ENVIRONMENTAL PRODUCT DECLARATION

SINAMICS V20

Basic converters for continuous motion

Type II according to ISO 14021 including life cycle impact assessment (LCIA)

SIEMENS

General information

This environmental product declaration (EPD) is based on the international standard ISO 14021 (“Environmental labels and declarations – Self declared environmental claims – Type II environmental labelling”). The data in this EPD has been evaluated on a full-scale life cycle assessment (LCA) study according to ISO 14040/44, taking into account the product category rules (PCR) for electronic and electrotechnical products and systems defined in EN 50693. The applied use phase scenario including load profile is based on EN 50598-3:2015 Table 5.

Siemens is dedicated to an environmentally conscious design of its products in line with IEC 62430 and has implemented an integrated management system according to ISO 9001, ISO 14001 and ISO 45001.

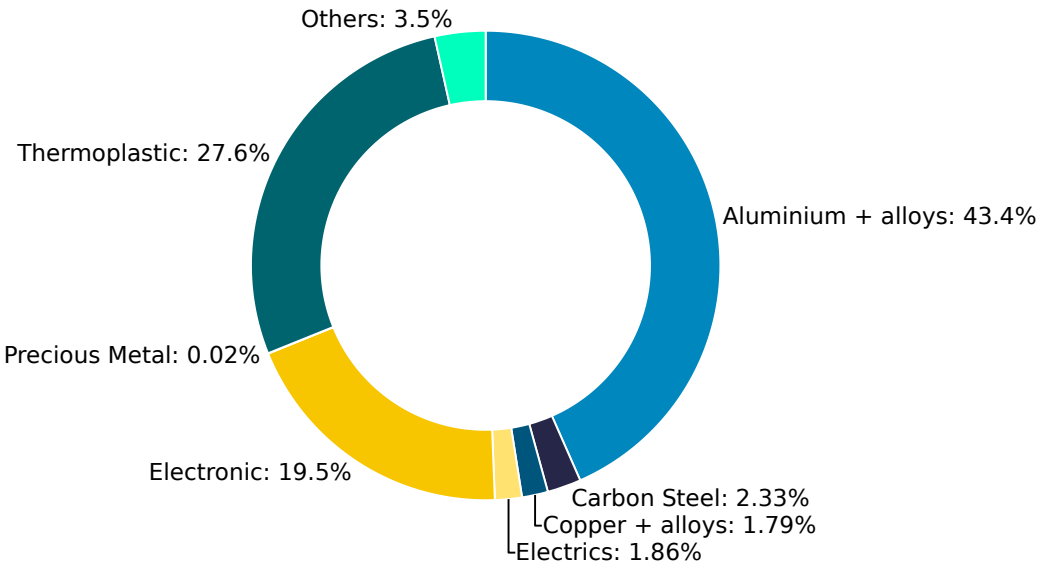
Products	**SINAMICS V20 converters, power range 0.12 to 3 kW at 200 ... 240 V 1 AC and 0.37 to 30 kW at 380 ... 480 V 3 AC**
Represented by the reference product	6SL3210-5BE21-5UV0, 1.5 kW (Unfiltered), 3AC 380 ... 480 V, IP20 6SL3210-5BE21-5UV1, 1.5 kW (Unfiltered), 3AC 380 ... 480 V, IP20
Product Description	SINAMICS V20 converter, IP20, air cooling, analog and digital I/Os, Modbus RTU and USS
Functional Unit	Speed control of asynchronous motors. Calculation of the environmental impacts is based on 15 years of product service lifetime[1]

[1] The lifetime value used for calculation is a reference value and does not equate with the minimum, average or real life time.

Material composition

The following chart outlines the overall material composition of the calculated reference product without packaging. Product weight of 1.0 kg adds up with packaging weight of 0.11 kg to a total weight of 1.11 kg. Packaging consists of: Graphic paper , Corrugated box (average composition).

Product Weight 1.0 kg



Substance assessment

At Siemens, we are committed to the development and production of environmentally sound and sustainably produced equipment. This includes avoiding hazardous substances in our products without compromising their benefits for our customers. Please visit the following website to learn more about how we comply with product-related environmental regulations like RoHS, REACH, WEEE and others: Product Related Environmental Protection

Life cycle stages and reference scenarios

Manufacturing

This stage covers the extraction of natural resources, production of raw materials, manufacturing, packaging, and transportation.

Distribution and Operation

This stage covers the product's distribution, installation, use, and maintenance. Different operating conditions can lead to deviations from the reference scenario.

End-of-Life

This stage covers the disassembly or shredding and material recycling of all recyclable materials, as well as energy recovery, thermal treatment and the disposal of all other materials.

Scenarios

Energy model used:
China (standard mix), China (Thermal energy from natural gas), China (renewable mix)

Transportation model:
Truck (7.5 t-12 t) 1000km

Energy model used:
Europe (standard mix)

Distribution scenario:
Truck (7.5 t-12 t) 3500 km

Use Scenario:
Operation profile is defined by 3 operational points (OP):
OP1 : 20% of time at 100% speed and 100% torque
OP2: 70% of time at 50% speed and 25% torque
OP3: 10% of time at 0% speed and 25% torque
Lifetime 15 years and annual operation 5000h/year

Energy model used:
EMEA

End-of-Life methodology:
Avoided burden (net-scrap calculation)

Key environmental performance indicators

The following impact categories characterize the product's environmental footprint. They have been calculated with LCIA methodology 01 EN15804+A2 (EF 3.1); LCA tool: Green Digital Twin (GDT), Database: One Siemens LCA Database (based on MLC CUP 2024.1, formerly GaBi).

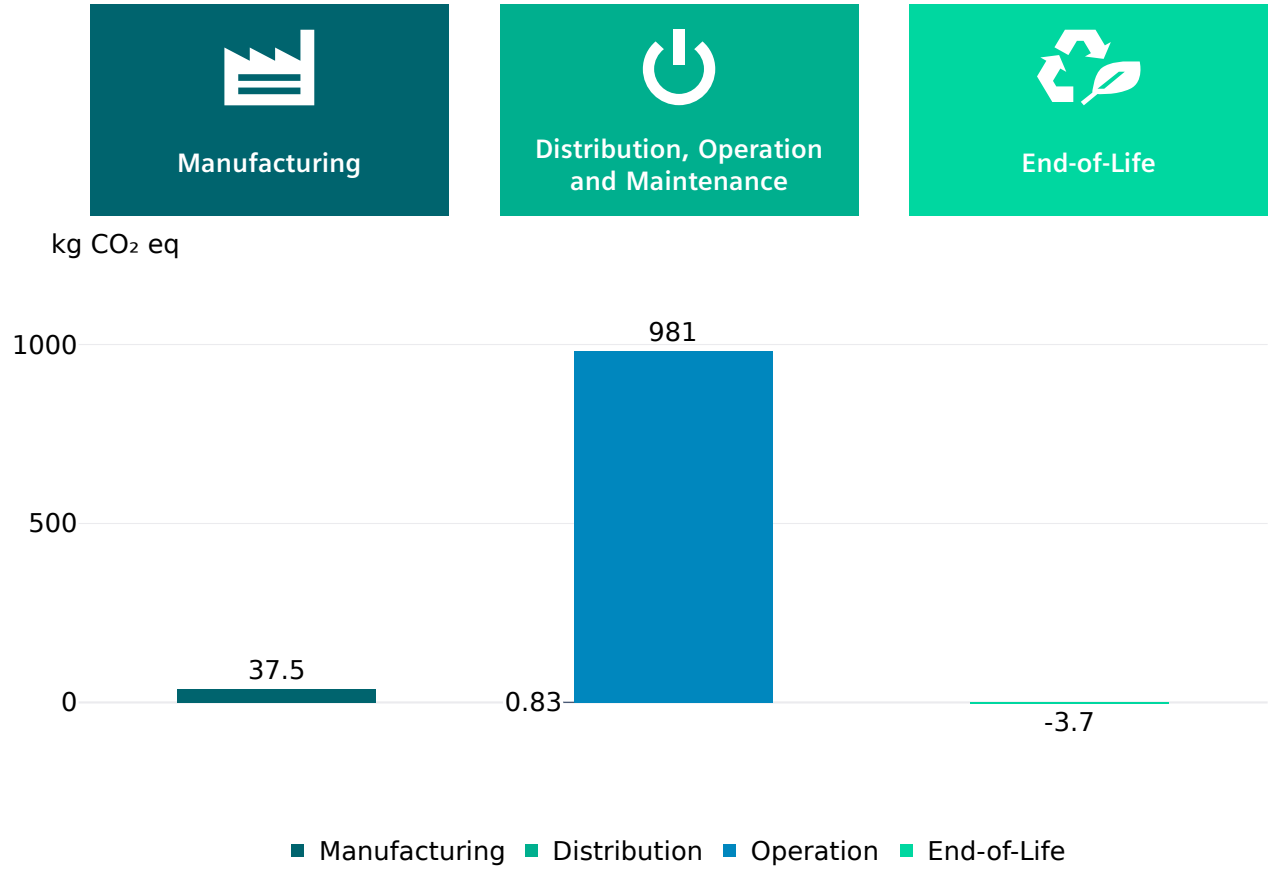
To ensure the high quality and completeness of the LCA results, Primary Data have been used whenever possible. Datasets for resources, such as electrical energy or natural gas, are chosen from the region where the device is produced and assembled. If primary data are not available, datasets reflecting state-of-the-art manufacturing technology are considered.

For products belonging to the same homogeneous product family range the following extrapolation criteria (Appendix) can be used to derive their climate change impact in kg CO2 eq. The rest of the listed impacts will be determined in the following version of the EPD.

Impact Category	Unit	Total	Manufacturing	Distribution	Operation	End of life
Acidification	Mole of H+ eq	2.04E+0	2.41E-1	1.25E-3	1.87E+0	-7.71E-2
Climate change – total	kg CO_2 eq	1.02E+3	3.75E+1	8.28E-1	9.81E+2	-3.74E+0
Climate change – fossil	kg CO_2 eq	1.00E+3	3.26E+1	8.12E-1	9.72E+2	-3.73E+0
Climate change – biogenic	kg CO_2 eq	1.39E+1	4.91E+0	2.35E-3	9.04E+0	-1.76E-3
Climate Change, land use and land use change	kg CO_2 eq	2.03E-1	4.12E-2	1.37E-2	1.48E-1	2.49E-5
Ecotoxicity, freshwater – total	CTUe	6.09E+3	2.03E+2	7.98E+0	5.90E+3	-1.62E+1
Eutrophication, freshwater	kg P eq	4.20E-3	1.49E-4	3.48E-6	4.05E-3	-3.82E-6
Eutrophication, marine	kg N eq	4.96E-1	3.15E-2	4.70E-4	4.68E-1	-4.51E-3
Eutrophication, terrestrial	Mole of N eq	5.20E+0	3.41E-1	5.56E-3	4.90E+0	-4.92E-2
Human toxicity, cancer – total	CTUh	3.63E-7	3.37E-8	1.61E-10	3.31E-7	-1.47E-9
Human toxicity, non-cancer – total	CTUh	5.36E-6	3.17E-7	7.23E-9	5.08E-6	-4.40E-8
Ionising radiation, human health	kBq U235 eq	5.35E+2	1.68E+0	2.84E-3	5.34E+2	-4.90E-1
Land Use	dimensionless (pt)	8.71E+3	9.13E+1	5.29E+0	8.61E+3	-2.79E+0
Ozone depletion	kg CFC-11 eq	2.26E-8	6.25E-10	0.00E+0	2.20E-8	-2.71E-11
Particulate matter	Disease incidences	1.84E-5	3.41E-6	1.37E-8	1.57E-5	-6.47E-7
Photochemical ozone formation, human health	kg NMVOC eq	1.32E+0	9.84E-2	1.23E-3	1.24E+0	-1.63E-2
Resource use, fossils	MJ	2.08E+4	4.68E+2	0.00E+0	2.03E+4	-5.41E+1
Resource use, mineral and metals	kg Sb eq	1.28E-2	1.33E-2	7.11E-8	1.82E-4	-6.66E-4
Water use	m^3 world eq deprived water	2.75E+2	1.13E+1	1.26E-2	2.65E+2	-9.65E-1

Climate change

This chart shows the overall impact of the product on climate change – total. The operations phase is the lifecycle phase with the biggest overall impact. Different operating conditions can lead to deviations from the reference scenario. The distribution stage of the reference product is not shown in the chart due to its relatively small contribution to climate change and its impact is included in the operation bar.



End-of-Life results

The end-of-life stage considers the recyclability rates of metal, plastics contents and minimum disposal rates according to the guidelines IEC TR 62635:2012 for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment.

It leads to:

- **product recyclability of up to 56%** mainly due to metal content
- **energy recoverability of up to 32%** from plastic materials
- **minimum disposal rate of 12%**

The exact final values depend on the used recycling process and add up to 100%.

Note: The device should not be disposed of as unsorted municipal waste. Special treatment for specific components may be mandated by law or recommended for environmental reasons. Observe all local and applicable laws.

Appendix

For other MLFBs covered by this EPD under SINAMICS V20 homogenous product family, the climate change impact (CC) in kg CO_2 eq. can be calculated for the manufacturing and end of life phases using linear regression equations according to the Mass in kg(x) of the assessed product.

The following equation based on linear regression is defined as:

$$\boldsymbol{y = m \times x + b}$$

where,

y .... climate change in kg CO_2eq.

m.... scaling factor in kg CO_2eq./kg of product

x .... mass of the product in kg without packaging

b .... intercept (offset) in kg CO_2eq.

Thus, the factors for the **manufacturing phase** are:

m = 21.15 kgCO_2eq./kg of converter, b= 15.87 kg CO_2eq

For **End of Life**:

m = -3.99 kgCO_2eq./kg of converter, b= 0.39 kg CO_2eq

For the operation phase, the climate change in kgCO_2eq was derived for 230 V and 400 V and rated power P_R (LO) in kW for European standard energy mix, lifetime of 15 years, annual operation 5000h/year and three operational points. Climate change impact of the use phase for 230 V is listed in Table 1.1and 1.2 and for 400 V in 1.3 and 1.4. The mass of V20 modules is listed in Table 2.1 and 2.2.

OP1: 20% of time at 100% speed and 100% torque

OP2: 70% of time at 50% speed and 25% torque

OP3: 10% of time at 0% speed and 25% torque

Table. 1.1 Climate change results for the operation phase

Version	Unfiltered									
Voltage	V	230	230	230	230	230	230	230	230	230
P_R(LO)	kW	0.12	0.25	0.37	0.55	0.75	1.1	1.5	2.2	3
Climate change	kg CO_2eq	499	591	669	828	884	1044	1460	1940	2250

Table. 1.2 Climate change results for the operation phase

Version	Filtered									
Voltage	V	230	230	230	230	230	230	230	230	230
P_R(LO)	kW	0.12	0.25	0.37	0.55	0.75	1.1	1.5	2.2	3
Climate change	kg CO_2eq	499	593	673	834	893	1054	1475	1968	2290

Table. 1.3 Climate change results for the operation phase

Version	Unfiltered														
Voltage	V	400	400	400	400	400	400	400	400	400	400	400	400	400	400
PR(LO)	kW	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5	11	15	18.5/22	22/30
Climate change	kg CO2eq	619	671	687	843	981	1234	1575	1827	2210	2908	4053	4659	6060	6662

Table. 1.4 Climate change results for the operation phase

Version	Filtered														
Voltage	V	400	400	400	400	400	400	400	400	400	400	400	400	400	400
P_R(LO)	kW	0.37	0.55	0.75	1.1	1.5	2.2	3	4	5.5	7.5	11	15	18.5/22	22/30
Climate change	kg CO_2eq	619	671	687	843	981	1234	1577	1830	2216	2914	4068	4681	6084	6698

Table. 2.1 Mass of modules

Voltage(V)	Version	MLFB	Power Rating(kW)	Mass(kg)
230	Unfiltered	6SL3210-5BB11-2UV1	0.12	0.6
		6SL3210-5BB12-5UV1	0.25	0.6
		6SL3210-5BB13-7UV1	0.37	0.6
		6SL3210-5BB15-5UV1	0.55	0.8
		6SL3210-5BB17-5UV1	0.75	0.8
		6SL3210-5BB21-1UV1	1.1	1.2
		6SL3210-5BB21-5UV1	1.5	1.2
		6SL3210-5BB22-2UV1	2.2	1.9
		6SL3210-5BB23-0UV1	3	1.9
	Filtered	6SL3210-5BB11-2BV1	0.12	0.7
		6SL3210-5BB12-5BV1	0.25	0.7
		6SL3210-5BB13-7BV1	0.37	0.7
		6SL3210-5BB15-5BV1	0.55	0.9
		6SL3210-5BB17-5BV1	0.75	0.9
		6SL3210-5BB21-1BV1	1.1	1.4
		6SL3210-5BB21-5BV1	1.5	1.4
		6SL3210-5BB22-2BV1	2.2	2.2
		6SL3210-5BB23-0BV1	3	2.2

Table. 2.2 Mass of modules

Voltage(V)	Version	MLFB	Power Rating(kW)	Mass(kg)
400	Unfiltered	6SL3210-5BE13-7UV0 6SL3210-5BE13-7UV1	0.37	0.9
		6SL3210-5BE15-5UV0 6SL3210-5BE15-5UV1	0.55	0.9
		6SL3210-5BE17-5UV0 6SL3210-5BE17-5UV1	0.75	0.9
		6SL3210-5BE21-1UV0 6SL3210-5BE21-1UV1	1.1	1
		6SL3210-5BE21-5UV0 6SL3210-5BE21-5UV1	1.5	1
		6SL3210-5BE22-2UV0 6SL3210-5BE22-2UV1	2.2	1
		6SL3210-5BE23-0UV0 6SL3210-5BE23-0UV1	3	1.6
		6SL3210-5BE24-0UV0 6SL3210-5BE24-0UV1	4	1.6
		6SL3210-5BE25-5UV0 6SL3210-5BE25-5UV1	5.5	2.4
		6SL3210-5BE27-5UV0	7.5	3.7
		6SL3210-5BE31-1UV0	11	3.7
		6SL3210-5BE31-5UV0	15	3.9
		6SL3210-5BE31-8UV0	18.5/22	6.2
		6SL3210-5BE32-2UV0	22/30	6.4
	Filtered	6SL3210-5BE13-7CV0 6SL3210-5BE13-7CV1	0.37	1
		6SL3210-5BE15-5CV0 6SL3210-5BE15-5CV1	0.55	1
		6SL3210-5BE17-5CV0 6SL3210-5BE17-5CV1	0.75	0.9
		6SL3210-5BE21-1CV0 6SL3210-5BE21-1CV1	1.1	1.1
		6SL3210-5BE21-5CV0 6SL3210-5BE21-5CV1	1.5	1.1
		6SL3210-5BE22-2CV0 6SL3210-5BE22-2CV1	2.2	1.1
		6SL3210-5BE23-0CV0 6SL3210-5BE23-0CV1	3	1.8
		6SL3210-5BE24-0CV0 6SL3210-5BE24-0CV1	4	1.8
		6SL3210-5BE25-5CV0 6SL3210-5BE25-5CV1	5.5	2.6
		6SL3210-5BE27-5CV0	7.5	4
		6SL3210-5BE31-1CV0	11	4.1
		6SL3210-5BE31-5CV0	15	4.3
		6SL3210-5BE31-8CV0	18.5/22	6.8
		6SL3210-5BE32-2CV0	22/30	7

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Published by

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