EPD Steel/stainless steel windows

Environmental **P**roduct **D**eclaration
Acc. to ISO 14025 and EN 15804

Steel/stainless steel windows

Jansen AG
CH-9463 Oberriet

model-EPD -
as a basis for issuing EPDs for window manufacturers in accordance with the scope

Declaration code
M-EPD-SFE-GB-000003

Note: This EPD based on the model-EPD Steel/stainless steel windows

Environmental Product Declaration in accordance with ISO 14025 and EN 15804

Steel/stainless steel windows

Summary

Programme operator	**ift Rosenheim GmbH** Theodor-Gietl-Strasse 7-9 D-83026 Rosenheim
Holder of the declaration	Jansen AG Industriestraße 34 CH-9463 Oberriet SG
Declaration code	M-EPD-SFE-GB-000003
Designation of declared product	Steel/stainless steel windows
Scope	Steel/stainless steel windows for use in office and administration buildings as well as public buildings and for residential applications

LCA results per m² window		Manufacture A1 – A5	Use B1 – B7	End-of-Life C1 – C4	Recycling potential D
Primary energy – non-renewable ($PE_{n\ renw}$) in MJ		1,930.00	B1: 7,680.00 B2-B7: 720.00	32.70	-660.00
Primary energy – renewable (PE_{renw}) in MJ		168.00	B1: 37.10 B2-B7: 36.70	4.97	-3.47
Global warming potential (GWP 100) in kg CO_2-equiv.		115.00	B1: 469.00 B2-B7: 43.00	2.01	-46.00
Ozone depletion potential (ODP) in kg R11 -equiv.		1.04E-06	B1: 1.30E-08 B2-B7: 2.27E-07	1.19E-09	1.69E-10
Acidification potential (AP) in kg SO_2-equiv.		0.63	B1: 0.39 B2-B7: 0.32	0.01	-0.33
Eutrophication potential(EP) in kg PO_4^{3-}-equiv.		0.05	B1: 0.05 B2-B7: 0.03	9.92E-04	-0.02
Photochemical ozone creation potential (POCP) in kg C_2H_4-equiv.		0.04	B1: 0.07 B2-B7: 0.02	-4.90E-04	-0.03
Abiotic depletion potential (elements) ($ADP_{el.}$) in kg Sb-equiv.		4.15E-03	B1: 1.30E-08 B2-B7: 1.43E-03	2.39E-07	-9.69E-05
Abiotic depletion potential (fossil) (ADP_{fos}) in MJ		1,930.00	B1: 7,680.00 B2-B7: 720	32.60	-660.00
Water consumption in m³		213.00	B1: 48.00 B2-B7: 41.30	7.11	-3.08

Prof. Ulrich Sieberath
Director of Institute, ift Rosenheim GmbH

Patrick Wortner, Dipl.-Ing. (FH)
Verifier

Basis

- EN ISO 14025:2011
- EN 15804:2012

Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen (Guidance on preparing Type III Environmental Product Declarations).

This Declaration is based on the PCR document ""Windows" PCR-FE-1.1 : 2011

Validity

This verified Environmental Product Declaration applies solely to the specified products and is valid for a period of 5 years from the date of issue. The declaration holder assumes full liability for the underlying data, certificates and verifications.

Date created:
01 November 2012

Date of issue:
01 xxx 2013

Next revision:
01 November 2017

LCA basis

The LCA was prepared in accordance with EN ISO 14040 and EN ISO 14044. The base data include both the average of the data collected at various manufacturing plants as well as generic data from the "GaBi 5" data base. LCA calculations were based on the "cradle to grave" life cycle including all upstream processes (e.g. raw material extraction, etc.).

Notes on publication

The "Conditions and Guidance on the Use of **ift** Test Documents" apply.

Environmental Product Declaration in accordance with ISO 14025 and EN 15804

Steel/stainless steel windows

Detailed version

1 Product definition

Product definition

This EPD applies to **steel/stainless steel windows** as per EN 14351-1 regardless of their dimensions. LCA calculations were based on the standard dimensions of 1.23 m x 1.48 m as defined in EN 14351-1.

Product description:

Profile system	Steel profile with and without thermal break, rebate insulation; Total installation depth 50 to 120 mm, or up to 220 mm for lift and slide doors (depth of frame member plus casement/sash overlap)**.**
System supplier	**Forster Rohr- & Profiltechnik AG, Jansen AG and RP Technik GmbH Profilsysteme**.
Type of opening / opening direction	All types of openings incl. fixed light
Frame material	Steel/stainless steel, with and without thermal break made of polyamide, polypropylene, ABS, GRP / stainless steel,
Overall dimensions of frame member	Regardless of dimensions

Rebate design

Rebate seal/gasket (hardware)

Centre/ internal	Seal/gasket made of EPDM or CR or TPE or TPV or silicone
External	Seal/gasket made of EPDM or CR or TPE or TPV or silicone

Surface coating

Type	Powder coated, wet paint, mechanical surface treatment, anodic oxidation

Infill panel

Type	Single glass or insulating glass unit - double or triple in accordance with EPD for insulating glass units. TSG/LSG in accordance with EPD for float glass/TSG/LSG or opaque infill panels, respectively. Fire resistant windows require fire-resistant glass for classes E/EW

Mounting of infill panels

Glazing gasket

External	Sealing material made of silicone or EPDM/TPE/TPV
Internal	Gunned silicone sealant or sealing material made of EPDM/TPE/TPV

Hardware

Type	Hardware in accordance with EPD for window hardware

This EPD does not apply to:

- Roof windows because of significant design differences between the declared windows and roof windows
- Structural glazing

Additional building components such as external / internal shutter for e. g. roller shutters, solar protection devices, roller shutter boxes must be considered separately

Additional information for the architect:

- Face width of frame: approx. 40 mm up to 160 mm and up to 220 mm for lift and slide doors
- Seal/gasket: central seal/gasket and if applicable, internal overlap seal/gasket, additional external seal/gasket possible

In addition observe the system descriptions provided by the manufacturer.

Application Steel windows as per EN -14351-1 for use in residential and non-residential buildings

Quality assurance (optional) The following verifications are held:

- Performance characteristics as per EN 14351-1
- Quality assurance as per RAL-GZ 695

Additional Information For detailed structural characteristics refer to the CE marking and the documents accompanying the product.

2 Materials used

2.1 Primary materials

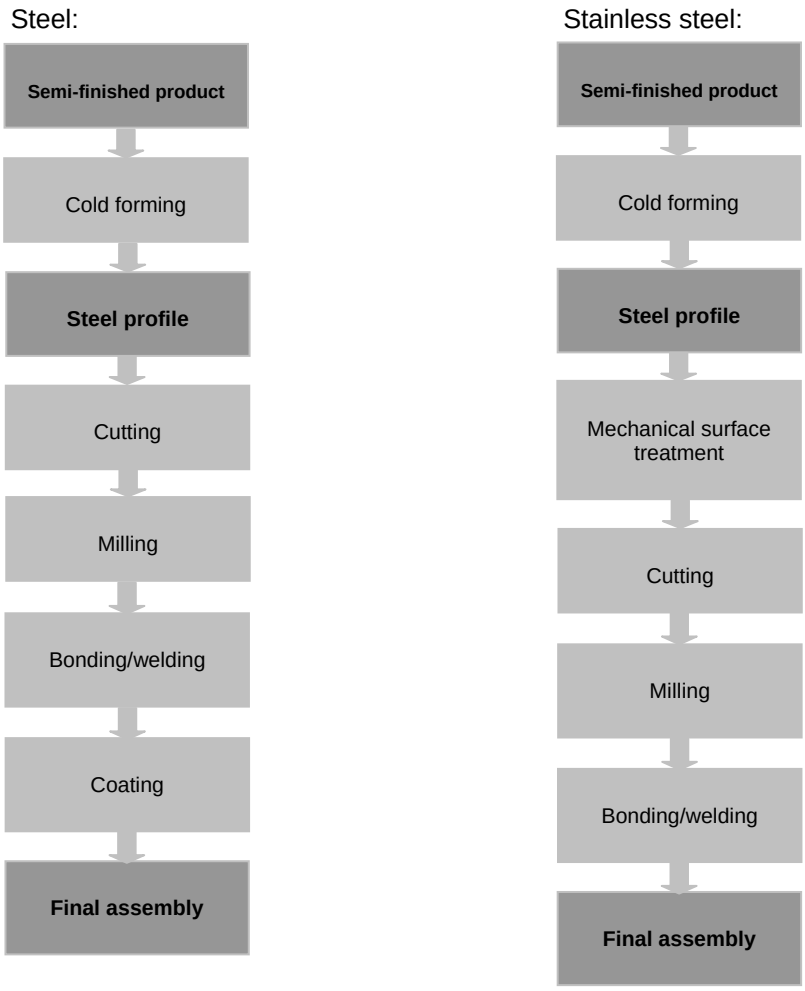
Primary materials The primary materials used are listed in the LCA (see Section 7).

2.2 Declarable substances

Declarable substances In accordance with the REACH candidate list, no substances of very high concern are contained.

3 Product stage

Product manufacture



4 Construction process stage

Processing recommendations, installation

Planning and execution/details of assembly/installation are state-of-the art. (e. g. in accordance with RAL- Leitfaden zur Planung und Ausführung der Montage von Fenstern und Haustüren [RAL-Guide to planning and installation of windows and entry doors]). Observe the information and recommendations given in the system descriptions / accompanying documents provided by the manufacturer.

5 Use stage

Emissions to the environment

Steel windows are not known to have an increased impact on the environment/health.

Reference service life (RSL)

A reference service life of 50 years as per table "Nutzungsdauer von Bauteilen" (service life of building components) from the information platform "Nachhaltiges Bauen – Baustoff- und Gebäudedaten –mittlerer Wert" (sustainable construction - building materials and building data) (mean value) has been specified for steel windows. Here the following applies:
"The data sets of the given table cannot include all the different influential factors relevant to the replacement cycles of building components (built conditions, climatic influences, wear, maintenance concepts, etc.). Neither can all the different building component variants and grades/properties, e.g. anodised film thicknesses, etc. be shown in detail. No sufficient data are available yet in some instances, and extreme differentiation would counteract the goal of an applicable table to be used without too much effort."
For the reference service life the following characteristics apply:

- Declared product characteristics: refer to product definition
- Application parameters for the construction: refer to processing recommendations, additional information
- Expected quality of workmanship: refer to processing recommendations, application
- External conditions: no impacts are known that could have a negative effect on the reference service life
- Internal conditions: no impacts are known that could have a negative effect on the reference service life
- Conditions of use: refer to Annex scenarios The reference service life solely applies to the specified conditions of use
- Maintenance: refer to scenario B2

The service life solely applies to the characteristics specified in this EPD or corresponding references, respectively.

6 End-of-life stage

Possible end-of-life stages

The steel windows are shipped to central collection points. The window is shredded and sorted into its original pure components.

Steel can be recycled over and over again. All other material e. g. plastics or glass are recycled through the respective channels.

Disposal routes

The LCA includes the average disposal routes.

All life cycle scenarios are detailed in the Annex.

7 Life Cycle Assessment (LCA)

Environmental product declarations are based on life cycle analyses (LCAs) which use material and energy flows for the calculation and subsequent representation of environmental impacts.

As the basis for this, an LCA was prepared for steel windows. The LCA was developed in accordance with EN 15804 and the requirements set out by the international standards DIN EN ISO 14040, DIN EN ISO 14044, ISO 21930 and EN ISO 14025.

The LCA is representative of the products presented in the Declaration and the specified reference period.

The Declaration covers a life cycle of 1 m² window.
Steel windows based on standard dimensions 1.23 x 1.48 m.

7.1 Definition of goal and scope

Goal

The goal of the LCA is to demonstrate the environmental impacts of steel doors. As set out by EN 15804 the environmental impacts covered by the Environmental Product Declaration are presented in the form of basic information. The specified environmental impacts are as follows:

- Primary energy demand (renewable and non-renewable)
- Global Warming Potential (GWP)
- Acidification Potential (AP)
- Ozone depletion potential (ODP)
- Eutrophication Potential (EP)
- Photochemical Ozone Creation Potential (POCP)
- Abiotic Depletion Potential elements ($ADP_{elements}$)
- Abiotic Depletion Potential fossil (ADP_{fossil})
- Water consumption (WD)

They are specified for the entire life cycle of 1 m² steel/stainless steel tubular frame door. Apart from these no other environmental impacts have been specified/presented.

Data quality and data availability

The base data were collected at various manufacturer plants. They represent the typical data of this industry. The values were averaged on the basis of weighted production volumes. The glass data originate from the EPDs for float glass/TSG/LSG or the EPD for insulating glass units , respectively.
The data used are less than 5 years old.
The life cycle to illustrate the production and recycling of steel windows was modelled using the sustainability software tool “GaBi 5“, developed by PE INTERNATIONAL GmbH. All background data sets relevant to window production originate from the database of the GaBi 5 software.

Geographical and time-related system boundaries

The data used for the essential parts of this LCA originate mainly from the years 2011 and 2012 and refer only to Europe as the geographical area.

Scope and system boundaries

The Life Cycle Analysis for steel windows covers all life cycle stages (cradle to grave), i.e. manufacture, use and end-of-life.)

Cut-off criteria

All data from the company data collected i.e. all commodities/input and raw materials used, the thermal energy used as well as electricity consumption were taken into consideration.

The boundaries cover only the production-relevant data. Building sections/parts of facilities that are not relevant to the manufacture of the product were excluded.

The transport distances of primary materials are included as generic values.

It can be assumed that the total of negligible processes per life cycle stage does not exceed 5 percent. The life cycle calculation also includes material and energy flows that account for less than 1 percent.

7.2 Inventory analysis

Goal

All material and energy flows are described below. The processes covered are presented as input and output parameters and refer to the declared/functional units.

The models of the unit processes used for the LCA have been documented in a transparent manner.

Life cycle stages

The Annex depicts the entire life cycle of steel windows as follows: product stage A1-A3, construction process stage A4-A5, use stage B1 - B7, end-of-life stage C1 - C4 and benefits and loads beyond the system boundaries D.

Benefits

The recycling potential is calculated from the energy obtained from the incineration of seals/gaskets and thermal breaks (energy mix and heat from natural gas firing), the recycled materials and the re-use of glass shards. Glass shards replace primary raw materials for the production of container glass or glass wool.

Allocation procedures Allocation of co-products

Allocations do not need to be performed for the production of steel windows.

Allocations for re-use and recycling

If steel windows are re-used/recycled in the manufacturing process (rejects) they are shredded and then sorted into their original pure components as necessary. This is realised by different process plants e.g. magnetic separators.

Allocations based on life cycle boundaries

Use of recycled materials in the manufacturing process was based on the current market-specific situation. In parallel to this, a recycling potential was taken into consideration that reflects the economic value of the product after recycling (recyclate). The system boundary set for the recycled material refers to collection.

Secondary materials

Secondary materials were included in the benefits.

- Open loop (waste recycled into new products)

Inputs

The LCA includes the production-relevant inputs per m² window given below:

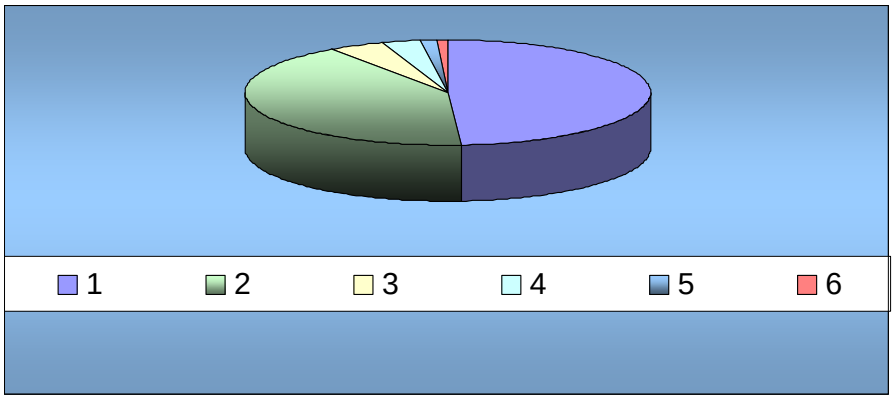
Energy:

The electricity mix is based on European electricity mix.
Gas is based on European natural gas.

Water:

The water consumed by the individual process steps for the manufacture of windows amounts to a total of 0.4 l per m² window.

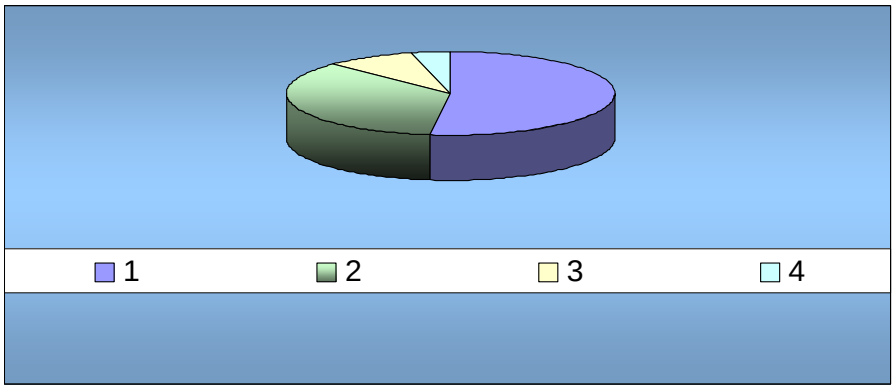
Raw material/primary materials:



No.	Material	Mass in %
1	Steel profile	49.0 %
2	Insulating glass unit	41.3 %
3	Thermal insulation	4.4 %
4	Hardware	2.9 %
5	Seals/gaskets:	1.6 %
6	Other materials	< 1.0 %

Ancillary materials:

The following amount of ancillary materials is required for 1 m² window. - share in % is given below:



No.	Material	Mass in %
1	Welding wire	51.9 %
2	Cleaning agent	35.4 %
3	Lubricants	8.8 %
4	Other	3.9 %

Outputs

Generated waste:

Refer to Section 7.3 - Impact assessment

Waste water:

0.4 l waste water is produced during the manufacture of windows.

7.3 Impact assessment

Goal

Impact assessment covers inputs and outputs. The impact categories applied are set out below:

LCA results per m² steel window	Unit	A1 – A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Environmental impacts																
Global warming potential (GWP 100)	kg CO_2-equiv.	111.11	4.11	-	469	2.65	40.20	-	-	-	-	-	0.66	1.35	-	-46.00
Ozone depletion potential (ODP)	kg R11-equiv.	1.04E-06	-2.39E-10	-	1.30E-08	1.26E-09	2.26E-07	-	-	-	-	-	1.15E-11	1.18E-09	-	1.69E-10
Acidification potential of soil and water (AP)	kg SO_2-equiv.	0.61	0.01	-	0.39	7.94E-03	0.31	-	-	-	-	-	2.85E-03	7.66E-03	-	-0.33
Eutrophication potential(EP)	kg PO_4^{3-}-equiv.	0.05	3.29E-03	-	0.05	1.25E-03	0.03	-	-	-	-	-	6.53E-04	3.39E-04	-	-0.02
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	0.04	-4.70E-03	-	0.07	7.03E-04	0.02	-	-	-	-	-	-9.15E-04	4.25E-04	-	-0.03
Abiotic depletion potential - non-fossil resources (ADP - elements)	kg Sb-equiv.	4.15E-03	1.33E-07	-	1.82E-05	2.07E-05	1.41E-03	-	-	-	-	-	2.46E-08	2.14E-07	-	-9.69E-05
Abiotic depletion potential - fossil resources (ADP – fossil fuels)	MJ	1,890.00	39.70	-	7,680.00	45.60	673.00	-	-	-	-	-	9.150	23.50	-	-660.00
Use of resources	**Unit**	**A1 – A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Use of renewable primary energy resources used as raw material (material use)	MJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	168.00	0.65	-	37.10	4.78	31.80	-	-	-	-	-	0.36	4.61	-	-3.47
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Use of non-renewable primary energy resources used as raw material (material use)	MJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	1,890.00	39.70	-	7,680.00	45.70	674.00	-	-	-	-	-	9.15	23.60	-	-660.00
Use of secondary materials	kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Use of renewable secondary fuels	MJ	1.57E-04	1.48E-04	-	0.07	3.71E-03	7.22E-03	-	-	-	-	-	5.78E-05	5.40E-04	-	0.51
Use of non-renewable secondary fuels	MJ	6.54E-04	1.54E-03	-	0.76	0.04	0.07	-	-	-	-	-	6.06E-04	5.66E-03	-	5.32
Use of net fresh water	m³	214.00	-1.65	-	48.00	5.64	35.60	-	-	-	-	-	0.04	7.07	-	-3.08

LCA results per m² steel window	Unit	A1 – A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Waste categories																
Hazardous waste disposed	kg	0.05	-	-	-	-	0.07	-	-	-	-	-	-	-	-	-
Non hazardous waste disposed	kg	329.00	1.24	-	52.90	8.78	106.00	-	-	-	-	-	0.03	14.30	-	-264.00
Radioactive waste disposed	kg	0.10	-8.21E-04	-	0.03	3.40E-03	0.02	-	-	-	-	-	1.27E-05	3.43E-03	-	2.23E-03
Output material flows	**Unit**	**A1 – A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use	kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Materials for recycling	kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Materials for energy recovery	kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exported energy	MJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Values that cannot be shown or are inexistent or marginal, are expressed as [**-**].

7.4 Interpretation, LCA presentation and critical verification

Interpretation

The environmental impacts presented here are suitable for the certification of buildings.

Report

The LCA report was prepared in accordance with the requirements of EN ISO 14040, EN ISO 14044, EN 15804 and EN ISO 14025.

The results of the study are not designed to be used for comparative statements intended for publication.

The results and conclusions reported to the target group are complete, correct, without bias and transparent.

The report is not addressed to third parties due to confidential information contained in the report.

Critical verification

The LCA was critically verified by Mr Patrick Wortner, independent **ift** verifier.

8 General information regarding the EPD

Comparability

This EPD was prepared in accordance with EN 15804 and is therefore only comparable to those EPDs that also comply with EN 15804.

For a comparison of EPDs for construction products the rules as per EN 15804 (Clause 5.3) apply.

Communication

The communications format of this EPD meets the requirements of EN 15942:2011 and is therefore the basis for B2B communication. Only the nomenclature has been changed according to EN 15804.

Verification

Verification of the Environmental Product Declaration is documented in accordance with the **ift** gudiline "Richtlinie zur Erstellung von Typ III Umweltproduktdeklarationen" (Guidance on preparing Type III Environmental Product Declarations) in accordance with the requirements set out by EN ISO 14025.

This Declaration is based on the **ift** PCR document “Fenster” (Windows) PCR-FE-1.1 : 2010

The European standard EN 15804 serves as the core PCR[a]
Independent verification of the declaration according to EN ISO 14025:2010 ☒ internal ☐ external
Independent third party verifier Patrick Wortner
[a] Product category rules

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Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnlichen Vorgängen, (Law on harmful environmental impacts by air contamination, noise, vibrations and similar processes), 26 September 2002 (BGBl. I S. 3830)

[28] Chemikaliengesetz – ChemG (Chemicals Act)
Gesetz zum Schutz vor gefährlichen Stoffen (Law on Protection against hazardous substances)
Subdivided into Chemicals Law and a series of regulations; of relevance here: Gesetz zum Schutz vor gefährlichen Stoffen (Law on Protection against hazardous substances), 2 July 2008 (BGBl. I S.1146)

[29] Chemikalien-Verbotsverordnung – ChemVerbotsV (Chemicals Prohibition Regulation)
Verordnung über Verbote und Beschränkungen des Inverkehrbringens gefährlicher Stoffe, Zubereitungen und Erzeugnisse nach dem Chemikaliengesetz, (Regulation on bans and restrictions of the placing on the market of hazardous substances, formulations and products covered by the Chemicals Law), 21 July 2008 (BGBl. I S. 1328)

[30] Gefahrstoffverordnung – GefStoffV (Hazardous substances regulation)
Verordnung zum Schutz vor Gefahrstoffen, (Regulation on protection against hazardous substances), 23 December 2004 (BGBl. I S. 3758)

[31] Federal Environmental Agency, AgBB – Ausschuss zur gesundheitlichen Bewertung von Bauprodukten (Committee for Health-related Evaluation of Building Products): „AgBB – Bewertungsschema für VOC aus Bauprodukten“ (Evaluation of VOC emissions from building products). Dessau-Roßlau, May 2010

[32] **ift** Rosenheim: "PCR Windows. Product Category Rules as per ISO 14025 and EN 15804". Rosenheim, December 2010

[33] EPDs für transparente Bauelemente (EPDs for transparent building components) research project **ift** Rosenheim, 2011

[34] Forschungsvorhaben „Untersuchung der Emissionen von Fenstern und Außentüren zur Bewertung des Verhaltens von Bauelementen in Bezug auf Hygiene, Umweltschutz und Gesundheit“, (Research project "Analysis of emissions from windows and exterior doors for the evaluation of building products and their behaviour in terms of hygiene, environmental protection and health) **ift** Rosenheim, Hochschule Rosenheim, 2011

[35] ECHA: "Candidate List of Substances of Very High Concern for authorisation", Helsinki, 2011.

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Annex:
Description of life cycle scenarios for windows

Product stage			Con-struc-tion process stage		Use stage							End-of-life stage				Benefits and loads beyond the systems boundaries
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Modification/refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste management	Disposal	Re-use Recovery Recycling potential

Calculation of the scenarios was based on a service life of 50 years in accordance with the table "Nutzungsdauer von Bauteilen" [service life of building components] of the information portal "Baustoff- und Gebäudedaten – „mittlerer Wert“).(Sustainable construction - data of building materials and buildings - "average value").
Furthermore, the scenarios of the research project "EPDs für transparente Bauelemente (EPDs for transparent building components) were used.[33].

A4 Transport

No.	Scenario	Description
A4.1	Small batches Direct sales	7.5 t truck, 20 % capacity used, approx. 50 km to construction site and empty return trip
A4.2	Small batches through local manufacturers	7.5 t truck, capacity fully used, approx. 50 km distance and 7.5 t truck, 20 % capacity used, 50 km distance and empty return trip.
A4.3	**Small batches through distributors**	**40 t truck, capacity fully used, approx. 150 km distance and 7.5 t truck, 20 % capacity used, 50 km distance and empty return trip.**
A4.4	Large-scale project	40 t truck, capacity fully used, approx. 150 km

Average weight per m ² steel window: 51.8 kg

A4 Transport from the production site /gate to the construction site	Unit	A4.1	A4.2	A4.3	A4.4
Global warming potential (GWP 100)	kg CO_2-equiv.	3.17	1.26	**4.11**	0.21
Ozone depletion potential (ODP)	kg R11-equiv.	1.78E-09	4.66E-10	**-2.39E-10**	7.94E-11
Acidification potential (AP)	kg SO_2-equiv.	0.01	5.33E-03	**0.01**	9.44E-04
Eutrophication potential (EP)	kgPO_{43}-equiv.	3.09E-03	1.22 E-03	**3.29E-03**	2.17E-04
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	-	-	**-4.70E-03**	-
Abiotic depletion potential elements ($ADP_{el.}$)	kg Sb-equiv.	1.25E-07	4.96E-08	**1.33E-07**	8.45E-09
Abiotic depletion potential fossil (ADP_{fos})	MJ	43.79	17.37	**39.70**	2.96
Use of resources					
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	1.72	0.68	**-**	0.12
Use of renewable primary energy resources used as raw material (material use)	MJ	-	-	**-**	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	1.72	0.68	**0.65**	0.12
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	47.14	18.70	**-**	3.18
Use of non-renewable primary energy resources used as raw material (material use)	MJ	-	-	**-**	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	47.14	18.70	**39.70**	3.18
Use of secondary materials	kg	-	-	**-**	-
Use of renewable secondary fuels	MJ	2.78E-04	1.1E-04	**1.48E-04**	1.88E-05
Use of non-renewable secondary fuels	MJ	2.91E-04	1.15E-03	**1.54E-03**	1.96E-04
Use of net fresh water	m^3	0.17	0.07	**-1.65**	0.01

A4 Transport	Unit	A4.1	A4.2	A4.3	A4.4
Waste categories					
Hazardous waste disposed	kg	0.16	0.06	**-**	0.01
Non hazardous waste disposed	kg	6.1E-05	2.42E-05	**-1.24**	4.3E-06
Radioactive waste disposed	kg	0.16	0.06	**-8.21E-04**	0.01
Output material flows					
Components for re-use	kg	-	-	**-**	-
Materials for recycling	kg	-	-	**-**	-
Materials for energy recovery	kg	-	-	**-**	-
Exported energy	MJ	-	-	**-**	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

A5 Construction / Installation

No.	Scenario	Description
A5.1	**Manually**	**The window is installed without the use of additional lifting devices or tools.**
A5.2	Small lifting trolley/lifting platform	A small lifting platform/lifting trolley is required for the installation of the elements.
A5.3	Crane	The installation of the elements requires a crane.

Installation of the windows forms part of the site management and is covered at the building level.

B1 Use

See Section 5 Emissions to the environment

B1.1 Use of space heat

No.	Scenario	Description
B1.1.1	Standard	U_{CW}=1.3; g=0.6; τ_V=0.8 for a period of 50 years
B1.1.2	**Improved thermal insulation**	**U_{CW}=1.0; g=0.6; τ_V=0.7 for a period of 50 years**
B1.1.3	High-performance thermal insulation	U_{CW}=0.80; g=0.6; τ_V=0.7 for a period of 50 years
B1.1.4	Solar control glazing	U_{CW}=1.3; g=0.3; τ_V=0.6 for a period of 50 years

* As a rule solar control glazing is used for thermal insulation in summer and/or in order to reduce or avoid using energy for air conditioning. These effects cannot be taken into consideration when evaluating only the space heat demand.

B1.1 Use of space heat	Unit	B1.1.1	B1.1.2	B1.1.3	B1.1.4
Global warming potential (GWP 100)	kg CO_2-equiv.	618.90	**469.00**	361.20	881.90
Ozone depletion potential (ODP)	kg R11-equiv.	1.06E-06	**1.30E-08**	6.19E-07	1.51E-07
Acidification potential (AP)	kg SO_2-equiv.	0.48	**0.39**	0.28	0.69
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	0.07	**0.05**	0.04	0.09
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	0.09	**0.07**	0.05	0.12
Abiotic depletion potential elements ($ADP_{el.}$)	kg Sb-equiv.	2.20E-05	**1.82E-05**	1.29E-05	3.14E-05
Abiotic depletion potential fossil (ADP_{fos})	MJ	10,026.00	**7,680.00**	5,851.00	14,286.00
Use of resources					
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	44.10	**-**	25.70	62.80
Use of renewable primary energy resources used as raw material (material use)	MJ	-	**-**	-	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	44.10	**37.10**	25.70	62.80
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	11,214.00	**-**	6,544.00	15,978.00
Use of non-renewable primary energy resources used as raw material (material use)	MJ	-	**-**	-	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	11,214.00	**7,680.00**	6,544.00	15,978.00
Use of secondary materials	kg	-	**-**	-	-
Use of renewable secondary fuels	MJ	0.09	**0.07**	0.05	0.13
Use of non-renewable secondary fuels	MJ	0.937	**0.756**	0.547	1.33
Use of net fresh water	m^3	88.50	**48.00**	50.10	36.20

B1.1 Use of space heat	Unit	B1.1.1	B1.1.2	B1.1.3	B1.1.4
Waste categories					
Hazardous waste disposed	kg	-	-	**-**	-
Non hazardous waste disposed	kg	65.50	**52.90**	38.20	93.40
Radioactive waste disposed	kg	0.04	**0.03**	0.02	0.06
Output material flows					
Components for re-use	kg	-	-	**-**	-
Materials for recycling	kg	-	-	**-**	-
Materials for energy recovery	kg	-	-	**-**	-
Exported energy	MJ	-	-	**-**	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

B2 Maintenance

B2.1 Cleaning

No.	Scenario	Description
B2.1.1	Rarely manually	Less than 2.5 m in height or industrial climber, manually using suitable cleaning agents - annually
B2.1.2	Rarely using machines	More than 2.5 m in height, using bucket truck, crane, travelling cradle/maintenance platform, etc. - annually
B2.1.3	**Frequently manually**	**Less than 2.5 m in height or industrial climber, manually using suitable cleaning agents – every three months**
B2.1.4	Frequently using machines	More than 2.5 m in height, using bucket truck, crane, travelling cradle/maintenance platform, etc. – every three months

B2.1 Cleaning	Unit	B2.1.1	B2.1.2	**B2.1.3**	B2.1.4
Global warming potential (GWP 100)	kg CO_2-equiv.	0.64	1.82	**2.58**	3.75
Ozone depletion potential (ODP)	kg R11-equiv.	1.24E-08	8.80E-08	**4.97E-08**	1.25E-07
Acidification potential (AP)	kg SO_2-equiv.	1.69E-03	0.01	**6.77E-03**	0.01
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	2.94E-04	5.67E-04	**1.18E-03**	1.45E-03
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	1.47E-04	4.86E-04	**5.87E-04**	9.26E-04
Abiotic depletion potential elements ($ADP_{el.}$)	kg Sb-equiv.	5.14E-06	5.25E-06	**2.06E-05**	2.07E-05
Abiotic depletion potential fossil (ADP_{fos})	MJ	7.91	21.27	**31.63**	44.99
Use of resources					
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	1.04	4.60	**4.18**	7.73
Use of renewable primary energy resources used as raw material (material use)	MJ	-	-	**-**	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	1.04	4.60	**4.18**	7.73
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	10.65	32.34	**42.61**	64.29
Use of non-renewable primary energy resources used as raw material (material use)	MJ	-	-	**-**	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	10.65	32.34	**42.61**	64.29
Use of secondary materials	kg	-	-	**-**	-
Use of renewable secondary fuels	MJ	0.09	0.07	**0.05**	0.13
Use of non-renewable secondary fuels	MJ	0.94	0.76	**0.55**	1.33
Use of net fresh water	m^3	1.37	7.03	**5.46**	11.13

B2.1 Cleaning	Unit	B2.1.1	B2.1.2	**B2.1.3**	B2.1.4
Waste categories					
Hazardous waste disposed	kg	-	-	**-**	-
Non hazardous waste disposed	kg	2.18	7.20	**8.73**	13.8
Radioactive waste disposed	kg	8.42E-04	3.8E-03	**3.3E-03**	6.3E-03
Output material flows					
Components for re-use	kg	-	-	**-**	-
Materials for recycling	kg	-	-	**-**	-
Materials for energy recovery	kg	-	-	**-**	-
Exported energy	MJ	-	-	**-**	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

B2.2 Maintenance

No.	Scenario	Description
B2.2.1	**Low use (e. g. residential construction)**	**Functional check every two years, visual inspection, lubrication/greasing of hardware, check for damage and, if necessary, maintenance**
B2.2.2	Normal use (e. g. office or public buildings)	Annual cleaning and lubrication/greasing of hardware, check for damage and, if necessary, maintenance
B2.2.3	Heavy use (e. g. schools and hotels)	Every six months cleaning and lubrication/greasing of hardware, check for damage and if necessary maintenance

B2 Maintenance	Unit	B2.2.1	B2.2.2	B2.2.3
Global warming potential (GWP 100)	kg CO_2-equiv.	**0.13**	0.26	0.52
Ozone depletion potential (ODP)	kg R11-equiv.	**7.84E-10**	1.57E-09	3.13E-09
Acidification potential (AP)	kg SO_2-equiv.	**7.56E-04**	1.51E-03	3.02E-03
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	**3.60E-05**	7.20E-05	1.44E-04
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	**1.03E-04**	2.06E-04	4.13E-04
Abiotic depletion potential elements ($ADP_{el.}$)	kg Sb-equiv.	**1.50E-08**	3.00E-08	6.00E-08
Abiotic depletion potential fossil (ADP_{fos})	MJ	**6.44**	12.89	25.78
Use of resources				
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	**0.03**	0.07	0.14
Use of renewable primary energy resources used as raw material (material use)	MJ	**-**	-	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	**0.03**	0.07	0.14
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	**7.00**	14.01	28.01
Use of non-renewable primary energy resources used as raw material (material use)	MJ	**-**	-	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	**7.00**	14.01	28.01
Use of secondary materials	kg	-	-	-
Use of renewable secondary fuels	MJ	**4.08E-05**	2.73E-05	1.09E-04
Use of non-renewable secondary fuels	MJ	**4.30E-04**	2.85E-04	1.14E-03
Use of net fresh water	m^3	**0.05**	0.10	0.20

B2.2 Maintenance	Unit	B2.2.1	B2.2.2	B2.2.3
Waste categories				
Hazardous waste disposed	kg	**-**	-	-
Non hazardous waste disposed	kg	**0.09**	0.18	0.36
Radioactive waste disposed	kg	**2.62E-05**	5.23E-05	1.05E-04
Output material flows				
Components for re-use	kg	**-**	-	-
Materials for recycling	kg	**-**	-	-
Materials for energy recovery	kg	**-**	-	-
Exported energy	MJ	**-**	-	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

B3 Repair

No.	Scenario	Description
B3.1	**Normal use and heavy use**	**One replacement of hardware, seals/gaskets, glass incl. glazing gasket, if necessary, maintenance/repair**

B3 Repair	Unit	B3.1
Global warming potential (GWP 100)	kg CO_2-equiv.	**40.20**
Ozone depletion potential (ODP)	kg R11-equiv.	**2.26E-07**
Acidification potential (AP)	kg SO_2-equiv.	**0.31**
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	**0.03**
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	**0.02**
Abiotic depletion potential (elements) ($ADP_{el.}$)	kg Sb-equiv.	**1.41E-03**
Abiotic depletion potential (fossil) (ADP_{fos})	MJ	**673.00**
Use of resources		
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	**-**
Use of renewable primary energy resources used as raw material (material use)	MJ	**-**
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	**31.80**
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	**-**
Use of non-renewable primary energy resources used as raw material (material use)	MJ	**-**
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	**674.00**
Use of secondary materials	kg	**-**
Use of renewable secondary fuels	MJ	**7.22E-03**
Use of non-renewable secondary fuels	MJ	**0.07**
Use of net fresh water	m^3	**35.60**

B3 Maintenance / Repair	Unit	B 3.1
Waste categories		
Hazardous waste disposed	kg	**0.07**
Non hazardous waste disposed	kg	**106.00**
Radioactive waste disposed	kg	**0.02**
Output material flows		
Components for re-use	kg	-
Materials for recycling	kg	-
Materials for energy recovery	kg	-
Exported energy	MJ	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

B4 Replacement

The service life of 50 years assumed here does not include window replacement, with the exception of the components listed in scenario B3.

B5 Modification/refurbishment

No modification/refurbishment of windows necessary when used as intended and appropriately.

B6 Operational energy use

No.	Scenario	Description
B6.1	**Manually operated**	**No energy consumed during use**
B6.2	Power operated	per drive: 0.33 Wh; open and close once a day => 6 kWh / 50a

B6 Operational energy use	Unit	B6.1	B6.2
Global warming potential (GWP 100)	kg CO_2-equiv.	-	2.83
Ozone depletion potential (ODP)	kg R11-equiv.	-	1.81E-07
Acidification potential (AP)	kg SO_2-equiv.	-	0.01
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	-	6.53E-04
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	-	8.15E-04
Abiotic depletion potential (elements) (ADP$_{el.}$)	kg Sb-equiv.	-	2.92E-07
Abiotic depletion potential (fossil) (ADP$_{fos}$)	MJ	-	32.07
Use of resources			
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	-	8.53
Use of renewable primary energy resources used as raw material (material use)	MJ	-	-
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	-	8.53
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	-	52.04
Use of non-renewable primary energy resources used as raw material (material use)	MJ	-	-
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	-	52.04
Use of secondary materials	kg	-	-
Use of renewable secondary fuels	MJ	-	9.09E-04
Use of non-renewable secondary fuels	MJ	-	9.52E-03
Use of net fresh water	m³	-	13.60

B6 Operational energy use	Unit	B6.1	B6.2
Waste categories			
Hazardous waste disposed	kg	-	-
Non hazardous waste disposed	kg	-	22.20
Radioactive waste disposed	kg	-	5.95E-03
Output material flows			
Components for re-use	kg	-	-
Materials for recycling	kg	-	-
Materials for energy recovery	kg	-	-
Exported energy	MJ	-	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

B7 Operational water use

No water consumption when used as intended. Water consumption for cleaning is specified in module B2.1.

C1 De-construction

No.	Scenario	Description
C1.1	Dismantling	95 % de-construction of steel windows The energy consumed in de-construction is negligible.

C2 Transport e. g. to collection point or disposal/landfill site

No.	Scenario	Description
C2.1	Transport	Transport to collection point with 7.5 t truck, capacity fully used, distance 50 km, from collection point to recycling plant with 40 t truck, capacity fully used, approx. 150 km distance

Average weight per m² steel window: 51.8 kg

C2 Transport e. g. to collection point or disposal/landfill site	Unit	C2.1
Global warming potential (GWP 100)	kg CO_2-equiv.	**0.66**
Ozone depletion potential (ODP)	kg R11-equiv.	**1.15E-11**
Acidification potential (AP)	kg SO_2-equiv.	**2.85E-03**
Eutrophication potential (EP)	kg PO_4^{3-}-equiv.	**6.53E-04**
Photochemical ozone creation potential (POCP)	kg C_2H_4-equiv.	**-9.15E-04**
Abiotic depletion potential (elements) (ADP$_{el.}$)	kg Sb-equiv.	**2.46E-08**
Abiotic depletion potential (fossil) (ADP$_{fos}$)	MJ	**9.15**
Use of resources		
Use of renewable primary energy - excluding renewable primary energy resources used as raw materials	MJ	**-**
Use of renewable primary energy resources used as raw material (material use)	MJ	**-**
Total use of renewable primary energy resources (primary energy and renewable primary energy resources used as raw materials) (energy + material use)	MJ	**0.36**
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	**-**
Use of non-renewable primary energy resources used as raw material (material use)	MJ	**-**
Total use of non-renewable primary energy resources (primary energy and non-renewable primary energy resources used as raw materials) (energy + material use)	MJ	**9.15**
Use of secondary materials	kg	**-**
Use of renewable secondary fuels	MJ	**5.78E-05**
Use of non-renewable secondary fuels	MJ	**6.06E-04**
Use of net fresh water	m³	**0.04**

C2 Transport e. g. to collection point or disposal/landfill site	Unit	C2.1
Waste categories		
Hazardous waste disposed	kg	-
Non hazardous waste disposed	kg	0.03
Radioactive waste disposed	kg	1.19E-05
Output material flows		C2
Components for re-use	kg	-
Materials for recycling	kg	-
Materials for energy recovery	kg	-
Exported energy	MJ	-

Values that cannot be shown or are inexistent or marginal, are expressed as [-] .

C3 Waste management

No.	Scenario	Description
C3.1	Dismantling and recycling	De-construction of glazing 90 %, recycling of steel 98 %, recycling of other metals 90 %, residual fractions to waste incinerator 90 %

C4 Disposal

No.	Scenario	Description
C4.1	Disposal	Non-recordable amounts and losses within the re-use/ recycling chain (C1 and C3) are modelled as "disposed".

D Benefits and loads beyond the system boundaries

No.	Scenario	Description
D	Recycling potential	Steel scrap from C3.1 excluding scrap used in A3 replaces 100 % of steel Approx. 95% of glass is recycled. Benefits credited from waste incinerator: electricity replaces European electricity mix, thermal energy replaces thermal energy from natural gas.

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