

ENVIRONMENTAL PRODUCT DECLARATION



In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

ConverLight® Dynamic

with 2x5mm heat strengthened flat glass

from

ChromoGenics AB

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-12307
Publication date:	2024-01-22
Valid until:	2029-01-22

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com



General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
website:	www.environdec.com
e-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification

Product Category Rules (PCR)

CEN standard EN 15804 serves as the Core Product Category Rules (PCR).

Product Category Rules (PCR): Construction products PCR 2019:14 v.1.3.2, C-PCR-009 (to PCR 2019:14) Glass in buildings

PCR review was conducted by: The Technical Committee of the International EPD® System, IVL Swedish Environmental Research Institute - Secretariat of the International EPD® System. The review panel may be contacted via info@environdec.com.

EPD general information

EPD owner: ChromoGenics AB, Sweden.

EPD geographical scope: Europe.

Declaration no: S-P-12307.

Date of publication: 2024-01-22.

EPD valid until: 2029-01-22.

Product name: ConverLight® Dynamic.

UN CPC code: UN CPC 3711 Unworked glass, flat glass and pressed or moulded glass for construction; glass mirrors.

Functional unit: One square metre (1m²) ConverLight® Dynamic, in the configuration of two panes of 5 mm thick heat strengthened glass laminated to the ConverLight® Interlayer electrochromic foil, with a light transmittance of 75% in its brightest stage and heat transfer blockage of 80% in its darkest stage.

System boundaries: Cradle to grave and module D.

Reference service life: 20 years according to an ISO 18543:2021 stress test.

Life Cycle Assessment (LCA)

LCA conducted by: Pia Stoll Konsult AB, www.piaastoll.se, info@piaastoll.se.

LCA software: openLCA v.2.0.3

Background database: ecoinvent 3.9.1 EN15804 add-on

Impact assessment methods: EN15804 reference package based on EF 3.1, Feb.2023.

Third-party verification

Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:

EPD verification by individual verifier

Third-party verifier: Viktor Hakkarainen, CHM Analytics AB



Approved by: The International EPD® System

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Company information

Contact information

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Production plant: ChromoGenics AB

- Sweden: Ullforsgatan 15, SE-75228 Uppsala

Web page(s): <https://chromogenics.com/>, <https://converlight.com/>

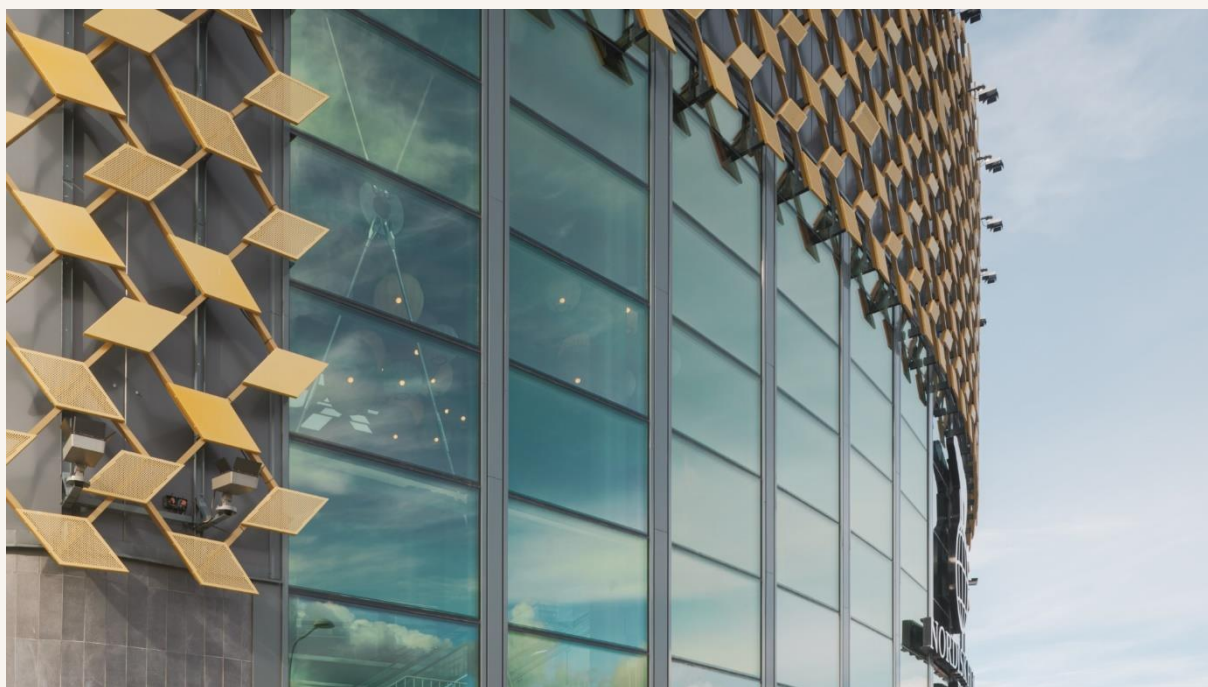
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Company description

Founded in 2003 from research at Uppsala University, Sweden, ChromoGenics specializes in electrochromic materials, leading to a strong patent portfolio in this domain. ChromoGenics' focus is on property technologies (proptech), aligning with ESG (Environmental, Social, and Governance) principles.

The company is known for its innovative product ConverLight® Dynamic, launched in 2016. In addition to ConverLight® Dynamic, ChromoGenics also sells the static glass technology ConverLight® Static, ConverLight® Paragon as well as the energy efficient coloured solar cell panels ConverLight® Energy for facades. All ideas and products that are being developed at ChromoGenics have environment and health in mind. That means a focus on environmentally friendly material, reduced energy use, increased access to daylight and views as well as improved indoor comfort.



Product information

ConverLight® Dynamic

ConverLight® Dynamic provides solar control for increased indoor comfort and energy efficiency in buildings. The electrochromic technology in the smart dynamic glass stops the solar heat before it even enters the building. The dynamic glass solution adjusts the solar transmittance depending on conditions such as time of day, outdoor temperature, and window position. The effect is that the window blocks the solar heat when it is warm and lets the solar heat in when it is cold, in order to regulate the indoor comfort.



The ConverLight Control Unit is compact, wireless, and easily integrated into a wall, ceiling, or connection box, providing a convenient and cost-effective installation. ChromoGenics Cloud is a web-based portal service with user-specific interfaces for various users like operators, property owners, and tenants.

With the ChromoGenics products, a building's facade can be grouped into zones based on their solar exposure levels. An algorithm then automatically manages the dynamic properties of the glass, delivering a seamless and aesthetically pleasing tint adjustment. The transition becomes noticeable within a few minutes, with the full transformation taking approximately 20 minutes.

The ConverLight® Dynamic is available in two versions, ConverLight65 and ConverLight75. When built into a standard insulated glass unit (IGU) with three panes of glass, ConverLight65 has a light transmittance of 56% in its brightest stage and blocks 90% of the heat transfer in its darkest stage. ConverLight75, in a three glass pane IGU, has a light transmittance of 61% in its brightest stage and blocks 80% of the heat transfer in its darkest stage. ConverLight65 is preferred when heat transfer reduction is prioritized, whereas ConverLight75 gives a higher light transmission.

ConverLight® Dynamic can be delivered in many different shapes like rectangle, triangle, polygon, round, or ellipse. As of the publication date of this EPD, it is the only commercially available electrochromic product that can be produced in curved forms, thanks to the flexibility of the ConverLight® Interlayer foil. It is available in dimensions up to 1550×4400 mm with a thickness of 10-22 mm. This EPD covers the case of a flat glass thickness of 2x5mm in a one square metre configuration.

ConverLight® Dynamic has successfully passed the important ISO 18543:2021 aging test. The ISO 18543 test is designed to assess electrochromic glass in buildings by subjecting them to high UV intensity, high temperature, and frequent switching between transparent and dark states. The test result for ConverLight® Dynamic is a RSL of 20 years.

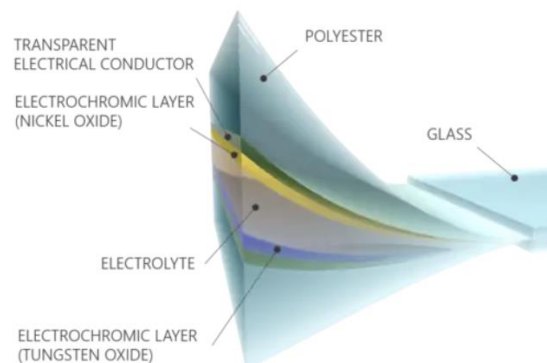
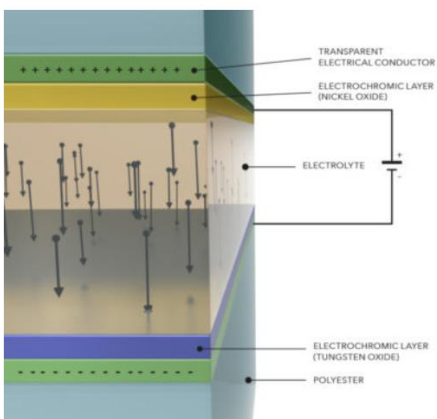
Manufacturing

ChromoGenics state-of-the-art production facility includes climate-stabilized cleanroom facilities, production lines for ConverLight® Dynamic, testing and development facilities.



In 2019 ChromoGenics invested in sputter machines and built a brand new sputtering plant in Uppsala. This factory is unique in its kind for northern Europe and was operational in 2021. The purpose of the new factory was to increase the sustainability of our production by reducing transport, shorten lead times, and get a direct control of the product quality.

The manufacturing of the ConverLight® Dynamic starts with two electrochromic plastic films being produced by sputtering one plastic film with a conductor target and nickel target, and one plastic film with a conductor target and a tungsten target. An electrolyte laminates the two electrochromic films into a flexible and lightweight electrochromic foil, the ConverLight® Interlayer.



The final manufacturing step is to laminate the ConverLight® Interlayer between two panes of heat strengthened flat glass, resulting in the ConverLight Dynamic® product where the ConverLight® Interlayer is fully weather protected.

For the ChromoGenics production processes, a 2% loss factor was added in the modelling.

Packaging and transportation scenario

The ConverLight® Dynamic is transported wrapped in kraft paper and plastic film using cellular plastic to separate the ConverLight Dynamic glass laminates, and plywood as the outer encapsulation of the packaging. The package is put on a recirculated wooden rack which is neither produced nor waste handled in the ConverLight® Dynamic lifecycle, as its impact is considered insignificant. Its weight is added to the transport A4.

The transportation from the production plant's gate to the installation site is done through a distribution circuit: from Uppsala, Sweden, to an Insulating Glass Unit manufacturer (IGU) in Europe (1500 km), and from the IGU manufacturer to a European installation site (100km). The mode of transport is a lorry 16-32 metric ton EURO5 type. The packaging is utilized for transportation to the IGU manufacturer. From the IGU manufacturer to the installation site, the packaging is fully allocated to the IGU.

Installation scenario

The installation is not considering the ancillary elements to install the IGU because there are many different considerations related to the installation in the building according to the c-PCR-009. These ancillary elements will be considered in the scenarios established under the environmental product declaration of the IGU. Glass products are delivered in the final configuration and "ready to install", no waste other than packaging waste is generated.

For the ConverLight® Dynamic, the LCA study has added a 10 minute use of an electric power tool to connect and attach its cabling.

Product use and maintenance scenario

According to the c-PCR-009 the use of the glass products installed in the building generates no environmental impacts. c-PCR-009 stipulates that the only maintenance operation for glass products is cleaning and as a reference, the use of 0,2 l of cleaning solution with 0,01 l detergent per square meter glass and year is to be used. c-PCR-009 also states that repair, replacement, or refurbishment activities of glass products installed in the building are covered in the service life of glass. Operational water use is not applicable for any type of glazing according to c-PCR-009. For active glazing such as the ConverLight® Dynamic, the energy use can be included. The included energy use of the ConverLight® Dynamic is very small, only 0.92 kWh/RSL/m².

End-of-life scenario

The waste handling C-D of the ConverLight® Dynamic glass laminate is designed as 5% closed-loop recycling, according to the scenario description in Annex D of the c-PCR-009, and as 95% landfill. The control unit is 100% recycled as required for E-waste within the EU. From the E-waste, the metals are extracted and smelted, and the remaining plastic waste incinerated.

The waste from the installation site is transported 50 km to a local recycling station for sorting. From the local recycling station, the following average distances are used: a distance of 400km to the flat glass recycling location, a distance of 100km to the landfill, and a distance of 100km to the E-waste recycling location. The C2 lorry transports are modelled as “lorry 16-32 ton, EURO5”.

The scenario for life cycle stage D, Benefits and loads beyond the system boundary, are as described in the table below.

Waste	Waste processing in A5 and C3	Benefits and loads in D
Kraft paper packaging	Paper waste, unsorted, is turned into deinked pulp.	Deinked pulp replaces sulphate pulp.
Wood packaging waste.	Incinerated.	Recovered energy in A5 replaces the production of electricity and heat.
Plastic packaging waste	Incinerated.	Recovered energy in A5 replaces the production of electricity and heat.
Flat glass waste	Glass laminate is shredded, crushed and XRF analysed, resulting in sorted flat glass cullet ready for recycling.	Sorted flat glass cullet replaces flat glass raw materials and reduces energy usage and carbon dioxide emissions from carbonatization and energy use in flat glass production.
PVB waste	PVB is removed in the glass laminate shredding and crushing process, resulting in sorted PVB.	Sorted recycled PVB replaces production of new PVB.
Electronics waste	Treatment processes to extract and smelt the metals from the electronics waste. Plastic waste from industrial electronics is incinerated.	Recycled metals replaces production of new metals, remaining waste goes to energy recovery as heat and electricity.
Sputtered PET foil waste	Incinerated.	Recovered energy in C3 replaces the production of electricity and heat.

Content declaration

Product components	Weight (kg/FU)	Post-consumer material in product, weight-%	Biogenic material in product, weight-%	Biogenic carbon content (kgC)
2x5mm flat glass	2.5e1	0%	0%	0%
ConverLight® Interlayer	5.8e-1	0%	0%	0%
PVB film	1.7e0	0%	0%	0%
Control unit	1.1e-1	0%	0%	0%
Total	2.7e1	0%	0%	0%
Packaging materials	Weight (kg/FU)	Weight-% (versus the product)	Biogenic carbon content in packaging material, weight-%	Biogenic carbon content (kgC)
Paper	1.5e-2	5.5e-4	44%	6.6e-3
Plastic	5.0e-2	1.9e-3	0	0
Wood	7.6e-2	2.8e-3	50%	3.8e-2
Total	1.4e-1			

No dangerous substances from the candidate list of SVHC for Authorisation under the REACH regulations are present in this product either above the threshold for registration with the European Chemicals Agency or above 0.1% (wt/wt).

LCA information

The LCA was carried out by Pia Stoll Konsult AB, Sweden, using openLCA v.2.0.3 software and generic background data were taken from the openLCA Nexus database ecoinvent 3.9.1 EN15804 add-on. The LCA used the tool's EN15804 impact method based on the EN15804 reference package (EF 3.1) that was released Feb.2023 by the EU commission. Specific production data and transportation data for the calendar year 2022 from the ChromoGenics AB Uppsala manufacturing facilities was used.

Functional unit

The functional unit is one square metre (1m²) ConverLight® Dynamic, in the configuration of two panes of 5mm thick heat strengthened glass laminated to the ConverLight® Interlayer electrochromic foil, with a light transmittance of 75% in its brightest stage and heat transfer blockage of 80% in its darkest stage, when built into an insulated glass unit with three sheets of glass.

Reference service Life

The reference service life (RSL), established in an ISO 18543:2021 test, is 20 years.

Geographical scope

The geographical scope of the EPD is Europe, reflecting the region where the majority of suppliers and customers of ChromoGenics' ConverLight® Dynamic are based. Located in Sweden, which is within Europe, the production facility for ConverLight® Dynamic aligns with this focus. Consequently, all transportation, installation, usage, and end-of-life processes for the product are European.

System boundaries

This is an EPD type c, “cradle to grave and module D”, including modules A1-A3, modules A4-A5, modules B1-B7, modules C1–C4, and module D.

	Product stage			Construction /installation stage		Use stage							End of life stage				Benefits and loads beyond the system boundary	
	Raw material supply	Transportation	Manufacturing	Transportation	Construction / installation process	Use	Maintenance (incl. transportation)	Repair (incl. transportation)	Replacement (incl. transportation)	Refurbishment (incl. transportation)	Operational energy use	Operational water use	De-construction demolition	Transportation	Waste processing	Disposal		Reuse / recovery / recycling potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
Modules declared*	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geography	US, CH, Europe (EUR)			EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR	EUR
Variation - products	0%			-	-													
Variation - sites	0%			-	-													
Share of specific data's contribution to GWP-GHG	13%																	

*(X=Declared)

Following c-PCR-009, there are no burdens associated with modules B1, B3, B4, B5, and B7. These modules are marked as included but will receive an impact of zero in the results.

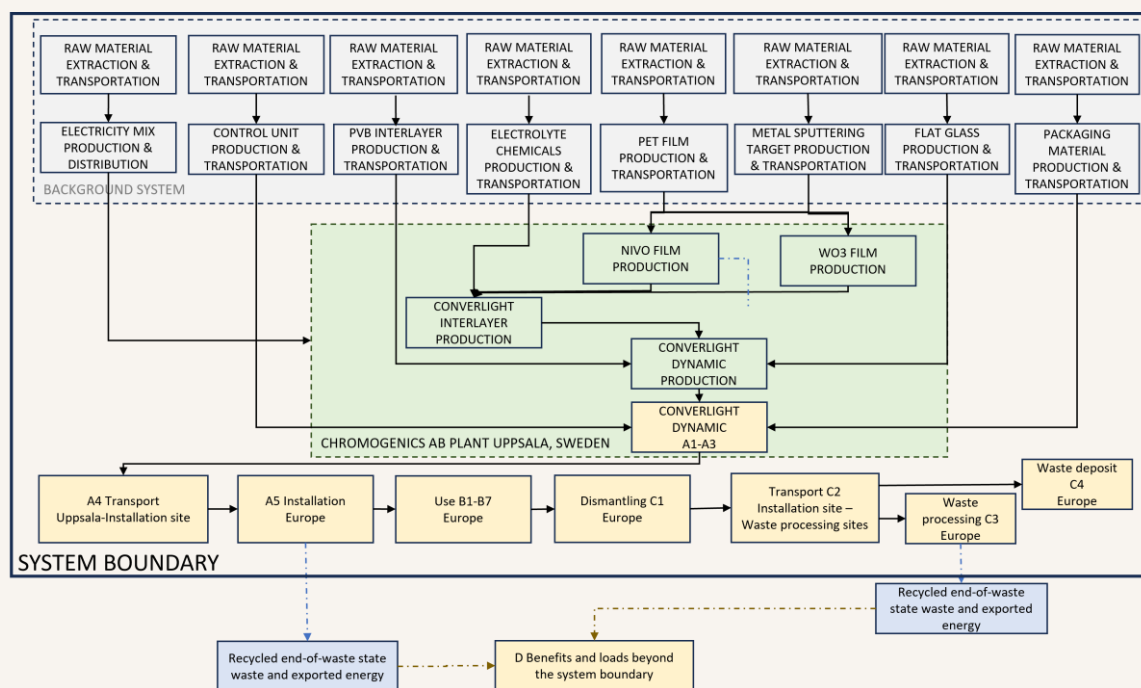
As required by PCR 2019:14 v.1.3.2, modules A1-A3 are declared in aggregated form. No products have been averaged and only one production plant has been used in the LCA study.

The production of the machinery, buildings, and vehicles are included in the generic LCI data, but not in the modelling of the ConverLight® Dynamic production processes in A3 since they are considered as an insignificant contribution to the A1-A3 results over the product's RSL according to the c-PCR-009.

The percentage of the GWP-GHG A1-A3 result from specific data is 13%.

The ConverLight® Dynamic product life cycle covered by this EPD is illustrated in the technical flowchart below, showing the background system consisting of the raw material

suppliers' processes, the ChromoGenics AB manufacturing processes, the waste handling/transportation/installation processes, and the benefits and loads of recycling/reuse/recovery processes.



Data sources and data quality

The specific data provided by ChromoGenics AB refer to the year 2022, the average values represent the annual production 2022 and are scaled to one square meter (1 m²) of ConverLight Dynamic. One proxy was necessary to use for PVB polymer production, which is not part of the generic LCI database ecoinvent v.3.9.1 EN15804 add-on. The proxy was an EVA polymer since PVB and EVA are the most common and widely used two kinds of laminated glass interlayers.

The generic LCI data from the openLCA Nexus EN15804 add-on to ecoinvent v.3.9.1 database is tagged with 2022-12-15 as the last update. The EN15804 add-on for ecoinvent is a database for Environmental Product Declarations (EPDs) developed by GreenDelta GmbH according to the EN15804+A2 norm and is verified by a third party verifier to be compliant with EN15804+A2.

The LCA study estimated the quality values for the LCA study's constructed flows, using the EN15804+A2 Annex E method for geographical, technical, and time representativeness. Overall the quality is "good". The absence of EPDs conforming to the EN15804+A2 standard for the suppliers' materials prevents achieving a 'very good' quality rating.

Cut-off criteria

According to the c-PCR-009, cumulative mass and energy use cut-off shall not exceed 5% per life stage module A, B, C or D.

According to the c-PCR-009, flows related to human activities and the production of plants, machines and transportation systems inside the factories are also excluded since the related flows are assumed to be negligible, compared to the production of glass products when the comparison is done at the timescale of the reference service life of plants, machines, and transportation systems inside the factory. The LCI data in the background system includes the impact of capital goods but does not include personnel activities in the production flows.

The flat glass cullet mass possibly attached to the recycled PVB mass is assumed to be below 1 wt% of C3 and not included. The small amounts of PVB possibly attached to the PET-foil is assumed to be below 1 wt% of C3 and not included.

Allocations

According to the PCR 2019:14 v.1.3.2 and EN 15804+A2, co-allocation should be used for waste that has reached its end of waste state in the modules A1-A3. No benefits and loads from waste processing in A1-A3 are modelled in the D-module. Instead, the economic method and the cost/revenues of the output flow and output waste flow were used to calculate the co-allocation for waste in A1-A3.

Besides co-allocation of end-of waste streams in A1-A3, no co-allocation is used.

Electricity information

The electricity used in ChromoGenics' core processes is modelled using ChromoGenics' supplier's Guarantees Of Origin for the contract's electricity mix. Since final composition of origin type is only documentable after cancellation of certificates for the portfolio's total consumption at the end of the year, the final composition from the year 2022 is used:

- Nuclear power: 55%
- Hydro power: 35%
- Wind power: 7%
- Geothermal power: 2%
- Solar power: 1%

The GWP-GHG impact of the ChromoGenic's supplier's electricity mix is 22 gCO_{2e}/kWh.

Electricity used in background processes and in A5, B6, C1, C3, and D scenario processes, is modelled using the generic market flow data "market group for electricity, low voltage | electricity, low voltage | EN15804, U - ENTSO-E" since ENTSO-E is the EU electricity market.

Impact indicators

The LCA study uses the impact assessment method EN15804+A2 of the openLCA tool, which in its turn uses the CFs of the "EN15805 reference package" based on the EF 3.1 package, released Feb. 2023 by the EU commission.

Core environmental impact (EN15804:2012+A2:2019):

Impact category	Indicator	Unit
Climate change – total	Global Warming Potential (GWP-total)	kg CO ₂ eq.
Climate change – fossil	Global Warming Potential fossil fuels (GWP-fossil)	kg CO ₂ eq.
Climate change – biogenic	Global Warming Potential biogenic (GWP-biogenic)	kg CO ₂ eq.
Climate change – land use and land use change	Global Warming Potential land use and land use change (GWP-luluc)	kg CO ₂ eq.
Ozone depletion	Depletion potential of the stratospheric ozone layer (ODP)	kg CFC11 eq.
Acidification	Acidification potential, Accumulated Exceedance (AP)	mol H ⁺ eq.
Eutrophication aquatic freshwater	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-freshwater)	kg P eq.
Eutrophication aquatic marine	Eutrophication potential, fraction of nutrients reaching freshwater end compartment (EP-marine)	kg N eq.
Eutrophication terrestrial	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	mol N eq.
Photochemical ozone formation	Formation potential of tropospheric ozone (POCP)	kg NMVOC eq.
Depletion of abiotic resources – minerals and metals	Abiotic depletion potential for non-fossil resources (minerals and metals) (ADP-minerals&metals)	kg Sb eq.
Depletion of abiotic resources – fossil fuels	Abiotic depletion potential for fossil resources (ADP-fossil)	MJ
Water use	Water deprivation potential, deprivation weighted water consumption (WDP)	m ³

Additional impact (EN15804:2012+A2:2019):

Impact category	Indicator	Unit
Particulate matter emissions	Potential incidence of disease due to PM emissions (PM)	Disease incidence
Ionizing radiation, human health	Potential Human exposure efficiency relative to U235 (IRP)	kBq U235 eq.
Ecotoxicity (freshwater)	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe
Human toxicity, cancer effects	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh
Human toxicity, non-cancer effects	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh
Land use related impacts / soil quality	Potential Soil Quality index (SQP)	dimensionless

GWP-GHG

In addition to the EN15804+A2 impact categories, the PCR 2019:14 v1.3.2 requires the GWP-GHG to be calculated and reported. The GWP-GHG calculation is described by PCR 2019:14 v 1.3.2 as shown below. The GWP-GHG result is achieved by adding the LCA tools' GWP fossil and GWP biogenic results, with the characterization factor (CF) of biogenic carbon dioxide set to zero.

Characterization factors (CF) for GWP-GHG

PCR 2019:14 and EN 15804+A2 (based on EF 3.1)			
kg CO ₂ e/kg	GWP fossil	GWP biogenic	GWP-GHG
CO ₂ fossil	1	0	1
CO ₂ biogenic	0	0*	0
CH ₄ fossil	29.8	0	29.8
CH ₄ biogenic and CH ₄ non-fossil	0	27*	27*
N ₂ O	273	0	273

*CFs according to the EF 3.1 EN15804 package released Feb. 2023 by the EU commission.

GWP biogenic calculations

In order to calculate the GWP biogenic according to PCR 2019:14, the CF for biogenic CO₂ was set to zero and the biogenic CO₂ uptake and emissions of packaging and product added manually according to the table below. Biogenic methane emissions are reported as calculated by the LCA tool.

Manually added biogenic carbon dioxide uptake and emissions for packaging and product.

CO ₂ biogenic	A1	A3	A5	C3	Unit
A1 packaging	6.2e-2	-6.2e-2	0	0	kgCO ₂ eq.
A3 packaging	0	1.6e-1	-1.4e-1	-1.2e-2*	kgCO ₂ eq.
ConverLight® Dynamic	0	0	0	0	kgCO ₂ eq.

*Virtual, since the paper packaging waste is recycled several times outside the system boundary.

Primary energy, Resources, Waste, and Output flows

PCR 2019:14 requires the Primary energy indicator impacts to be reported and c-PCR 009 requires in addition that the use of resources, waste and output flows are reported.

PCR 2019:14 v.1.3.2 Impact category	PCR 2019:14 v.1.3.2 Indicator	Unit
Primary energy	Non-renewable (energy use) (PENRE)	MJ
Primary energy	Non-renewable (material use) (PENRM)	MJ
Primary energy	Non-renewable (total) (PENRT)	MJ
Primary energy	Renewable (energy use) (PERE)	MJ
Primary energy	Renewable (material use) (PERM)	MJ
Primary energy	Renewable (total) (PERT)	MJ

Primary energy, Resources, Waste, and Output flow indicators are not represented as impact categories in the LCA tool's impact method EN15804+A2 method based on the EN15804 package released by the EU commission, which in its turn is based on the EF 3.1 package released by the EU commission in Feb 2023.

Instead these impact categories' results are based on the LCA tool's EN15804+A2 impact method using the ecoinvent 3.9.1 EN15804 addon database release June 2023.

c-PCR 009 Impact category	c-PCR 009 Indicator	Unit
Resources	Net use of fresh water (FW)	m ³
Resources	Non-renewable secondary fuels (NRSF)	MJ
Resources	Renewable secondary fuels (RSF)	MJ
Resources	Secondary materials (SM)	kg
c-PCR 009 Impact category	c-PCR 009 Indicator	Unit
Waste	Hazardous waste disposed (HWD)	kg
Waste	Non-hazardous waste disposed (NHWD)	kg
Waste	Radioactive waste disposed (RWD)	kg
c-PCR 009 Impact category	c-PCR 009 Indicator	Unit
Output flow	Components for reuse (CRU)	kg
Output flow	Exported energy (electrical) (EEE)	MJ
Output flow	Exported energy (thermal) (EET)	MJ
Output flow	Materials for energy recovery (MER)	kg
Output flow	Materials for recycling (MFR)	kg

Environmental Performance Results

The use of the results of modules A1-A3 without considering the results of module C is discouraged. The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

EN15804+A2 Core environmental impact assessments

Life cycle impact assessment per indicator and module and per functional unit																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-total	kgCO ₂ eq.	5,2E+01	8,5E+00	-4,7E-02	0,0E+00	6,9E-01	0,0E+00	0,0E+00	0,0E+00	3,2E-01	0,0E+00	3,2E-03	8,5E-01	3,1E-01	0,0E+00	-6,9E-01
GWP-fossil	kgCO ₂ eq.	5,1E+01	8,5E+00	8,2E-02	0,0E+00	6,5E-01	0,0E+00	0,0E+00	0,0E+00	3,1E-01	0,0E+00	3,2E-03	8,5E-01	3,2E-01	0,0E+00	-6,8E-01
GWP-biogenic	kgCO ₂ eq.	4,6E-01	2,7E-03	-1,3E-01	0,0E+00	2,1E-03	0,0E+00	0,0E+00	0,0E+00	1,9E-03	0,0E+00	1,8E-05	2,7E-04	-1,2E-02	0,0E+00	-2,0E-03
GWP-luluc	kgCO ₂ eq.	5,0E-02	4,1E-03	1,4E-04	0,0E+00	4,7E-02	0,0E+00	0,0E+00	0,0E+00	8,3E-04	0,0E+00	7,8E-06	4,1E-04	6,2E-05	0,0E+00	-8,4E-04
ODP	kg CFC 11 eq.	1,0E-05	1,9E-07	3,6E-10	0,0E+00	5,4E-08	0,0E+00	0,0E+00	0,0E+00	6,1E-09	0,0E+00	6,4E-11	1,9E-08	6,2E-10	0,0E+00	-1,5E-08
AP	mol H+ eq.	6,3E-01	2,8E-02	1,1E-04	0,0E+00	4,7E-03	0,0E+00	0,0E+00	0,0E+00	1,7E-03	0,0E+00	2,0E-05	2,8E-03	2,3E-04	0,0E+00	-8,5E-03
EP-freshwater	kg P eq.	2,0E-02	6,0E-04	9,4E-06	0,0E+00	2,4E-04	0,0E+00	0,0E+00	0,0E+00	3,1E-04	0,0E+00	3,0E-06	6,0E-05	1,6E-05	0,0E+00	-8,2E-04
EP-marine	kg N eq.	1,2E-01	9,6E-03	1,6E-04	0,0E+00	1,4E-03	0,0E+00	0,0E+00	0,0E+00	3,1E-04	0,0E+00	3,2E-06	9,6E-04	7,4E-05	0,0E+00	-8,6E-04
EP-terrestrial	mol N eq.	1,4E+00	1,0E-01	3,1E-04	0,0E+00	1,0E-02	0,0E+00	0,0E+00	0,0E+00	2,5E-03	0,0E+00	3,2E-05	1,0E-02	6,7E-04	0,0E+00	-9,8E-03
POCP	kg NMVOC eq.	3,8E-01	4,1E-02	9,8E-05	0,0E+00	2,9E-03	0,0E+00	0,0E+00	0,0E+00	8,0E-04	0,0E+00	8,5E-06	4,1E-03	2,0E-04	0,0E+00	-3,1E-03
ADP minerals & metals ^{2,3}	kg Sb eq.	2,6E-03	2,8E-05	1,5E-07	0,0E+00	8,2E-06	0,0E+00	0,0E+00	0,0E+00	4,0E-06	0,0E+00	8,4E-08	2,8E-06	1,2E-07	0,0E+00	-1,5E-04
ADP fossil ²	MJ, net caloric value	1,9E+03	1,1E+02	2,0E-01	0,0E+00	1,0E+01	0,0E+00	0,0E+00	0,0E+00	7,1E+00	0,0E+00	6,6E-02	1,1E+01	5,4E-01	0,0E+00	-1,4E+01
WDP ²	m ³	-2,6E+02	-2,5E+00	-3,7E-02	0,0E+00	-1,5E+00	0,0E+00	0,0E+00	0,0E+00	-2,1E+00	0,0E+00	-1,9E-02	-2,5E-01	-9,2E-02	0,0E+00	4,5E+00

Reading example: 1,0 E-03 = 1,0*10⁻³ = 0,00

^{1,2,3}See notes on next page.

EN15804+A2 Additional impact assessments

Life cycle impact assessment per indicator and module																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PM	disease incidence	8,5E-06	6,8E-07	2,8E-09	0,0E+00	5,0E-08	0,0E+00	0,0E+00	0,0E+00	6,7E-09	0,0E+00	9,4E-11	6,8E-08	1,5E-09	0,0E+00	-3,4E-08
IRP ¹	kBq U235 eq.	6,8E+01	1,6E-01	2,7E-03	0,0E+00	4,5E-02	0,0E+00	0,0E+00	0,0E+00	2,0E-01	0,0E+00	1,8E-03	1,6E-02	7,5E-03	0,0E+00	-1,2E-01
ETP ^{2,3} - fw	CTUe	5,7E+02	6,0E+01	4,8E-01	0,0E+00	1,2E+01	0,0E+00	0,0E+00	0,0E+00	1,2E+00	0,0E+00	1,6E-02	6,0E+00	1,9E+00	0,0E+00	-1,6E+01
HTP ^{2,3} - c	CTUh	4,8E-08	3,9E-09	5,4E-11	0,0E+00	5,6E-10	0,0E+00	0,0E+00	0,0E+00	1,6E-10	0,0E+00	2,1E-12	3,9E-10	8,8E-10	0,0E+00	-1,2E-09
HTP ^{2,3} - nc	CTUh	2,6E-06	8,6E-08	6,0E-10	0,0E+00	1,2E-08	0,0E+00	0,0E+00	0,0E+00	6,4E-09	0,0E+00	8,0E-11	8,6E-09	5,5E-08	0,0E+00	-8,8E-08
SQP ²	Dimension less	3,3E+03	7,2E+01	9,2E-02	0,0E+00	8,9E+00	0,0E+00	0,0E+00	0,0E+00	1,5E+00	0,0E+00	1,4E-02	7,2E+00	1,3E-01	0,0E+00	-7,2E+00

¹This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, from radon, and from some construction materials is also not measured by this indicator.

²The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

³The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, noncancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological, and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes

PCR 2019:14 v.1.3.2 GWP-GHG impact assessment

The GWP-GHG indicator is identical to GWP-total except that the characterisation factor (CF) for biogenic CO₂ is set to zero. This means that the uptake and emissions of biogenic CO₂ are “balanced out” already in modules A1-A3, instead of in modules A1-A5 (for packaging) or modules A-C (for product). The results over the entire product life cycle, from module A to C, are thus identical for GWP-GHG and GWP-total.

GWP-GHG																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP-GHG	kgCO ₂ eq.	5,2E+01	8,5E+00	9,3E-02	0,0E+00	6,5E-01	0,0E+00	0,0E+00	0,0E+00	3,1E-01	0,0E+00	3,2E-03	8,5E-01	3,2E-01	0,0E+00	-6,9E-01

PCR 2019:14 v.1.3.2 Primary energy impact assessments

Primary energy																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Non-renewable (energy use) (PENRE)	MJ	1,9E+03	1,1E+02	2,0E-01	0,0E+00	1,0E+01	0,0E+00	0,0E+00	0,0E+00	7,1E+00	0,0E+00	6,6E-02	1,1E+01	5,4E-01	7,7E+01	-1,4E+01
Non-renewable (material use) (PENRM)	MJ	7,6E+01	0,0E+00	-1,1E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	-3,8E+00	-7,1E+01	0,0E+00
Non-renewable (total) (PENRT)	MJ	1,9E+03	1,1E+02	-8,8E-01	0,0E+00	1,0E+01	0,0E+00	0,0E+00	0,0E+00	7,1E+00	0,0E+00	6,6E-02	1,1E+01	-3,2E+00	5,7E+00	-1,4E+01
Renewable (energy use) (PERE)	MJ	8,2E+02	1,9E+00	2,9E-02	0,0E+00	3,8E+00	0,0E+00	0,0E+00	0,0E+00	1,7E+00	0,0E+00	1,5E-02	1,9E-01	6,8E-02	7,6E-02	-1,8E+00
Renewable (material use) (PERM)	MJ	1,5E+00	0,0E+00	-1,3E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	-2,4E-01	0,0E+00	0,0E+00
Renewable (total) (PERT)	MJ	8,2E+02	1,9E+00	-1,3E+00	0,0E+00	3,8E+00	0,0E+00	0,0E+00	0,0E+00	1,7E+00	0,0E+00	1,5E-02	1,9E-01	-1,7E-01	7,6E-02	-1,8E+00

c-PCR 009 Resources, Waste, and Output flows impact assessments

Use of Resources																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Net use of fresh water (FW)	m ³	7,2E-01	1,5E-02	2,3E-04	0,0E+00	2,1E-02	0,0E+00	0,0E+00	0,0E+00	6,1E-03	0,0E+00	5,8E-05	1,5E-03	5,5E-04	0,0E+00	-1,0E-02
Non-renewable secondary fuels (NRSF)	MJ	1,6E+00	7,0E-02	8,2E-04	0,0E+00	3,9E-02	0,0E+00	0,0E+00	0,0E+00	5,9E-02	0,0E+00	5,2E-04	7,0E-03	2,3E-03	0,0E+00	-4,1E-02
Renewable secondary fuels (RSF)	MJ	5,1E-01	3,6E-02	6,3E-04	0,0E+00	6,8E-03	0,0E+00	0,0E+00	0,0E+00	5,9E-02	0,0E+00	5,2E-04	3,6E-03	1,9E-03	0,0E+00	-3,1E-02
Secondary materials (SM)	kg	1,3E+00	1,3E-01	1,7E-02	0,0E+00	4,3E-02	0,0E+00	0,0E+00	0,0E+00	1,0E-01	0,0E+00	9,1E-04	1,3E-02	5,6E-02	0,0E+00	-6,2E-02

Waste																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste disposed (HWD)	kg	1,8E+00	1,1E-01	1,6E-03	0,0E+00	3,1E-02	0,0E+00	0,0E+00	0,0E+00	6,5E-03	0,0E+00	8,9E-05	1,1E-02	3,7E-02	0,0E+00	-3,5E-02
Non-hazardous waste disposed (NHWD)	kg	6,6E+00	5,8E+00	4,7E-02	0,0E+00	8,7E-02	0,0E+00	0,0E+00	0,0E+00	2,3E-02	0,0E+00	2,2E-04	5,8E-01	7,2E-03	0,0E+00	-4,3E-02
Radioactive waste disposed (RWD)	kg	1,6E-02	3,9E-05	6,7E-07	0,0E+00	1,1E-05	0,0E+00	0,0E+00	0,0E+00	5,2E-05	0,0E+00	4,6E-07	3,9E-06	1,9E-06	0,0E+00	-3,0E-05

Output flows																
Indicator	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for reuse (CRU)	kg	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00
Exported energy (electrical) (EEE)	kg	0,0E+00	0,0E+00	1,2E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	1,7E+00	0,0E+00	0,0E+00
Exported energy (thermal) (EET)	kg	0,0E+00	0,0E+00	1,2E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	1,7E+00	0,0E+00	0,0E+00
Materials for energy recovery (MER)	kg	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00
Materials for recycling (MFR)	kg	0,0E+00	0,0E+00	1,5E-02	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	0,0E+00	1,4E+00	0,0E+00	0,0E+00

Additional information

For more information on ChromoGenics AB environmental and sustainability work, visit <https://chromogenics.com/environment-quality/environment/>.

For more information on ChromoGenics AB quality work, visit <https://chromogenics.com/environment-quality/quality/>.

You can learn more about the ChromoGenics different projects in the office sector, residential sector, and hospitality sector at <https://chromogenics.com/our-cases/>.

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