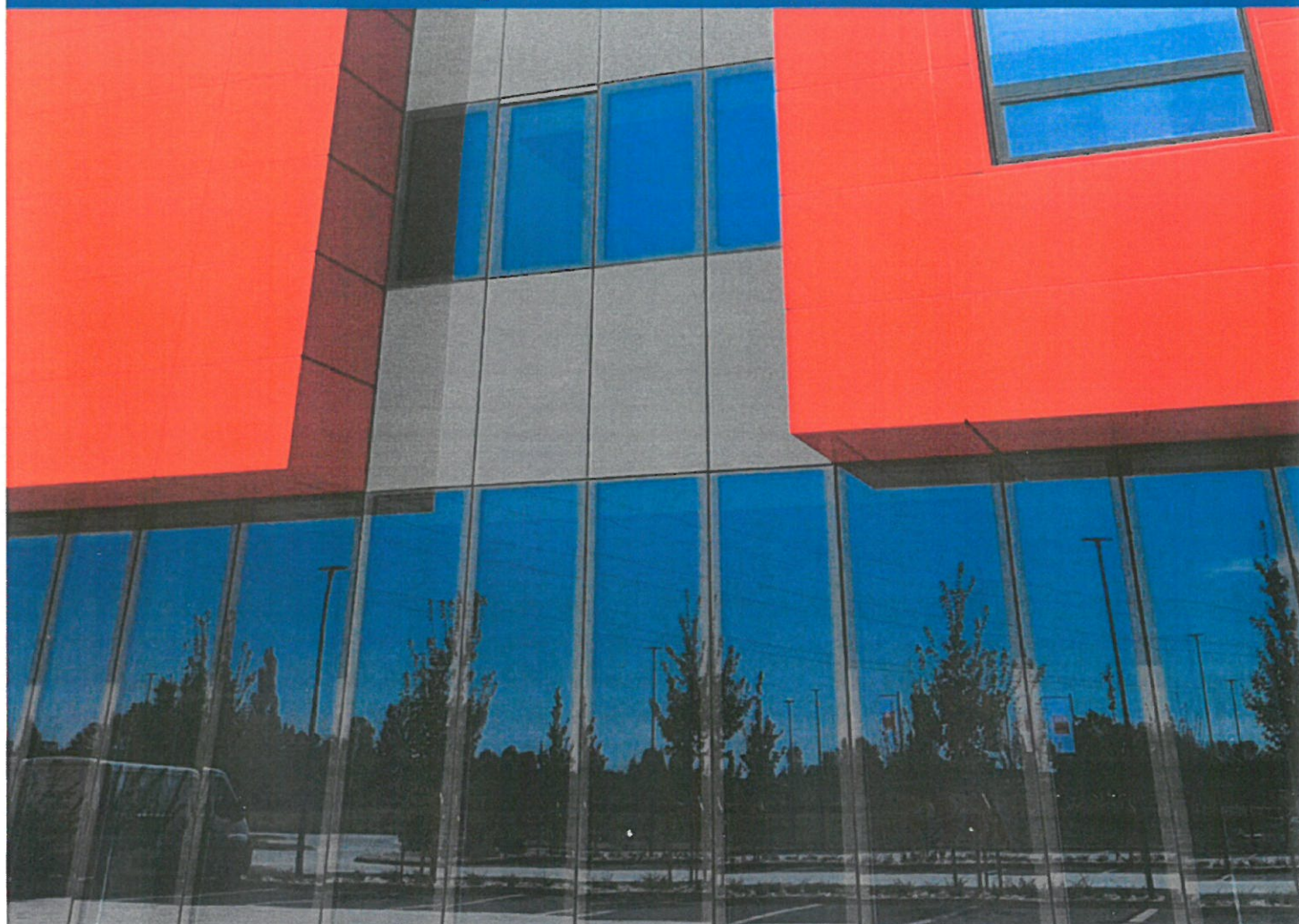


Environmental Product Declaration

According to ISO 14025 and EN 15804



Q-Air 5 - Transparent 5 chamber façade system

EPD number
ECO EPD number
EPD owner
Program operator
Issue Date / Update Date
Valid until

EPD-18/0002
00000767
Trimo d.o.o., Prijateljeva cesta 12, 8210 Trebnje
ZAG EPD
29. 10. 2018 / 21. 01. 2019
29. 10. 2023

www.zag.si



1 General information	Q-Air 5 façade system, elements and core unit						
Programme operator: Slovenian National Building And Civil Engineering Institute - ZAG Dimičeva 12 1000 Ljubljana http://www.zag.si	Owner of the Declaration: Trimo d.o.o. Prijateljeva cesta 12 8210 Trebnje https://www.trimo-group.com						
Number of Environmental Product Declaration: EPD-18/0002	Declared Unit: 1 m ² of FAÇADE						
This Declaration is based on the Product Category Rules (PCR): PCR by IBU, Part B: Requirements on the EPD for Self-supporting façade elements based on glazed curtain walls (2013), version 1.0	Scope: Cradle to gate (A1-A3 modules)						
Issue date / update date: 29. 10. 2018 / 21. 01. 2019	Verification: <table border="1"> <tr> <td colspan="2">The CEN standard EN 15804 serves as the core product category rule (PCR)</td> </tr> <tr> <td colspan="2">Independent verification of the EPD according to EN ISO 14025:2010</td> </tr> <tr> <td><input type="checkbox"/> internally</td> <td><input checked="" type="checkbox"/> externally</td> </tr> </table>	The CEN standard EN 15804 serves as the core product category rule (PCR)		Independent verification of the EPD according to EN ISO 14025:2010		<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally
The CEN standard EN 15804 serves as the core product category rule (PCR)							
Independent verification of the EPD according to EN ISO 14025:2010							
<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally						
Valid until: 29. 10. 2023	Title and the handwritten signature of verifier: Hudai Kara, PhD  Metsims Sustainability Consulting Oxford, U.K. www.metsims.com						
Title and the handwritten signature issuer:  Franc Copuder, M.Sc. Slovenian National Building And Civil Engineering Institute - ZAG	Title and the handwritten signature of leading expert:  Katja Malovrh Rebec, PhD Slovenian National Building And Civil Engineering Institute - ZAG						

2 Product

2.1 Product description and application

Q-Air 5 is a façade system (Q-Air 5-FS) made of interconnected elements (Q-Air 5-FE) in which insulation cores (Q-Air 5-IC) are integrated to form glazed curtain wall façade. Outer toughened safety glass layer is followed by five chambers from which four are filled with argon and one with air divided by three layers of float flat glass and one of expansion glass.

Components:

96% of Q-Air 5 by weight consists of the following materials: external glass pane, intermediate glass panes, internal glass pane, spacers and structural aluminium profiles.

The producer defined the following hierarchy of products:

1. Q-Air 5 TRANSPARENT FAÇADE SYSTEM (Q-Air 5 – FS)

This is the entire façade with its elements, joints and support parts. All support material used at the building site is included in the study.

2. Q-Air 5 TRANSPARENT FAÇADE ELEMENT (Q-Air 5 – FE)

These are elements of glass insulation core installed into on aluminium frame including the hooks and some other steel parts as well as EPDM gaskets.

3. Q-Air 5 TRANSPARENT INSULATION CORE (Q-Air 5 – IC)

This refers only to the insulation core made of five chambers divided by glass – three float flat glass layers that create four chambers filled with argon and one layer of expansion glass that creates the fifth chamber filled with air. The sealing of core elements is made in two variants – with polysulfide (PSSI) or silicone (SISI).

The dimensions of the model and calculations are taken axis for all elements, ie. in the middle of the joints between the elements.

2.2 Technical Data

Data	Value
Module width [mm]	850 – 1250
Module height [mm]	850 – 4000
The thickness of the insulating core [mm]	117-149
U thermal transmittance [W/m ² K] according to the EN 623:2011	0,37 for height 4000 mm 0,39 for height 2000 mm

Data	Value
Class of fire resistance according to EN 1364-1	NPD
Rw – sound insulation [dB] according to the EN ISO 140-3	45 – 55
Permeability for water according to the EN 12865 [Pa]	900 – 1500 Pa (CLASS B)
Wind load [kPa]	1,25 – 2,6 at the max L/400
Recyclability [%]	96



2.3 Placing on the market / Application rules

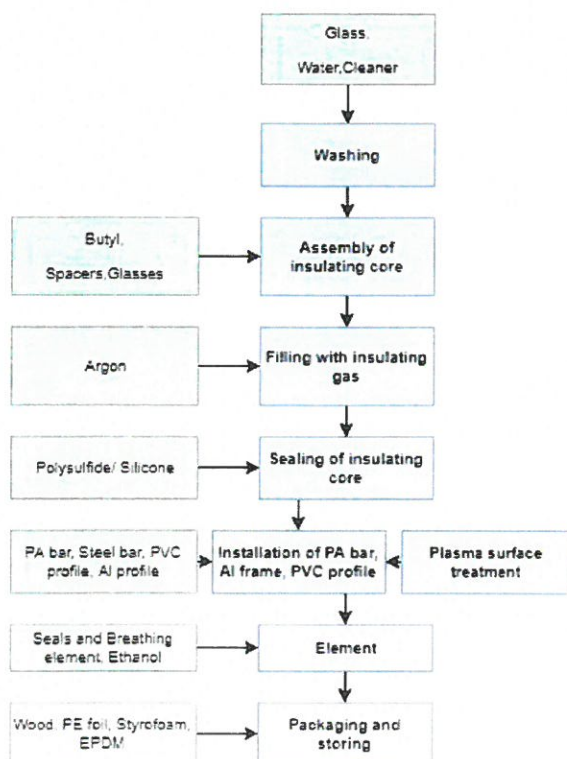
This façade system can be applied in different public institutions such as commercial skyscrapers, libraries, educational establishments, commercial business facilities.

2.4 Base materials / Ancillary materials

Float glass, toughened safety glass, butyl, argon gas, tap water, rinsing agent and sealing tape and steel sections for insulation core. Façade system includes aluminium profiles, plastic, PVC and steel parts, EPDM gaskets and adhesives.

2.5 Manufacturing process

The whole manufacturing process includes pre-processing, assembling, insulation gas, sealing, finishing and packing.



2.6 Environment and health during manufacturing

Trimo reports measured and calculated air emissions every three years. When conducting life cycle assessment we took into account the values reported in 2017. Volatile organic compounds are measured at the discharge location. Trimo collects emissions data for Q-Air 5 production line separately (no allocation was needed).

None of the substances used are listed in "Candidate List of Substances of Very High Concern (SVHC) for authorisation" or their content does not exceed 0.1 % of the weight of the product.

2.7 Packaging

Stretch and cover foil, pallets, EPDM parts and cork spacers.

2.8 Further information

Technical sheet available on:

www.trimo-group.com

3 LCA: Calculation rules

3.1 Declared unit

Declared unit is

1 m² of FAÇADE.

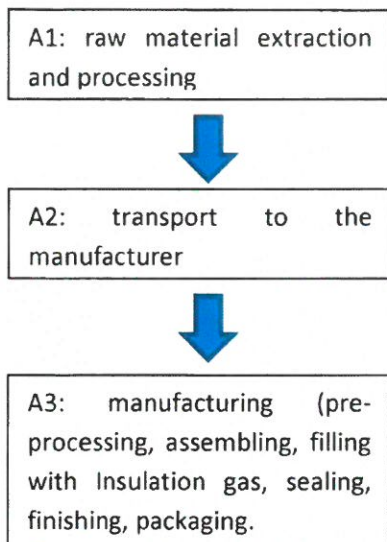
3.2 System boundary

Type of EPD: "from cradle to gate".

Modular principle described in the standard EN 15804:2012+A1:2013 has been applied for the system boundaries of this LCA.



The assessment relates to A1 to A3 modules this is the production phase that includes:



3.3 Cut-off rules

LCA analysis included data regarding basic raw materials, auxiliary materials, packaging materials, transport and energy in the production process provided by the producer Trimo. The available data has been included in the model. The use of renewable and non-renewable primary energy has been properly described. Energy cut-off is less than 1 %. Less than 5% of the total weight of the input materials in a specific production process has been disregarded or omitted. Capacity utilisation and type of truck were all assumed, the data was not provided by the manufacturer (85 % utilized diesel driven, Euro 5, truck, 28-32t gross weight, 22 t payload capacity). However, transport represents small % of total values, thus this assumptions fall under cut off. Return freight was not assumed (below cut off). Waste was included in the masses, thus polluter pays method was considered but treatment of waste materials has been omitted (below cut off). Waste treatment for packing foils and rubber spacers was omitted, pallets were

presumed to be reused, but were also not included in this study (below cut off). Some assumptions were made in the outsourced pre products for example data for generic production of spacers, steel profiles and polyamide bar was used.

3.4 Background data

Thinkstep (formerly PE International) Gabi Database (Professional and extensions-2018) have been used to model A1-A3 processes.

3.5 Data quality

The data used in LCA correspond to the requirements of BS EN 15804:

- Generic data sets used for calculations have been updated within the last 10 years.
- Producer specific data sets used for calculations have been updated within the last 5 years.
- All data sets are based on 1 year averaged data.
- The time period over which inputs to and outputs from the system shall be accounted for is 100 years from the year for which the data set is deemed representative.

3.6 Period under review

The reference year for data collection was 2017.

3.7 Allocation

Total consumption of electricity and water in the production process has been provided by the manufacturer and his subcontractors.

3.8 Comparability

EPD results comparison is only possible if the same system background has been taken into account and the data were collected in accordance with EN 15804. Furthermore the specific characteristics of the product and production rules and PCR must be taken into account as well.



4 LCA: Results

SYSTEM BOUNDARY																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
☒	☒	☒	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA
The modules of the product lifecycle, which are included in EPD are marked by "X" modules not included are marked with a "MNA" = module not assessed																

Results have been calculated for three levels products: Q-Air 5 insulation core, which is part of Q-Air 5 façade element and both are part of Q-Air 5 façade system. LCA has been made for four sets of data provided by producer: one for panel of dimensions 2 m per 1,25 m, the other for panels of dimensions 4 m per 1,25 m and both also for different core sealing options – with polysulfide (PSSI) or with silicone (SISI). The façade element general results are presented for the option with 10 mm outer glass thickness and 8 mm inner glass thickness.

Abbreviations used in tables below:

GWP ₁₀₀	Global warming potential
AP	Acidification Potential
EP	Eutrophication Potential
ODP	Ozone Depletion Potential
POCP	Photochemical ozone creation potential
ADP	Abiotic Resources Depletion Potential – elements and fossil fuels
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials
PERM	Use of renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PENRT	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
SM	Use of secondary material
ESF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water



HWD	Hazardous waste disposed
NHWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed
CRU	Components for re-use
MFR	Materials for recycling
MER	Materials for energy recovery
EE	Exported energy

Parameters describing environmental impacts

1m ² of façade, A1-A3 With Polysulphide core sealing - PSSI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
ADP ele	[kg Sb-Equiv.]	2,58E-04	2,68E-04	3,85E-04	4,33E-04	3,96E-04	4,49E-04
ADP fos	[MJ]	1,38E+03	1,32E+03	2,23E+03	2,39E+03	2,30E+03	2,50E+03
AP	[kg SO ₂ -Equiv.]	7,65E-01	7,46E-01	1,02E+00	1,07E+00	1,03E+00	1,09E+00
EP	[kg Phos-Equiv.]	7,38E-02	7,21E-02	9,22E-02	9,54E-02	9,30E-02	9,69E-02
GWP 100	[kg CO ₂ -Equiv.]	1,21E+02	1,15E+02	1,87E+02	1,98E+02	1,90E+02	2,05E+02
ODP	[kg CFC11-Equiv.]	-2,14E-10	-4,08E-10	-3,74E-10	-7,86E-10	9,71E-09	1,16E-08
POCP	[kg Eth-Equiv.]	-7,61E-02	-7,73E-02	-5,98E-02	-5,66E-02	-5,89E-02	-5,49E-02

* Q-Air 5 IC – Q-Air 5 Transparent insulation Core, Q-Air 5 FE – façade element, Q-Air 5 FS – façade system.

1m ² of façade, A1-A3 With Silicone core sealing - SISI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
ADP el	[kg Sb-Equiv.]	7,72E-04	8,92E-04	8,99E-04	1,05E-03	9,10E-04	1,07E-03
ADP fos	[MJ]	1,53E+03	1,50E+03	2,38E+03	2,52E+03	2,45E+03	2,62E+03
AP	[kg SO ₂ -Equiv.]	7,87E-01	7,72E-01	1,05E+00	1,08E+00	1,05E+00	1,09E+00
EP	[kg Phos-Equiv.]	7,77E-02	7,66E-02	9,60E-02	9,86E-02	9,69E-02	1,00E-01
GWP 100	[kg CO ₂ -Equiv.]	1,33E+02	1,29E+02	1,99E+02	2,08E+02	2,02E+02	2,14E+02
ODP	[kg CFC11-Equiv.]	-2,37E-09	-3,02E-09	-2,53E-09	-3,41E-09	7,56E-09	8,98E-09
POCP	[kg Eth-Equiv.]	-7,32E-02	-7,35E-02	-5,69E-02	-5,40E-02	-5,59E-02	-5,23E-02

* Q-Air 5 IC – Q-Air 5 Transparent insulation Core, Q-Air 5 FE – façade element, Q-Air 5 FS – façade system.

**** Comment:** Façade core contributes negative POCP values. This is related to CML calculation method - the negative for POCP are caused by the division of the NO_x emissions into the two single emissions NO₂ and NO during the upgrade from GaBi 4 to GaBi 5/6. The NO has a negative effect on the POCP since it reduces the close ground ozone formation.



Parameters describing resource use

1m ² of façade, A1-A3 With Polysulphide core sealing - PSSI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
PERE	[MJ]	3,96E+02	3,39E+02	5,51E+02	5,26E+02	5,31E+02	5,09E+02
PERM	[MJ]	1,32E+00	2,64E+00	1,32E+00	2,64E+00	1,32E+00	2,64E+00
PENRT	[MJ]	1,84E+03	1,71E+03	3,08E+03	3,05E+03	2,98E+03	3,18E+03
PENRE	[MJ]	1,83E+03	1,71E+03	2,92E+03	2,85E+03	2,80E+03	2,95E+03
PENRM	[MJ]	6,54E+00	5,77E+00	1,57E+02	2,00E+02	1,75E+02	2,28E+02
PERT	[MJ]	4,02E+02	3,45E+02	7,08E+02	7,26E+02	7,06E+02	7,37E+02
SM	[kg]	4,70E-01	4,70E-01	3,32E-01	3,32E-01	2,50E-01	2,50E-01
RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total freshwater use	[kg]	4,90E+02	4,80E+02	1,31E+03	1,05E+03	1,36E+03	1,48E+03

1m ² of façade, A1-A3 With Silicone core sealing - SISI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
PERE	[MJ]	5,08E+02	4,76E+02	6,63E+02	6,36E+02	6,51E+02	6,18E+02
PERM	[MJ]	1,32E+00	2,64E+00	1,32E+00	2,64E+00	1,32E+00	2,64E+00
PENRT	[MJ]	2,02E+03	1,93E+03	3,26E+03	3,20E+03	3,33E+03	3,32E+03
PENRE	[MJ]	2,01E+03	1,93E+03	3,11E+03	3,00E+03	3,16E+03	3,09E+03
PENRM	[MJ]	6,54E+00	5,77E+00	1,57E+02	2,00E+02	1,75E+02	2,28E+02
PERT	[MJ]	5,15E+02	4,82E+02	8,20E+02	8,35E+02	8,26E+02	8,46E+02
SM	[kg]	4,70E-01	4,70E-01	3,32E-01	3,32E-01	2,50E-01	2,50E-01
RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Total freshwater use	[kg]	6,21E+02	5,67E+02	1,44E+03	1,21E+03	1,55E+03	1,57E+03

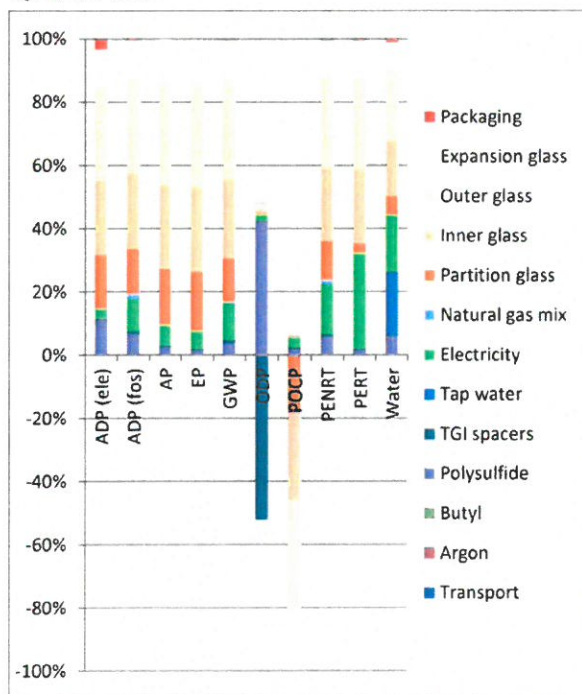
Other environmental information describing waste categories and output flows

1m ² of façade, A1-A3 With Polysulphide core sealing - PSSI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
HWD	[kg]	1,66E-02	2,02E-02	1,66E-02	2,02E-02	1,66E-02	2,02E-02
NHWD	[kg]	3,66E+02	3,66E+02	3,79E+02	3,82E+02	3,79E+02	3,82E+02
RWD	[kg]	5,81E-02	3,28E-02	1,03E-01	8,62E-02	1,05E-01	8,88E-02
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

1m ² of façade, A1-A3 With Silicone core sealing - SISI		Q-Air 5 IC* 4/1,25	Q-Air 5 IC 2/1,25	Q-Air 5 FE* 4/1,25	Q-Air 5 FE 2/1,25	Q-Air 5 FS* 4/1,25	Q-Air 5 FS 2/1,25
HWD	[kg]	1,60E-06	1,63E-06	3,00E-06	3,31E-06	4,36E-06	5,12E-06
NHWD	[kg]	3,65E+02	3,65E+02	3,78E+02	3,81E+02	3,78E+02	3,81E+02
RWD	[kg]	1,24E-01	1,24E-01	1,69E-01	1,78E-01	1,70E-01	1,80E-01
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

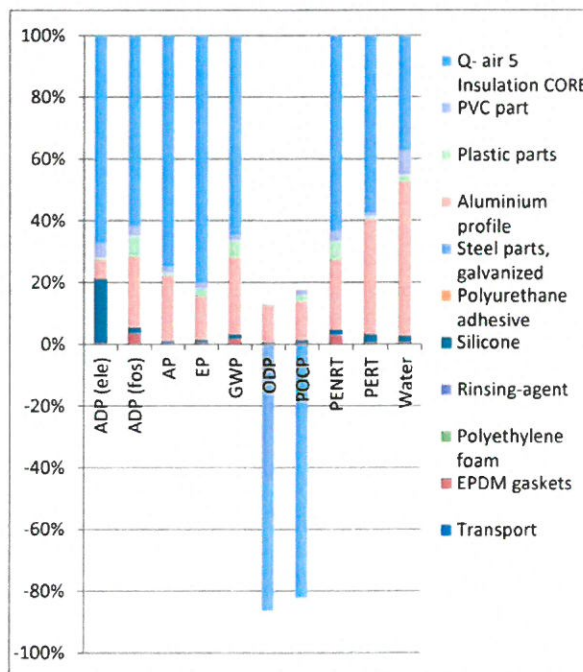
5 LCA: Interpretation

Q-Air 5 PSSI:



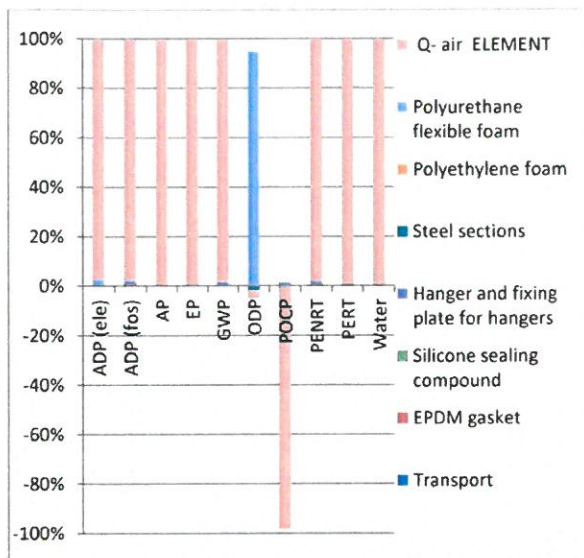
The biggest contributors to virtually all environmental parameters in the variant with polysulfide core sealing (PSSI) of Q-Air 5 insulation core are glass layers that represent between 55 and 92 % of core impacts. Negative values (positive impacts on the environment) in ODP and POCP are caused by methodology used.

Elaborating the Global warming potential (GWP) we notice that it is dominated by glass layers contribution (82 % of total value). Electricity plays a considerable role with 12 % of total GWP value and polysulfide adds another 4 % of total value. All the other components add less than 1 % of GWP value each.



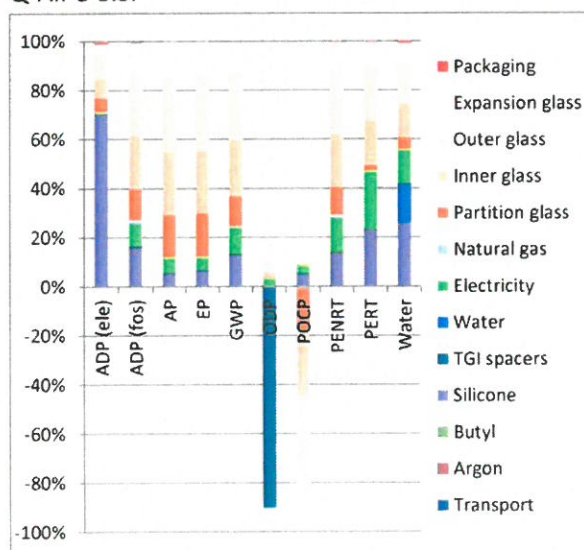
Analysis for the Q-Air 5 element (core + element) has been made as well. The biggest contributor to all environmental parameters in Q-Air 5 element is core (from 37 to 80 %), followed by aluminium profile (from 6 to 50 % of total value).

Elaborating the Global warming potential (GWP) we notice that it is dominated by the insulation core with 65 %, followed by aluminium profile (25 %) and plastic parts (6 %). Other components add less than 2 % each.



In façade system results (core + element + system) LCA revealed negligible values of contribution to the environmental parameters of Q-Air 5 façade system for Polyethylene foam, steel sections, hanger and plates, silicone, transport and EPDM gaskets. Polyurethane foam has a major impact on ODP.

Q-Air 5 SISI



In SISI variant of Q-Air 5 core sealing (with silicone) silicone is the main contributor for ADP ele parameter (70 %), followed by glass (28 %). Regarding water, glass layers have the biggest impact (43 %) as for all the other parameters of environmental impacts (between 52 and 88 %).

Elaborating the Global warming potential (GWP) we notice that it is again dominated by glass layers contribution (75 % of total value). Silicone contributes 12 % of total GWP value and electricity adds another 11 % of total value.

For Q-Air 5 element, core has the biggest impact, between 55 and 86 %. Second biggest impact in ADP ele is silicone with 9 %. In all other parameters, aluminium is the second most important contributor with values between 13 and 45 %.

Similarly to the Q-Air 5 PSSI system, system elements as polyethylene foam, steel sections, hanger and fixing plate, silicone, EPDM gaskets and transport are negligible compared with element impacts.

Packaging

Packing described by the producer includes foils/film (PE and PVC) as well as EPDM parts and cork spacers. The packing environmental parameters were modelled for total Q-Air 5 system. The packing represents a minority in overall sum for each of environmental impact categories (less than 1 %).



6 References

Background report

Report No. 20/17-530-2, Life Cycle Assessment of Q-Air O façade system, element and insulation core, ZAG, authored by Katja Malovrh Rebec, PhD

Software

GaBi 6 <http://www.pe-international.com>

Databases

[1] Gabi professional and extension database 2018

Standards

[1] SIST EN 15804:2012+A1:2013: Sustainability of construction works - Environmental

product declarations - Core rules for the product category of construction products

[2] SIST EN ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework (EN ISO 14040:2006)

[3] SIST EN ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines (EN ISO 14044:2006)

[4] SIST EN ISO 14025:2010 Environmental labels and declarations - Type III environmental

Product Category Rules (PCR)

Self-supporting façade elements based on glazed curtain walls (published by Institut Bauen und Umwelt e.V.)

