Environmental Product Declaration

Domat/Ems Wood-Fired Power Plant | Update 2018

EPD®

Valid until 12 September 2021
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Summary

Company

The wood-fired power plant in Domat/Ems is operated by Axpo Tegra AG, which is a fully consolidated subsidiary of Axpo Holding AG. Since 2006, the plant has produced energy from biomass that is used by neighbouring industries.

Declared products

The following products in the reference year 2017 are the subject of the EPD®:

- 1 kWh net electricity generation and subsequent feed-in to the supply network of the neighbouring chemical plant.
- 1 kWh process steam (230 °C, 25 bar) generation and subsequent feed-in to the supply network of the neighbouring chemical plant.

The International EPD® System

The International EPD® System managed by EPD International AB is a Type III environmental declaration programme according to ISO 14025. The relevant governing documents in hierarchical order are: Product Category Rules for the product group electricity, steam and hot/cold water generation (UN-CPC 171 and 173), General Programme Instructions for Environmental Product Declaration (EPD), ISO 14025 and ISO 14044.

Verification of the results presented

The complete material presented in this EPD® has been reviewed and certified by the accredited certification body Bureau Veritas Certification Sweden.

Environmental impact of Domat/Ems wood-fired power plant

The life cycle assessment methodology has been applied to quantify the environmental impact. It comprises the full fuel cycle and associated processes. The reference time period is 2017. The main results of the life cycle impact assessment are summarized in the table below. Further results, including raw material consumption information on noise, are shown in the EPD.

Environmental impact	Unit	Per kWh electricity at plant	Per kWh steam at plant
Greenhouse gases	g CO_2-equivalents	$3.43 \cdot 10^{1}$	$1.32 \cdot 10^{1}$
Ozone-depleting gases	g CFC-11-equivalents	$4.09 \cdot 10^{-6}$	$1.57 \cdot 10^{-6}$
Formation of ground-level ozone	g ethylene-equivalents	$5.25 \cdot 10^{-2}$	$2.02 \cdot 10^{-2}$
Acidifying substances	g SO_2-equivalents	$7.53 \cdot 10^{-1}$	$2.90 \cdot 10^{-1}$
Eutrophying substances	g PO_4^{3-}-equivalents	$1.29 \cdot 10^{-1}$	$4.95 \cdot 10^{-2}$
Depletion of fossil resources	MJ-equivalents	$5.28 \cdot 10^{-1}$	$2.03 \cdot 10^{-1}$

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1 Introduction

1.1 Declard products

This document constitutes the certified Environmental Product Declaration (EPD®) for electricity and process steam at the Domat/Ems wood-fired power plant. The wood-fired power plant in Domat/Ems is operated by Axpo Tegra AG, which is a fully consolidated subsidiary of Axpo Holding AG. Since 2006, the plant has produced energy that is used by neighbouring industries.

The following products in the reference year 2017 are the subject of the EPD®:

- 1 kWh net electricity generation and subsequent feed-in to the supply network of the neighbouring chemical plant.
- 1 kWh process steam (230 °C, 25 bar) generation and subsequent feed-in to the supply network of the neighbouring chemical plant.

1.2 The Environmental Product Declaration and the International EPD® System

The primary purpose of the International EPD® System is to support companies in the assessment and publication of the environmental performance of their products and services so that they will be credible and understandable. To this end it:

- offers a complete Type III environmental declaration programme for any interested organisation in any country to develop and communicate EPDs according to ISO 14025,
- supports other EPD programmes (i.e. national, sectorial, etc.) in seeking cooperation and harmonization as well as helping organisations to advantageously broaden the use of their EPDs on the international market.

This Environmental Product Declaration conforms to the standards of the International EPD® Programme, www.environdec.com. EPD® is a system for the international application of Type III environmental declarations conforming to ISO 14025 standards. The International EPD® System and its applications are described in the general programme instructions. The principal documents for the EPD® System in order of hierarchical importance are:

- Product Category Rules UN-CPC 171 and 173, (Product Category Rules for preparing an Environmental Product Declaration for electricity, steam and hot/cold water generation and distribution), Version 3.0.
- General Programme Instructions for Environmental Product Declarations, EPD®, Version 2.5.
- ISO 14025 on Type III environmental declarations.
- ISO 14040 and ISO 14044 on Life Cycle Assessment (LCA).

This EPD® contains an environmental performance declaration based on life cycle assessment. Additional environmental information is presented in accordance with the PCR:

- Information on land use, based on a categorisation according to CORINE[1] Land Cover Classes
- Information on biodiversity
- Information on environmental risks
- Information on electromagnetic fields
- Information on noise and vibration

1.3 Axpo, LCA and EPD®

There are many reasons to declare the environmental impact of electricity production. For Axpo, the decisive reasons are:

- Electricity generation is a fundamental component of modern society, as electricity is required for the production of most goods and the delivery of almost all services. Therefore, as the largest electricity producer in Switzerland, Axpo wants to take the initiative in communicating clearly and reliably.
- The scientific assessment and rigorous minimisation of environmental impact are core pillars of Axpo's sustainability strategy. Our main goal is to minimise environmental impacts throughout the total life cycle. An EPD® environmental declaration is a reliable foundation for the quantitative presentation of environmental impact, using a number of environmental indicators and taking into account the total production cycle.

For questions concerning this EPD®, contact Axpo.
E-mail: sustainability.ch@axpo.com.

For additional information about Axpo, please visit our website at www.axpo.com.

[1] CORINE: Coordination of information on the environment: www.eea.europa.eu/publications/COR0-landcover

2 Manufacturer and product

2.1 Axpo Tegra AG

With the burning of biomass (wood), Axpo Tegra AG uses renewable energy sources for generating electricity and heat. Axpo recognised this potential early on and held a 20 % stake in Axpo Tegra AG (formerly Tegra Holz & Energie AG) as early as 2007. The company produces around 100 000 megawatt hours (MWh) of electricity and 120 000 MWh of process steam annually at the Domat/Ems wood-fired power plant. The procurement of the fuel (including transport and preparation logistics) is also one of the core competencies of the company.

In 2008, Axpo Tegra AG was presented with the Watt d'Or award in the "Renewable energies" and "Energy technologies" categories. This award is presented annually by the Swiss Federal Office of Energy (SFOE).

Axpo is one of the leading energy companies in Switzerland. The following table summarises the most important key figures of the electricity production by the Axpo group in the 2016/17 financial year.

Electricity production 2016/17	Axpo (GWh)
Nuclear power plants	16 395
Hydroelectric plants	7846
Conventional thermal power plants (CCGT's)	7567
New renewable energies (incl. other associates)	1096

2.2 Product system description

2.2.1 Domat/Ems wood-fired power plant

The Domat/Ems wood-fired power plant is located in the municipality of the same name in the Chur Rhine Valley. Situated on the site of Ems-Chemie AG, it produces both electricity and heat in the form of process steam and hot water for neighbouring industries as well as for drying wood chips for third parties. The power plant is equipped with three blocks that can be used independently of each other. The key data for the power plant in the reference year 2017 is as follows:

	Block 1	Block 2	Block 3	Total
Commissioned (year)	2005	2007	2008	–
Forest wood (ADT[2])	0	71 700	91 300	163 000
Waste wood (ADT)	5400	11 500	1100	18 000
Combustion output (MW)	5.5	38	38	81.5
Thermal output (MW)	5.5	23.3	38	66.8
Heat production (MWh)	21 000	22 100	78 200	121 300
Installed power, electric (MWel)	–	12.0	10.3	22.3
Gross electricity production (MWh)	–	60 000	42 000	102 000

2.2.2 Life cycle of biomass combustion in the Domat/Ems wood-fired power plant

Core processes: operation of the power plant

After unloading at the power plant the wood chips are sent to a wood chip drying plant. This new plant was commissioned in 2016 and has a drying capacity of 160 m^3 of wood per hour. It is equipped with modern filter technologies to reduce dust emissions.

The energy content of dried wood chips is 45% higher than that of wet wood chips. Using a dry fuel with a constant moisture level optimises combustion and increases the overall performance of the wood-fired power plant. The dryed wood chips are thereafter sent to the incineration blocks.

Block 1 is used solely for generating process steam (25 bar), which is then fed into the network of Ems-Chemie. In blocks 2 and 3, demineralised water is heated by the exhaust gases from combustion, which can reach

[2] Air dry ton

temperatures of up to 1000 °C. The high pressure steam generated as a result (65 bar at 480 °C) is released on both blocks via a steam turbine. This in turn produces electrical energy and process steam (25 bar). The exhaust steam from the turbines is then condensed in heat exchangers cooled using water from the Rhine. Part of the process steam can be transformed into hot water (100 °C) via the heating system, which is then fed into the district heating network to the area where the large sawmill was previously in operation.

After being discharged by the boiler system, the exhaust gases first enter a centrifugal separator that separates any coarse and still smouldering dust particles. Fine dust extraction and the separation of acidic corrosive gases, heavy metals and organic pollutants is made in the downstream baghouse filter. To improve the separation performance, an adsorbent (chalk) is blown into the flue upstream of the filter. The dusts separated in the baghouse filter are fed into a filtered dust container via a mechanical conveyor system. The SNCR process is used for the denitrification of the exhaust gases. To do this, urea is injected into the exhaust gas immediately upstream of the boiler at temperatures of approximately 900 °C to 1000 °C. This reduces the majority of the nitrogen oxides to atmospheric nitrogen. Thanks to the methods used for cleaning the exhaust gases, the emission values are far lower than the limits specified by the clean air ordinance.

Filter ash and slag that accumulate in the woodburning process are disposed of at residual waste landfills and sanitary landfills, respectively.

Upstream processes: Fuel procurement
Wood chips made from untreated wood, bark, uncontaminated residual wood from sawmills, green waste and residual wood from forests are used as fuel in block 2 and block 3. The pro rata combustion of waste wood has been permitted in block 3 since September 2008 and in block 2 since August 2011, whereby the proportion of waste wood must not exceed 40%.

In block 1, wood chips made from untreated wood and waste wood were used until April 2013 at a ratio of 3:1 (three parts waste wood to one part fresh wood). Waste wood has been used here exclusively since modification of the grate in April 2014.

Forest wood
In general, Axpo Tegra AG purchases wood for the power plant directly in the forest. This wood is exclusively that classified as wood fuel, i.e. timber residue and lower-quality logs from Swiss forest management. Axpo Tegra AG organises the entire logistics chain, from the forest road right up to the power plant. Partners are forest rangers, forestry companies, chipping companies and transport companies. Where possible, the wood is processed into chips at its source.

Waste wood
Waste wood includes wooden components, products and materials from building demolitions, conversions and renovations. This wood can be untreated, treated or coated. Waste wood is divided into different classes depending on the level of treatment and coating. Only pollutant-free and quality-controlled waste wood (classes A1 and A2) is used in the Domat/Ems wood-fired power plant. Waste wood quality is reported to the proper authority on a annual basis.

Downstream processes: Distribution of electricity and process steam
The electricity generated in the Domat/Ems wood-fired power plant is fed directly into the local grid at Ems-Chemie via the 10.2 kV busbar. The generated process steam (25 bar) is also fed directly into the supply network at Ems-Chemie. This means that downstream processes such as energy distribution (transmission and SF6 losses, plus establishment of the transport infrastructure) are not relevant for this Environmental Product Declaration.

3 Environmental impact declaration

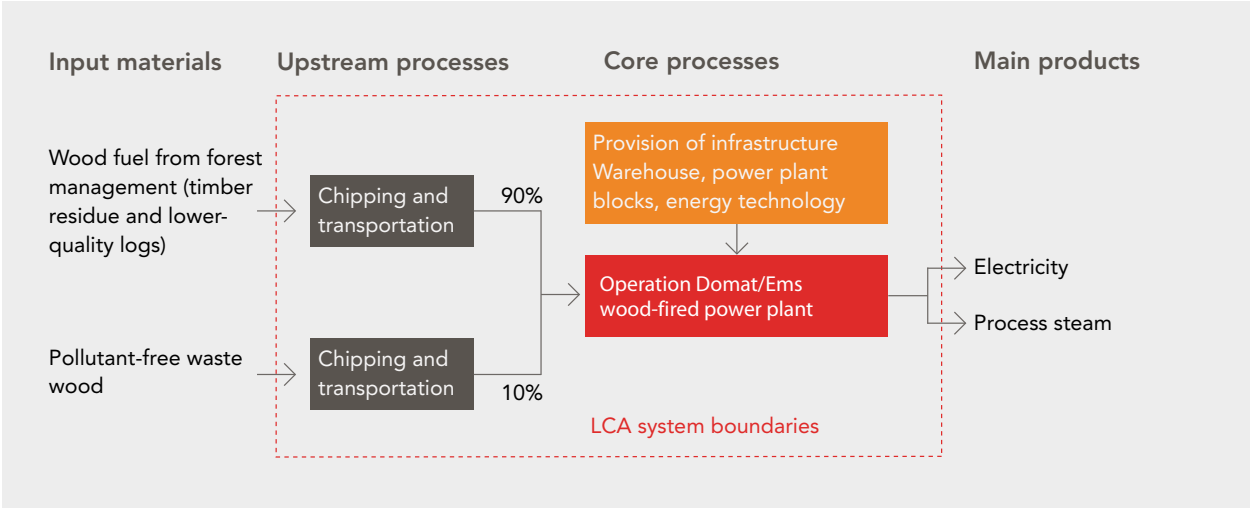
3.1 The life cycle assessment methodology

According to the ISO 14025 standard, the life cycle assessment (LCA) methodology was applied to quantify the environmental impact. LCA is a clearly structured framework, based on international standards[3], that facilitates the quantification and assessment of emissions to the environment and resource use along the entire electricity production chain. The LCA allows for comprehensive findings on overall energy, mass and emission flows, key processes that are involved and the quantification of important environmental impacts, such as greenhouse gas emissions.

However, despite these advantages, there are also some issues beyond the scope of an LCA. For example, the LCA study only focuses on the normal operation of processes. Unusual process conditions or even accidents are not included. Additionally, due to the investigation of the full process chain, local effects on the environment may not be considered, such as the impact on flora and fauna in the immediate vicinity of the power plant. Finally, a LCA study only quantifies environmental impacts; no economic, social or ethical aspects are included.

3.2 System boundaries, allocations and data source

The life cycle assessment takes into account the entire life cycle and all associated processes "from cradle to grave", starting with the construction of the power plant and the installations in the power plant through operation (including fuel procurement) right up to decommissioning of the power plant. The reference period is the year 2017. The following diagram is a simplified process scheme that illustrates the system limits of the life cycle assessment.



Data for all processes in the process chain presented above the operating personnel of the power plant. These data provide a reliable basis for an LCA study. For the calculation of the LCA results, all available data were used without using a cut-off for supposedly unimportant data. Data on energy supply (power mix), building material supply (e.g. steel and concrete production) and transport services as well as on waste treatment processes (e.g. dismantling of the power plant) connected to the investigated process chain was taken from the ecoinvent database[4]. The ecoinvent database is a joint initiative of institutes and departments of the Swiss Federal Institute of Technology and provides consistent, transparent and quality-assured life cycle inventory (LCI) data.

[3] ISO 14040 and ISO 14044, plus product category rules
[4] ecoinvent database, Swiss Centre for Life Cycle Inventories, www.ecoinvent.org

3.2.1 Allocation factors

The environmental impact of the upstream processes and core processes is divided up across the products according to the methods defined in the product category rules[5]. The allocation factors are as follows:

Products	Gross production in 2017	Allocation factors
Production of electricity (net)	90100 MWh	66.1 %
Production of process steam	105336 MWh	29.7 %
Production of hot water	15010 MWh	< 5 %

As the amount of produced hot water and thus, its allocated environmental burdens is small compared to the electricity and steam generation, it is not shown as a product in this EPD®.

3.2.2 Core processes

Detailed data was collected for both the infrastructure of the power plant and for the type and quantity of materials for installations such as turbines, generators and electrical technology. The amount of operating resources, emissions and waste was quantified by the operating personnel.

3.2.3 Upstream processes

The transport distances for fuel procurement were estimated by the operating personnel. Inventory data from the ecoinvent database was used for modelling the transport processes.

3.2.4 Downstream processes

Downstream processes are not relevant for this EPD® (see chapter 2.2.2).

3.3 Ecoprofile of electricity and steam generation

Results of the life cycle assessment are presented in the ecoprofile tables below and thereafter discussed in greater depth. More detailed LCA results were available for the certifier.

The ecoprofile consists of various types of life cycle assessment results, which can be summarised in three categories:

- **Life cycle inventory (LCI) results:**
  Inventory results are direct emissions to and resource consumption from the environment. Examples for inventory results are CO_2 emissions or the consumption of freshwater.

- **Life cycle impact assessment (LCIA) results:**
  In the impact assessment, inventory results, which contribute to the same environmental impact (e.g. climate change due to increasing greenhouse gas concentrations in the atmosphere), are grouped and their importance in relation to a specific basic substance is characterised with a factor (e.g. global warming potential of greenhouse gases such as CH4 in relation to CO_2).

- **Material flows:**
  Selected materials, which are subject to waste treatment or recycling, are presented in this category.

[5] Product Categery Rules UN-CPC 171 und 173, Annex 2, Allocation by the «Alternative Generation Method»

Ecoprofile – Resource use	Unit	Per kWh electricity at plant	Per kWh steam at plant
Non-renewable material resources			
Gravel and sand	g	$1.36 \cdot 10^{1}$	5.21
Calcite	g	2.03	$7.82 \cdot 10^{-1}$
Iron	g	$5.45 \cdot 10^{-1}$	$2.09 \cdot 10^{-1}$
Clay	g	$3.74 \cdot 10^{-1}$	$1.44 \cdot 10^{-1}$
Nickel	g	$3.67 \cdot 10^{-2}$	$1.41 \cdot 10^{-2}$
Chromium	g	$1.44 \cdot 10^{-2}$	$5.54 \cdot 10^{-3}$
Barite	g	$1.23 \cdot 10^{-2}$	$4.73 \cdot 10^{-3}$
Aluminium	g	$9.45 \cdot 10^{-3}$	$3.63 \cdot 10^{-3}$
Fluorite	g	$1.07 \cdot 10^{-3}$	$4.10 \cdot 10^{-4}$
Copper	g	$9.91 \cdot 10^{-3}$	$3.81 \cdot 10^{-3}$
Magnesite	g	$5.64 \cdot 10^{-3}$	$2.17 \cdot 10^{-3}$
Zinc	g	$1.23 \cdot 10^{-3}$	$4.73 \cdot 10^{-4}$
Kaolinite	g	$1.08 \cdot 10^{-3}$	$4.14 \cdot 10^{-4}$
Uranium	g	$3.46 \cdot 10^{-4}$	$1.33 \cdot 10^{-4}$
Zirconium	g	$6.98 \cdot 10^{-5}$	$2.68 \cdot 10^{-5}$
Renewable material resources			
Wood	g	$8.71 \cdot 10^{2}$	$3.35 \cdot 10^{2}$
Non renewable fossil energy resources			
Hard coal	MJ-equivalents	$5.96 \cdot 10^{-2}$	$2.29 \cdot 10^{-2}$
Crude oil	MJ-equivalents	$2.91 \cdot 10^{-1}$	$1.12 \cdot 10^{-1}$
Natural gas	MJ-equivalents	$1.65 \cdot 10^{-1}$	$6.32 \cdot 10^{-2}$
Lignite	MJ-equivalents	$1.14 \cdot 10^{-2}$	$4.38 \cdot 10^{-3}$
Renewable energy resources			
Energy, in biomass (incl. wood and recycled wood waste)	kWh	2.98	1.14
Direct energy consumption			
Electricity consumption in the power station	kWh	$1.07 \cdot 10^{-1}$	$4.11 \cdot 10^{-2}$
Use of recycled material			
Organic waste treated	g	$1.29 \cdot 10^{2}$	$4.94 \cdot 10^{1}$
Iron scrap	g	$2.21 \cdot 10^{-1}$	$8.49 \cdot 10^{-2}$
Water consumption			
Freshwater	g	$3.60 \cdot 10^{5}$	$1.38 \cdot 10^{5}$
Saltwater	g	$1.95 \cdot 10^{1}$	7.51

Ecoprofile – Pollutant emissions	Unit	Per kWh electricity at plant	Per kWh steam at plant
Airborne emissions – impact assessment results			
Greenhouse gases (net emissions[6])	g CO_2-equivalents	$3.43 \cdot 10^{1}$	$1.32 \cdot 10^{1}$
Ozone-depleting gases	g CFC-11-equivalents	$4.09 \cdot 10^{-6}$	$1.57 \cdot 10^{-6}$
Formation of ground-level ozone	g Ethylen-equivalents	$5.25 \cdot 10^{-2}$	$2.02 \cdot 10^{-2}$
Acidifying substances	g SO_2-equivalents	$7.53 \cdot 10^{-1}$	$2.90 \cdot 10^{-1}$
Airborne emissions contributing to given impact assessment results			
Ammonia	g	$3.09 \cdot 10^{-2}$	$1.19 \cdot 10^{-2}$
Carbon dioxide, fossil	g	$3.21 \cdot 10^{1}$	$1.23 \cdot 10^{1}$
Carbon monoxide, biogenic	g	$2.65 \cdot 10^{-1}$	$1.02 \cdot 10^{-1}$
Carbon monoxide, fossil	g	$7.21 \cdot 10^{-2}$	$2.77 \cdot 10^{-2}$
Dinitrogen monoxide	g	$1.31 \cdot 10^{-3}$	$5.04 \cdot 10^{-4}$
Methane, bromochlorodifluoro-, Halon 1211	g	$5.04 \cdot 10^{-8}$	$1.94 \cdot 10^{-8}$
Methane, bromotrifluoro-, Halon 1301	g	$1.47 \cdot 10^{-7}$	$5.66 \cdot 10^{-8}$
Methane, biogenic, total	g	$7.92 \cdot 10^{-4}$	$3.04 \cdot 10^{-4}$
Methane, fossil	g	$5.25 \cdot 10^{-2}$	$2.02 \cdot 10^{-2}$
Nitrogen oxides	g	$8.74 \cdot 10^{-1}$	$3.36 \cdot 10^{-1}$
NMVOC, non-methane volatile organic compounds	g	$3.79 \cdot 10^{-2}$	$1.46 \cdot 10^{-2}$
Sulphur dioxide	g	$8.14 \cdot 10^{-2}$	$3.13 \cdot 10^{-2}$
Other relevant non-radioactive airborne emissions			
Carbon dioxide, biogen	g	$1.77 \cdot 10^{3}$	$6.79 \cdot 10^{2}$
Particles < 10 µm	g	$8.55 \cdot 10^{-3}$	$3.28 \cdot 10^{-3}$
Particles < 2.5 µm	g	$1.83 \cdot 10^{-2}$	$7.04 \cdot 10^{-3}$
Particles > 10 µm	g	$1.48 \cdot 10^{-1}$	$5.67 \cdot 10^{-2}$
Arsenic	g	$2.11 \cdot 10^{-15}$	$8.09 \cdot 10^{-16}$
Cadmium	g	$4.36 \cdot 10^{-6}$	$1.68 \cdot 10^{-6}$
Dioxins	g	$8.01 \cdot 10^{-9}$	$3.08 \cdot 10^{-9}$
PAH, polycyclic aromatic hydrocarbons	g	$9.95 \cdot 10^{-6}$	$3.82 \cdot 10^{-6}$
Radioactive airborne emissions			
Carbon 14	kBq	$5.08 \cdot 10^{-4}$	$1.95 \cdot 10^{-4}$
Krypton (all isotopes)	kBq	$2.49 \cdot 10^{-4}$	$9.55 \cdot 10^{-5}$
Radon (all isotopes)	kBq	$3.06 \cdot 10^{-1}$	$1.18 \cdot 10^{-1}$
Waterborne emissions – impact assessment results			
Eutrophying substances	g PO_4^{3-}-equivalents	$1.29 \cdot 10^{-1}$	$4.95 \cdot 10^{-2}$
Waterborne emissions contributing to given impact assessment results			
Phosphate	g	$2.40 \cdot 10^{-3}$	$9.22 \cdot 10^{-4}$
COD, Chemical Oxygen Demand	g	$1.80 \cdot 10^{-2}$	$6.92 \cdot 10^{-3}$
Ammonium, ion	g	$6.58 \cdot 10^{-4}$	$2.53 \cdot 10^{-4}$
Nitrate	g	$1.66 \cdot 10^{-3}$	$6.38 \cdot 10^{-4}$
Other relevant non-radioactive waterborne emissions			
Sulphate	g	$3.14 \cdot 10^{-2}$	$1.21 \cdot 10^{-2}$
Oil	g	$5.10 \cdot 10^{-3}$	$1.96 \cdot 10^{-3}$
Radioactive waterborne emissions			
Tritium H3	kBq	$7.36 \cdot 10^{-2}$	$2.83 \cdot 10^{-2}$
Other relevant non-radioactive emissions soil			
Oil	g	$3.03 \cdot 10^{-3}$	$1.16 \cdot 10^{-3}$

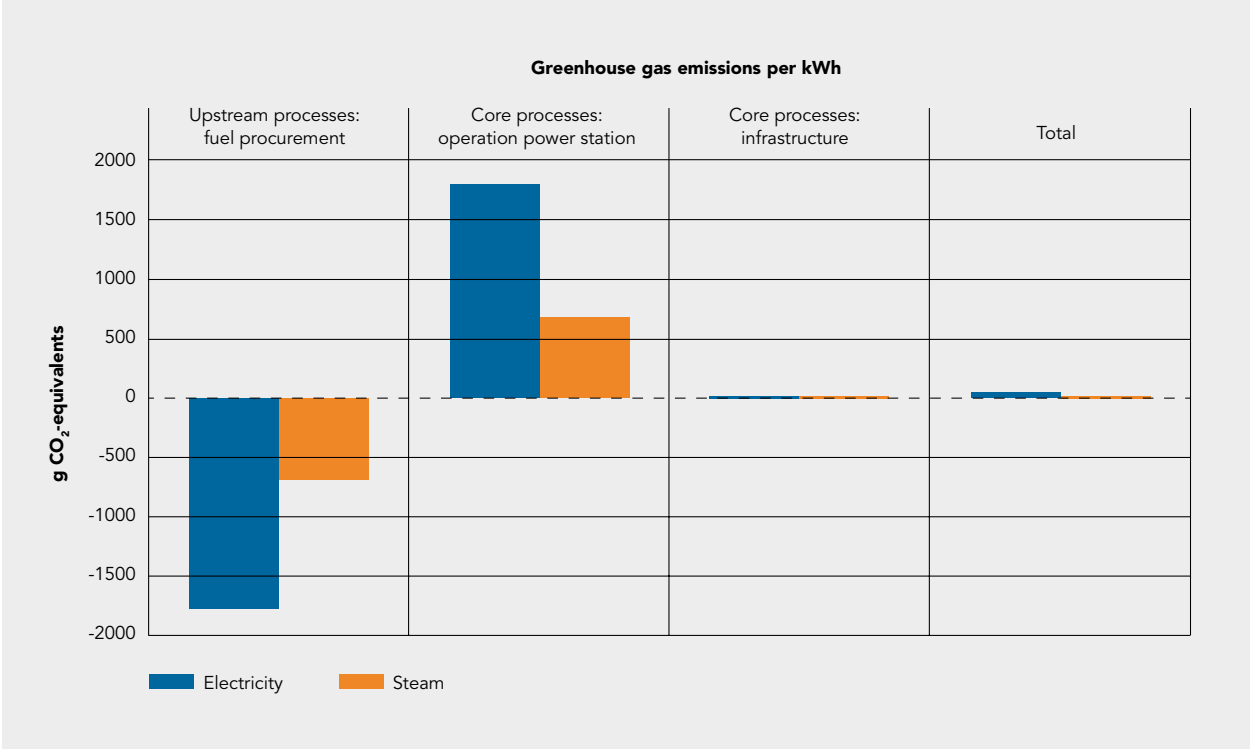
[6] Net emissions: The carbon absorbed from the atmosphere and stored in biomass is calculated against the biogenic carbon dioxide emissions from the wood-burning process.

Ecoprofile – Waste and material subject to recycling	Unit	Per kWh electricity at plant	Per kWh steam at plant
Waste related directly to the core processes			
Ash and slag to landfill	g	$3.28 \cdot 10^{1}$	$1.26 \cdot 10^{1}$
Waste related to background processes. Hazardous waste – radioactive			
SF/HLW/ILW [7] in final repository	m^3	$1.14 \cdot 10^{-10}$	$4.37 \cdot 10^{-11}$
LLW [8] in final repository	m^3	$1.61 \cdot 10^{-9}$	$6.19 \cdot 10^{-10}$
Hazardous waste – non-radioactive			
Hazardous waste to incineration	g	$5.28 \cdot 10^{-2}$	$2.03 \cdot 10^{-2}$
Other waste			
Non-hazardous waste to landfill	g	$7.59 \cdot 10^{-2}$	$2.92 \cdot 10^{-2}$
Non-hazardous waste to recycling	g	$3.35 \cdot 10^{-1}$	$1.29 \cdot 10^{-1}$
Non-hazardous waste to incineration	g	$2.51 \cdot 10^{-2}$	$9.66 \cdot 10^{-3}$

[7] SF/HLW/ILW: Spent fuel / high-level waste/medium-level waste with long half life
[8] LLW: Low and medium-level waste

3.4 Gross greenhouse gas emissions

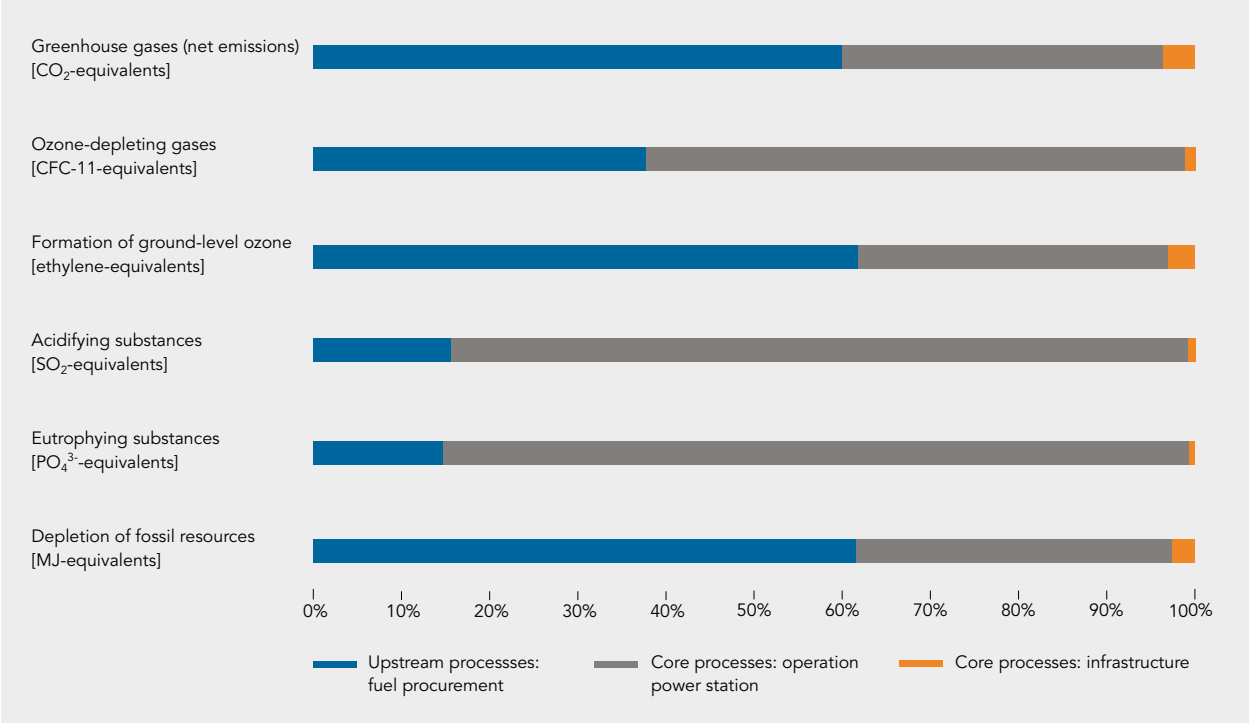
In accordance with the product category rules, both the biogenic carbon dioxide emissions and the absorption of atmospheric carbon in biomass are taken into account for biomass power plants when representing the total greenhouse gas emissions. The graphic below shows this balance across the different phases of the life cycle. The absorption of atmospheric carbon in biomass is taken into account for the upstream processes. The emission of biogenic carbon dioxide corresponds to the operation of the power plant.



3.5 Dominance analysis and conclusions

Various contributions from the life cycle to the total results are shown in the following diagram for all impact categories. The contributions are divided up as follows:

- **Upstream processes:** Fuel procurement including chipping and transportation to the plant.
- **Core processes (operation):** Use of operating resources (e.g. urea), emissions, waste and its treatment (e.g. ash and slag).
- **Core processes (infrastructure):** Material costs for constructing the power plant and its installations.



The overall comparison across the life cycle phases shows the following:

- Approximately 50 percent of greenhouse gas emissions and the use of fossil resources are caused by fuel procurement whereas operation itself causes approximately another 50 percent. In fuel procurement, this is the result of chipping and transport emissions and with respect to fossil resources as the diesel consumption by the trucks and by mobile coppers used in the forest. In operation, these environmental impacts occur mostly through the production of the urea used as an operating resource.
- Similarly, approximately 60 percent of the emissions that contribute to ground-level ozone (smog) are caused by fuel procurement (chipping and transportation) and 40 percent by the operating processes. In the operating processes, the directly produced carbon monoxide emissions and NMVOC emissions from the vehicles used in the plant (e.g. wheel loaders) are most significant.
- Emissions of ozone-depleting gases occur mostly in the preprocess chains as part of the petrochemical manufacture of oil, gas and the use of operating resources such as electricity and urea.
- In the impact categories acidification and eutrophication, the direct operating emissions of NOx, ammonia and SOx (acidification only) make a significant contribution to the overall environmental impact.

3.6 Differences versus the earlier version of the Domat/Ems EPD®

New plant layout
The main change compared to the earlier version of this EPD® is the new plant layout including the wood chips drying plant commissioned in 2016. Using a dry fuel with a constant moisture level optimises combustion and increases the overall performance of the wood-fired power plant. Moreover, air emissions as well as the use of anicillary products such as urea could be reduced significantely.

Updated allocation factors
In the presented EPD® the environmental burdens are allocated on the products electricity and steam. Allocation factors were updated according to the "alternative generation method" as required in the PCR.

Database update
A new version of the ETH ecoinvent database was used (version 3) for modelling background processes.

4 Additional environmental information

4.1 Land use

The land use is quantified systematically for the core processes in accordance with the PCR policy pursuant to the CORINE[9] Land Cover classes (CLC). The CORINE program was initiated by the European Commission in 1985 to record land use across Europe according to a uniform nomenclature, among other aspects. The system consists of 44 classes in three hierarchical levels (e.g. use of industrial, mining or forest areas).

As the land was already used as an industrial area before the power plant was constructed, there was no change in the CLC class.

Land used by the power plant	Land use type before construction of the power plant (CLC class)	Land use type after construction of the power plant (CLC class)
27 000 m^2	Industrial area, constructed (CLC class 121a)	Industrial area, constructed (CLC class 121a)

4.2 Biological diversity

There are no nationally or regionally important biotopes on the site of the plant or in the immediate vicinity. The wood used for operating the power plant from the surrounding forests is exclusively classified as wood fuel, i.e. timber residue and lower-quality logs from Swiss forest management and certified according to FSC or PEFC. No wood from protected areas is used. The biological diversity is thus not significantly affected by the operation of the Domat/Ems wood-fired power plant.

4.3 Environmental and health risks

Specific risks during operation of the wood-fired power plant include the risk of fire due to flammable solid materials and dusts that occur predominantly in the fuel warehouse as a result of wood chip preparation (such as shredding). In order to minimise these and other risks, Axpo Tegra AG follows a comprehensive concept for occupational health and safety. In this concept, risks are determined systematically and the corresponding measures for reducing them are established as necessary. For example, heat detectors, cameras and a large-scale sprinkler system are installed in the chipping hall to reduce the risk of fire.

4.4 Electromagnetic fields

The regulation on protection against non-ionising radiation (NISV, SR 814.710) is used as a basis for assessing the non-ionising radiation. This contains a plant limit of 100 µT (at a frequency of 50 Hz), which must be adhered to in sensitive locations (e.g. residential areas). The electromagnetic fields in and around the Domat/Ems power plant are so small that no special measures have to be taken. There is thus no danger to residents or to those inside the power plant.

4.5 Noise

The Swiss noise protection regulation (LSV, SR 814.41) specifies a noise emission limit for industrial areas of 70 dB(A) during the day and 60 dB(A) at night. These prescribed noise limits are adhered to both when driving vehicles to and from the plant and when operating under full load. As part of their study into noise pollution for employees working in power plants, SUVA[10] carried out noise measurements at various workplaces in 2011. Occupational health and safety was guaranteed through the implemented measures, such as wearing hearing protection.

[9] Coordination of Information on the Environment: http://terrestrial.eionet.europa.eu/CLC2000/classes

[10] SUVA: Swiss national accident insurance organisation

5 Certification body and mandatory statements

5.1 Information from the certification body

The certification of the Environmental Product Declaration, EPD®, of electricity and heat (steam and hot water) from the Domat/Ems wood-fired power plant has been carried out by Bureau Veritas Certification Sweden. Bureau Veritas Certification Sweden has made an independent verification of the declaration and data according to ISO 14025: 2006 EPD verification. The EPD® has been made in accordance with General Programme Instructions for an Environmental Product Declaration, EPD®, published by the International EPD® System and UN-CPC 171 and 173, Product Category Rules for preparing an Environmental Product Declaration (EPD®) for Electricity, Steam, and Hot and Cold Water Generation and Distribution. Bureau Veritas Certification Sweden has been accredited by SWEDAC, the Swedish Board for Accreditation and Conformity Assessment, to certify Environmental Product Declarations, EPD®. This certification is valid until 12 September 2021. The registration number is S-P-00748.

5.2 Mandatory statements

5.2.1 General statements

Note that EPDs from different EPD programmes may not be comparable.

5.2.2 Omission of life cycle stages

In accordance with the PCR, the use stage of produced electricity has been omitted since the use of electricity fulfils various functions in different contexts.

5.2.3 Means of obtaining explanatory materials

ISO 14025 prescribes that explanatory material must be available if the EPD® is communicated to final consumers. This EPD® is aimed at industrial customers and not meant for B2C (business-to-consumer) communication.

5.2.4 Information on verification

EPD programme
The International EPD® System, managed by EPD International AB.
www.environdec.com

Product Category Rules
UN-CPC 171 and 173, Product Category Rules (PCR) for preparing an Environmental Product Declaration (EPD®) for Electricity, Steam, and Hot and Cold Water Generation and Distribution, version 3.0.

PCR Review
The Technical Committee of the International EPD® System. Full list of TC members available on www.environdec.com/TC.

Independent verification
Independent verification of the declaration and data, according to ISO 14025: External, Bureau Veritas Certification, Sweden.
info@se.bureauveritas.com

6 Links and references

Further information on the company:
http://www.axpo.com

Information on the international EPD® program:
http://www.environdec.com
Information on the International EPD® System, the EPDs®,
PCRs and the General Programme Instructions, GPI v2.5

Background information on the life cycle assessment:
http://www.ecoinvent.org
ecoinvent v3 database, published by the Swiss Centre for Life Cycle Inventories

7 Regularly used abbreviations

CLC classes	CORINE Land Cover classes
EPD	Environmental Product Declaration
FSC / PEFC	Forest Stewardship Council / Programme for the Endorsement of Forest Certification
ISO	International Organization for Standardization
LCA	Life cycle assessment
LCI	Life cycle inventory
LCIA	Life cycle impact assessment
NMVOC	Non-methane volatile organic compounds
PCR	Product category rules

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