouse gas "x"
- CF – carbon footprint (greenhouse gas emissions) for item "i" and greenhouse gas "x"
- GWPx – contribution to climate change of greenhouse gas "x"
- CF CO_2 equiv. – carbon footprint (greenhouse gas emissions) expressed in carbon dioxide equivalents.

Presentation of results

In a subsequent step, the sub-items - emissions for individual activities and items - need to be summed to obtain aggregate results for all Scopes. In the case of larger companies that have several establishments, or multinational companies, it is necessary to perform a calculation for individual establishments/countries.

These data can be presented individually and only in a subsequent step then collectively for the entire company. The unit used in summary reporting is equivalents of carbon dioxide – CO_2 eq. When it comes to repeated calculation, it is advisable to include graphs and tables affecting the development of the company's emissions in individual years. Again, it is possible to present separately the results for Scopes and establishments.

Another possibility is the presentation of the development of the carbon footprint and economic results of the company in one graph. If it is a repeated calculation, it is advisable to include graphs and tables affecting the development of emissions of the given company in individual years. Again, it is possible to present separately the results for Scopes and establishments. Another possibility is the presentation of the development of the company's carbon footprint and economic results in one graph, which enables a simple view of the company's emission efficiency. Various examples of presentation of results are given in the box.

<u>Table No. 5</u>

National values for EF, calorific value, and oxidation factors

Excerpt from the Czech National Inventory Report 2020 regarding the calorific values and emission factors used.

Fuel (definition accordingly to IPCC 2006 Guidelines)	**NCV [TJ/kt]**	**CO_2 EF [a] [t CO_2/TJ]**	**Oxidation factor**	**CO_2 EF [b] [t CO_2/TJ]**
Crude Oil	42.5	73.3	1	73.3
Gas/Diesel Oil	42.6	74.1	1	74.1
Residual Fuel Oil	39.5	77.4	1	77.4
LPG [d]	45.945	65.86	1	65.86
Naphtha	43.6	73.3	1	73.3
Bitumen	40.193	80.7	1	80.7
Lubricants	40.193	73.3	1	73.3
Petroleum Coke	39.4	97.5	1	97.5
Other Oil	39.29	73.3	1	73.3
Coking Coal [d]	29.498	93.53	1	93.53
Other Bituminous Coal [d]	26.511	94.41	0.9707	91.64
Lignite (Brown Coal) [d]	13.228	99.35	0.9846	97.82
Brown Coal Briquettes	23.055	97.5	0.9846	96
Coke (Brown Coal Coke)	28.299	107	1	107
Coke Oven Gas	16.064	44.4	1	44.4
Natural Gas (TJ/Gg) [d]	47.114	55.45	1	55.45
Natural Gas (TJ/mill.m^3) [d]	34.51	55.45	1	55.45

a) Emission factor without oxidation factor
b) Resulting emission factor with oxidation factor
c) TJ/mill. m^3, t= 15 °C, p = 101.3 kPa
d) Country specific values of CO2 EFs and oxidation factors

Item	Emission factor ($t\ CO_2$ /TJ)
Brown coal	96.07
Black coal	89.80
Distant heat	110.00
Light fuel oil	72.53
Diesel	72.53

Item	Emission factor ($t\ CO_2$ /TJ)
Petrol	67.91
LPG	63.06
Natural gas (including CNG)	55.50
Propane butane	62.39

CO_2 emission factor from electricity production for the years 2020–2022

The current value of the CO_2 emission factor from electricity production is calculated based on the following methodology:

The primary energy of fossil fuels used in a given year (according to individual fuels) for the production of electricity is multiplied by specific emission factors for the given fuels (or for related fuels). The resulting total value is divided by the total gross production of electricity in the Czech Republic. The CO_2 emission factors from the burning of fossil fuels in the calculation are based on the IPCC 2006 methodology and national emission factors. In the calculation, RES are considered as CO_2 neutral, i.e. with zero emissions. This is a calculation based on the underlying data of the Comprehensive Energy Balance of the Czech Republic for 2019.

The values of the CO_2 emission factor of electricity calculated on the basis of this methodology are not identical to the values specified in Decree No. 480/2000, on energy audit and energy assessment, where the values of the CO_2 emission factor are determined for a specific purpose (enforcement of state policy) and relate to produce electricity from fossil sources. This decree will be replaced in 2021 by two decrees, the decree on energy audit and the decree on energy assessment.

The data below can be used exclusively for informational purposes, e.g. to monitor the real carbon footprint of companies that purchase electricity from the public grid, or e.g. for electricity sellers who purchase it on the open market.

Table No. 6

Year	$t\ CO_2$ / MWh
2020	0.384
2021	0.390
2022	0.413

5. Calculation

5.1. Combustion of natural gas

Natural gas is used to produce heat both for domestic hot water and for technology needs.

Table No. 7 - Calculation of the carbon footprint - combustion sources for burning natural gas

Parameter	Unit	2020	2021	2022
gas (consumption via main gas meter)	m^3	316,137	438,810	342,154
calorific value	kJ/m^3	34330	34330	34330
Heat in the fuel	TJ/year	10,853	15,064	11,746
Emission factor	t CO_2/TJ	55,450	55,450	55,450
Emissions of CO_2 equiv.	**tons/ year**	**601.798**	**835.318**	**651.324**

5.2. Consumption of electrical energy

Electrical energy is consumed both in production and in administration. It is supplied from external sources.

Table No. 8 – Electricity consumption

Parameter	Unit	2020	2021	2022
electrical energy	MWh	2001.042	2747.581	2111.279
share of supply from renewable sources	%	24.0	28.0	72.6
of which renewable	MWh	480.250	769.323	1532.789
non-renewable from it	MWh	1520.792	1978.258	578.490

Table No. 9 – Carbon footprint calculation – according to electricity consumption

Parameter	Unit	2020	2021	2022
Amount of electricity from non-renewable sources	MWh / year	1520.792	1978.258	578.490
Emission factor	t CO_2 / MWh	0.384	0.390	0.413
Emissions of CO_2 equiv.	**tons/year**	**583.984**	**771.521**	**238.916**

5.3. Combustion of fuel based on utility oils

Fuel based on utility oils is burned in the technology (heating). It is supplied from external sources.

Table No. 10 - Calculation of the carbon footprint - according to consumption of fuel based on useful oils

Parameter	Unit	2020	2021	2022
Quantity Fuel based on useful oils	Liters / year	0	2000	2000
Quantity Fuel based on useful oils	Kg / year	0	1900	1900
Calorific value	kJ / kg	40,000	40,000	40,000
Amount of energy	TJ / year	0	0.076	0.076
Emission factor	t CO_2 / TJ	72.53	72.53	72.53
Emissions of CO_2 equiv.	**tons/ year**	**0**	**5.512**	**5.512**

5.4. Emissions from transport - diesel fuel combustion

Diesel fuel is used in passenger cars and diesel generators.

Table No. 11 - Calculation of the carbon footprint - emissions from transport

Parameter	Unit	2020	2021	2022
Passenger cars -consumption diesel of own vehicles	litres / year	3177	4341	3035
Emission factor	t CO_2 /litre DF	0.00266	0.00266	0.00266
Emissions of CO_2 equiv.	**tons/year**	**8.451**	**11.547**	**8.073**

5.5. Emissions from acetylene combustion

Welding equipment using acetylene is used for maintenance purposes.

Table No. 12 - Calculation of the carbon footprint - emissions from the combustion of acetylene

Parameter	Unit	2020	2021	2022
Combustion sources for maintenance - amount of acetylene per year	kg/year	20	20	10
Emission factor	kg CO_2 /kg acetylene	3,385	3,385	3,385
Emissions of CO_2 equiv.	kg/year	67.7	67.7	33.85
Emissions of CO_2 equiv.	**tons/year**	0.0677	0.0677	0.03385

The combustion equation for burning acetylene is:

$$2\ C_2H_2 + 5\ O_2 = 4\ CO_2 + 2\ H_2O$$

Which represents:

2 x 26 + 5 x 32 = 4 x 44 + 2 x 18 (v g/mol)

Burning 52 g of acetylene and 160 g of oxygen produces 176 g of CO_2. The rest is water., 1 kg of acetylene produces 3.385 kg of CO_2

5.6. Greenhouse gases leak emissions

There are equipment containing greenhouse gases at the plant. These devices are hermetically sealed but may leak in the event of malfunctions or accidents.

Table No. 13 - Calculation of the carbon footprint - greenhouse gas emissions

Parameter	Unit	2020	2021	2022
HFC and other fillings	kg/year	there were no leaks.		

5.7. CO_2 emissions from compressed CO_2 consumption

Compressed CO_2 is used at the plant.

Table No. 14 - Calculation of the carbon footprint - emissions from the use of compressed CO_2

Parameter	Unit	2020	2021	2022
CO_2 compressed	kg/year	70	125	110
tons of CO_2	**t/year**	**0.070**	**0.125**	**0.110**

5.8. CO_2 emissions from Arsal 2125 and compressed CO_2 consumption

Arsel 2125 compressed by CO_2 is used at the plant.

Table No. 15 - Carbon footprint calculation - emissions from Arsal 2125

Parameter	Unit	2020	2021	2022
Arsal 2125	kg/year	0	500	1000
Sodium carbonate content	%	20	20	20
Amount of sodium carbonate	kg/year	0	100	200
Amount of CO_2 from 1 kg of sodium carbonate	kg / kg	0.4151	0.4151	0.4151
tons of CO_2	**t/year**	**0**	**0.042**	**0.083**

We assume 100% conversion. Detailed value is not available. The equation for the decomposition of sodium carbonate:

$$Na_2CO_3 = CO_2 + Na_2O$$

Which represents:

106 = 44 + 64 (v g/mol)

106 g of sodium carbonate produces 44 g of CO_2.

0.4151 kg of CO_2 is formed from 1 kg of sodium carbonate.

6. Conclusion

Between 2020 and 2022, the following amount of CO_2 eq. in tons was released into the atmosphere at the facility:

Table No. 16 – Grand total

Year	2020	2021	2022
Natural gas	601.798	835.318	651.324
Electrical energy	**583.984**	**771.521**	**238.916**
Fuel based on utility oils	0	5.512	5.512
Transport DF	8.451	11.547	8.073
Acetylene welding	0.068	0.068	0.034
Greenhouse gases	0	0	0
Using compressed CO_2	0.070	0.125	0.110
Use of Arsal 2125	0	0.042	0.083
In total	**1,194.371**	**1,624.133**	**904.052**
Of which			
Scope 1	**610.387**	**852.612**	**665.136**
Scope 2	**583.984**	**771.521**	**238.916**

Table No. 17 – Total amount of CO_2 eq. from the Mimon plant

Year		
2020	**2021**	**2022**
tons of CO_2 per year		
1,194.371	**1,624.133**	**904.052**

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