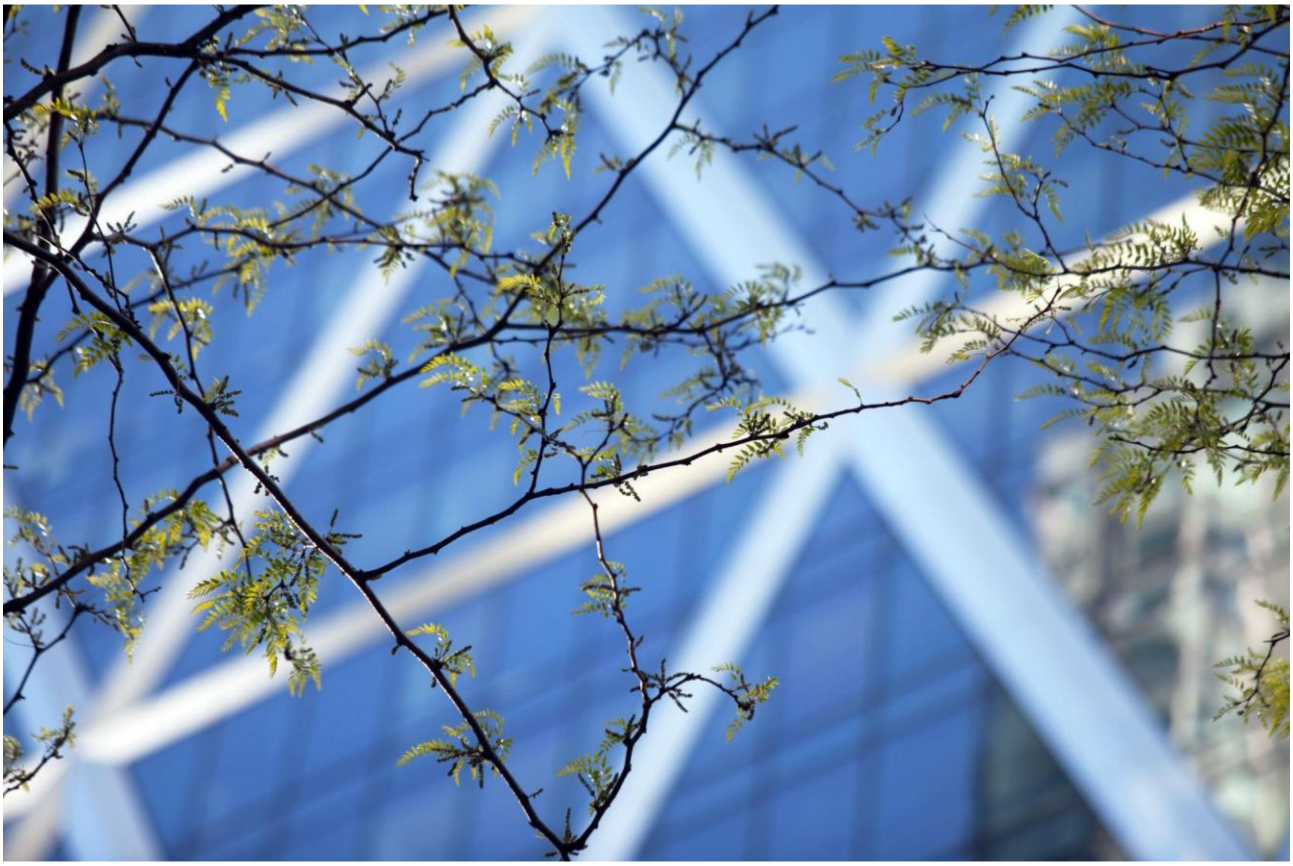


Sustainability at Scheldebouw

CO2 Performance Ladder

Value chain analysis

-

- rev. 01

19-10-2023

Report name	**:**	CO2 Performance Ladder, Value chain analysis
Project name	**:**	Sustainability at Scheldebouw
Project number	**:**	-
Report number	**:**	-
Revision	**:**	01
File name	**:**	----R01
Date	**:**	19-10-2023
Status	**:**	For External Audit
Author	**:**	J. Verkerk-Evers
Checked by	**:**	R. Riemens
Approved by	**:**	S. Josefsson
Authorised by	**:**	J. Mönnikes

Scheldebouw B.V.

Herculesweg 17 | 4338 PL Middelburg
Smedestraat 2 | 6411 CR Heerlen
P.O. Box 8042 | 4330 EA Middelburg
The Netherlands

Tel. +31 (0) 118 679 900
Tel. +31 (0) 455 437 437
scheldebouw.permasteelisagroup.com

Table of contents

Revisions

Rev. #.	Chapter:	Revision:
00		First issue
01		marked yellow

Proprietary Note

01 Introduction

The construction industry has realised that we have to act now and start lowering the human impact on the environment, if we want future generations to enjoy our planet the same way as previous generations did. Sustainability has finally become a key performance criterion in facade design, which allows us to create solutions and make decisions which were not viable before.

Our mission
Scheldebouw strives to be a front runner in the facade industry with our sustainability approach

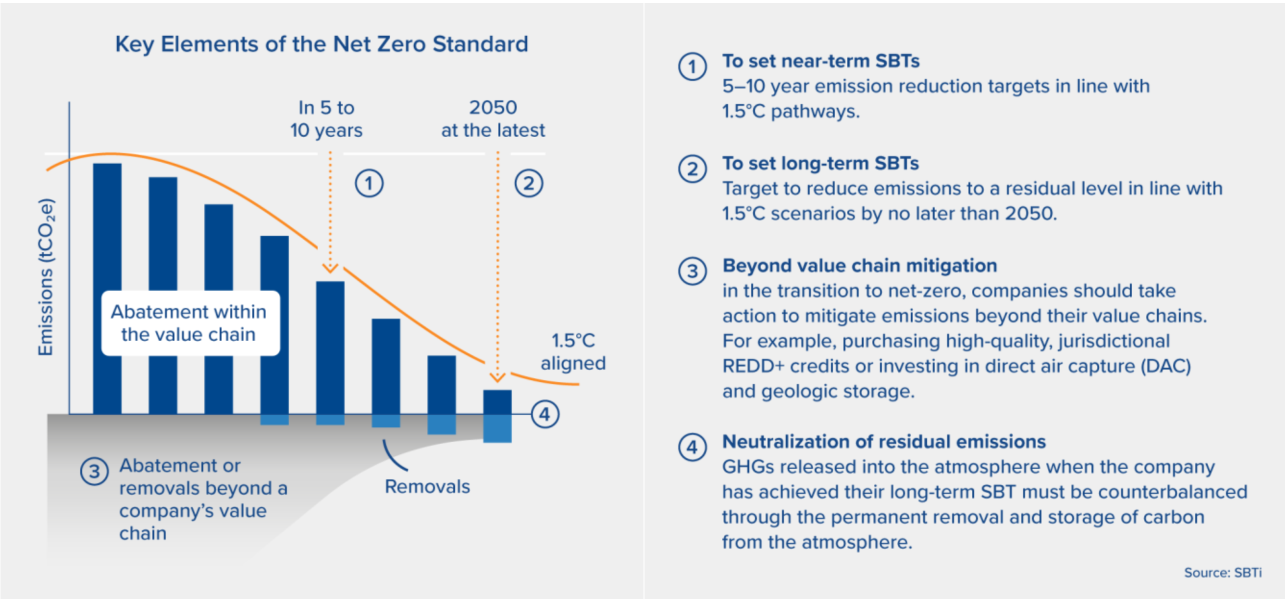
To achieve this, we need to:

- Understand our environmental impact
- Develop knowledge and tools
- Deliver what we promise on the projects
- Show it to the world

01.1 Target and Aim

In line with Paris agreements we need to reduce our CO2 emissions and waste to zero before the year 2050. Because this is a worldwide target, the general consensus is that developed countries need to reach this goal well before 2050 to compensate for developing countries.

Before 2030 we already need to be halfway our reduction target to make sure that we don't exceed the total "carbon budget" (the surface area under the curve).



Based on the principles of the Science Based Targets initiative (SBTi) Scheldebouw commits to the following near-term reduction targets:

	Base year (FY22)	Target year (FY31)	% SBT reduction
Scope 1	419 tCO2e	241 tCO2e	-42.6%
Scope 2	750 tCO2e	435 tCO2e	-42.0%
Scope 3	19,008 tCO2e	11,025 tCO2e	-42.0%
Total	20,177 tCO2e	11,700 tCO2e	-42.0%

01.2 CO_2 performance ladder

The CO_2 performance ladder is a Dutch initiative for companies in the construction sector that want to be pro-active and set ambitious targets to reduce their carbon footprint as a company. The initiative is chosen by Scheldebouw, because it provides a structured framework to manage our sustainability developments. It is aligned with current and expected European legislation and helps us to stay ahead of what is strictly mandatory.

We are currently in the process to be audited for the CO2 Performance Ladder for the first time in September 2023. We are aiming for a level 3 certificate and will also be audited for level 4 to see how far we are to obtain this certificate as well. In this report the life cycle analyses are explained which we did as a pilot study on one of our projects. The results are compared to our findings in the “CO2 emission inventory”, which together form the basis of our “Carbon reduction plan”.

02 Life Cycle Analysis – pilot study

Before starting to apply for the CO2 Performance Ladder initiative the environmental analyses in our organisation focused mainly on the production process of our facades. Using the LCA (Life Cycle Analysis) method, we went through the entire life cycle of our facades and mapped out the environmental impact per phase. In this chapter the pilot LCA study is described.

02.1 Characterisation of product portfolio

Scheldebouw is not a manufacturer of standard products, but makes custom design solutions for every unique project. The starting point is an architectural design intent and a performance specification. To meet these requirements a new design is made for every project, followed by the selection of suppliers for the specific materials and performance testing of the façade design. The result is a product portfolio with a huge diversity in colours, shapes and materials. Developing a strategy to improve the environmental impact of our products is therefore not as straightforward. On the other hand it is possible to give a characterisation of what a “typical” unitised curtain wall element by Scheldebouw looks like, which covers the biggest part of our projects.

Impression of a “typical” unitised curtain wall element by Scheldebouw

02.1.1 Frame

Most Scheldebouw façades are made of rectangular elements with a frame of aluminium profiles (mullions and transoms) that are either anodised or powder coated. For thermal insulation purposes these profiles can be split into an inner and an outer shell, which are connected by polyamide insulator parts. A façade element may contain intermediate mullions or transoms to facilitate the use of different types of infills.

02.1.2 Glazing infills

Vision panels have an infill of glazing units that are usually built up out of two or three glazing panes, separated by spacer bars with an argon filled cavity and one or more coatings on the glass panes. The glass may be laminated and/or heat treated. It is also possible to have coloured frits on the glass.

Single glass panes are used as the outer layer of an opaque infill panel or can be added to create a double skin façade.

02.1.3 Opaque infills

The non-vision part of a façade element is usually made of a rockwool insulated spandrel panel, containing a pre-galvanised steel sheet at the back. When the steel sheet is visible from the inside, it is usually powdercoated. The outer layer of the spandrel panel can be made of an almost infinite list of materials. The most common are:

- Anodised or powdercoated aluminium sheetwork, either flat, corrugated or in any other shape
- Single or double glazing
- Terracotta
- Glass Fibre Reinforced Concrete (GFRC)
- Natural stone
- or a combination of materials

02.1.4 Architectural features

Additional components can be attached to the façade elements to give texture or to provide functions like shading or access to the outside. Also here the list of possible materials is almost infinite. Most common are the following:

- Projecting horizontal or vertical fins of aluminium extrusions, anodised or powdercoated
- Anodised or powdercoated aluminium sheetwork, cut and bended into various shapes
- Fins in other materials like wood, terracotta and GFRC
- Balconies
- Louvres / brise soleils

The distinction between what is an architectural feature and what belongs to the frame of an element or what is the outer layer of an opaque infill, is sometimes a bit arbitrary. This category is mainly used when it provides additional insight for analysis purposes. It is more important to keep the distinction consistent within the same project, than to come up with a general definition that should always be followed.

02.1.5 Other materials

To complete the list of materials that are used in unitised curtain wall facades, the following components are also typically present:

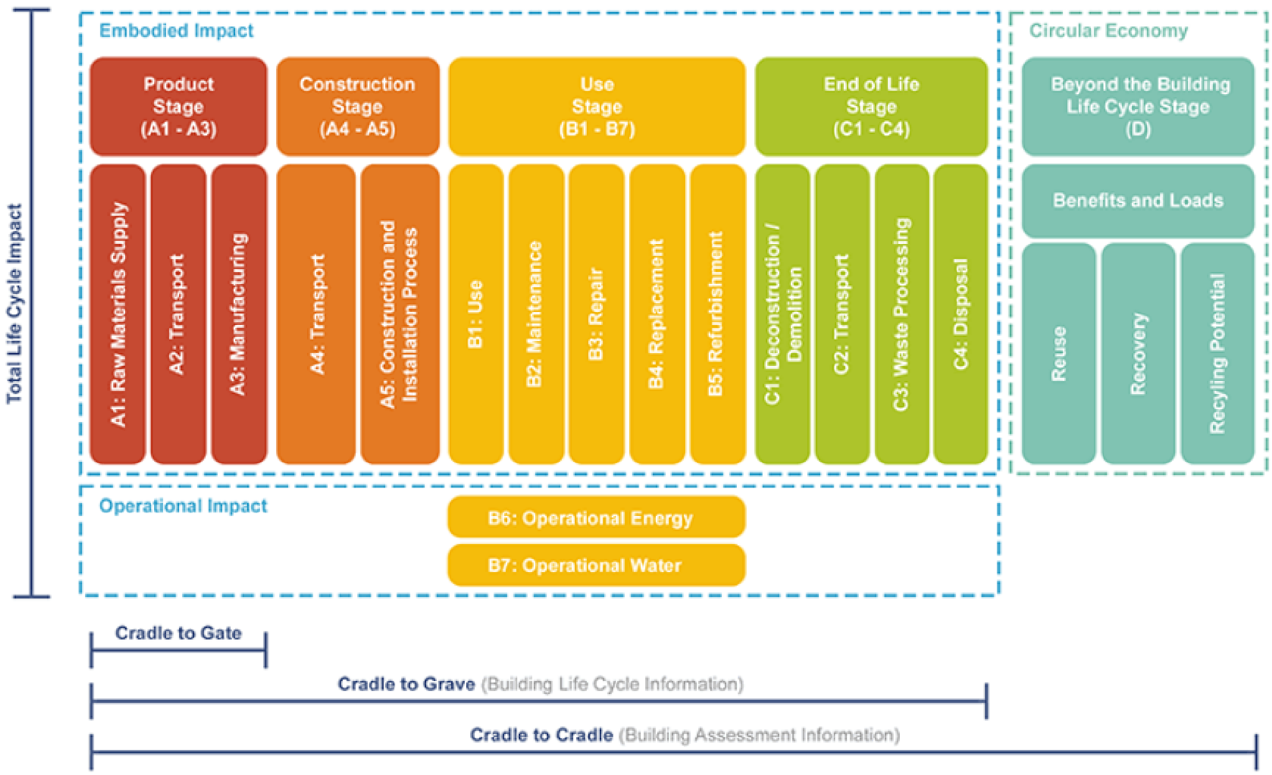
- Galvanised steel bracket to fix the façade units to the concrete structure
- Rockwool insulation and optionally steel sheets to close the gap between the concrete floor and the façade unit
- EPDM gaskets
- Fasteners (bolts, nuts, screws, rivets, etc.) usually stainless steel
- Silicone sealant

02.2 LCA / EPD approach

To assess the embodied carbon of our façades a Life Cycle Analysis (LCA) was conducted for the pilot project “n2” in London, using the software application R<THINK by NIBE, which is based on the LCA method EN 15804:2019+A2. This standard also serves as the core PCR, in compliance with ISO 14040:2006 and ISO 14044:2006.

The R<THINK software assesses and reports all life cycle stages A to D and the whole list of environmental impact categories. From the list of environmental impact indicators in EN 15804 the total Global Warming Potential (GWP-total) is taken to express the impact on climate change, often briefly called “carbon”.

The finished LCA calculations were sent to a third party for review. Once approved, an Environmental Product Declaration (EPD) was drawn up and published on ECO platform through MRPI.



Life cycle stages of a Life Cycle Analysis (LCA)

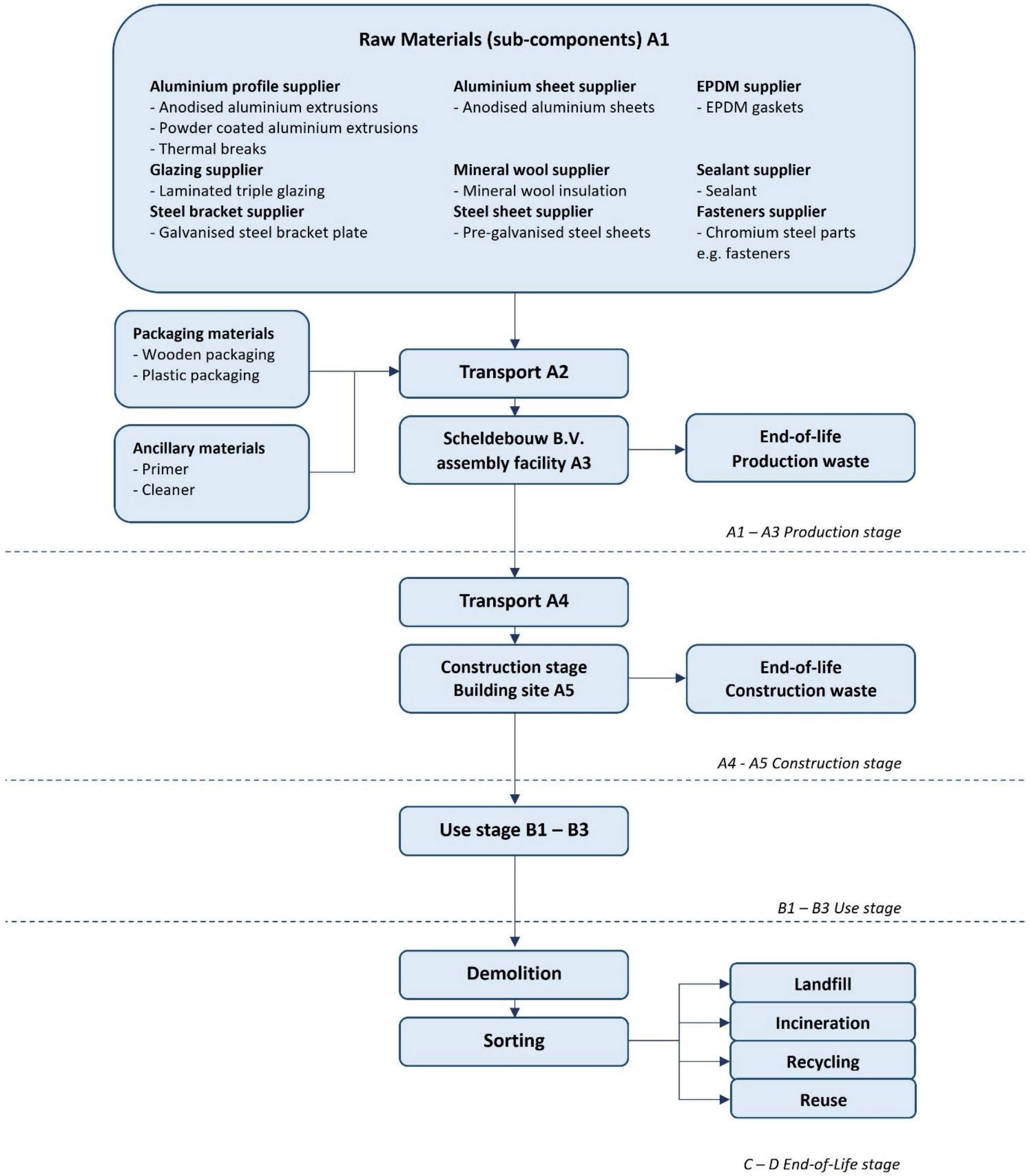
02.3 Assumptions and boundary conditions

02.3.1 Functional and declared unit

The LCA was conducted for a typical curtain wall façade element FT01A of the project “n2” in the Nova development, Victoria, London, including floor brackets and firestop.

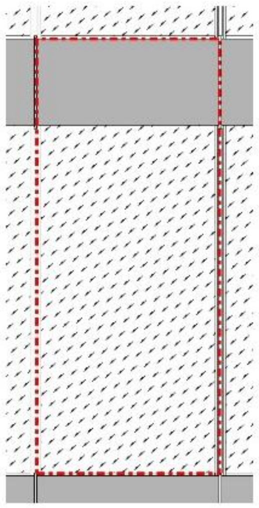
- Size: 1.5 x 3.55 = 5.325 m^2
- Weight: 357.23 kg
- Conversion factor is 1/5.325 for results per m^2 of facade.
- Declared unit: piece (p)
- Performance in accordance with DoP and CE-marking nr. 2021-91211

02.3.2 Process flow diagram

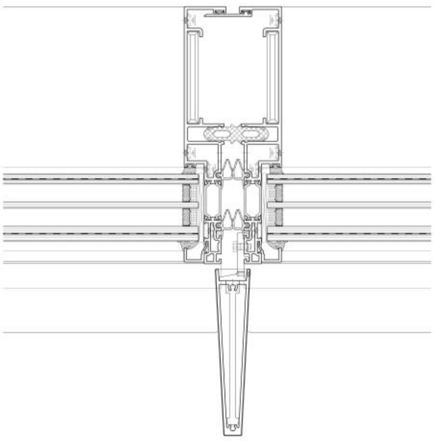


02.3.3 Materials (A1)

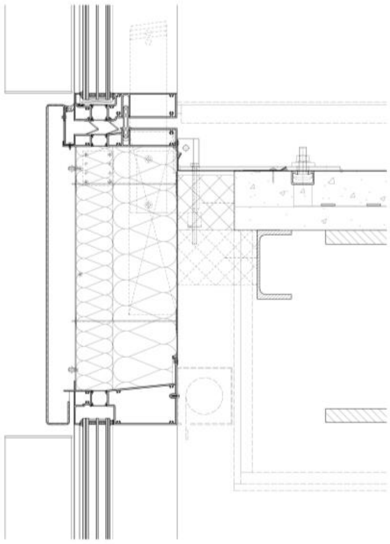
Supplier processes are based on a detailed analysis of Scheldebouw's supply chain and represents the performance that can always be delivered without specific supplier agreements. It must therefore be seen as the current baseline performance of our organisation's supply chain and serves as the starting point for comparisons to analyse the impact of embodied carbon reduction measures.



FT01A – Typical elevation



FT01A - Typical mullion



FT01A - Typical floor edge detail

One typical façade element FT01A consists of the following materials:

Material	Amount [kg]
Glass	
Vision glass (triple)	243.14
Frame	
Aluminium profiles, anodised	13.74
Aluminium profiles, powdercoated	31.68
Thermal breaks	2.46
Opaque infills	
Steel sheets, pre-galvanised	13.12
Insulation	7.86
Aluminium sheets, anodised	15.90
External Features	
Aluminium profiles, anodised	7.42
Other materials	
Steel brackets, galvanised	6.30
EPDM gaskets	6.68
Silicone sealant	0.61
Fasteners (stainless steel)	1.15
Steel sheets, pre-galvanised	4.60
Lamatherm firestop	2.57
	357.23

02.3.4 Transport (A2 and A4)

The transport (A2) by lorry between the different suppliers and Scheldebouw's assembly facility in Middelburg is based on the average distance of the top 3 suppliers per material:

Average supplier distances (stage A2)	km
Glazing	1000
Aluminium profiles	877
Aluminium sheets	372
Mineral wool	199
Steel sheets	161
Steel brackets	206
Gaskets	390
Fasteners	156
Sealant, incl. primer and cleaner	104
Wooden packaging	7.4
Plastic packaging	0.75

The transport (A4) from the Scheldebouw assembly facility in Middelburg to the building site in London is outlined in the table below:

Transport conveyance (stage A4)	Distance	Weight x distance
Lorry (truck): Middelburg-Rotterdam	85 km	
Transoceanic ship: Rotterdam-Purfleet	282 km	
Lorry (truck): Purfleet-London	31 km	
Total:	398 km	147.99 tkm

02.3.5 Production and construction (A3 and A5)

The processes in the Scheldebouw assembly facility (A3) are based on the yearly consumption in 2020 of the following materials divided by the area (m^2) of produced elements in that year:

- Ancillary materials (cleaner, primer)
- Energy consumption (electricity, natural gas)
- Packaging (wood, plastic)

Waste percentages of the façade materials are:

- 3% for materials that arrive from the suppliers in that form that they will be used
- 15% for materials that undergo cutting and machining
- 50% for sealant

The processes on the building site (A5) are based on the following:

- Energy consumption: estimate of electricity use of handheld tools
- Waste: an additional 3% for prefabricated units

02.3.6 Service life (B3)

The facade consists of various parts with different service lifetimes. During the reference service life (RSL) of the facade (60 years), several parts like glazing, sealants and gaskets need to be replaced. The replacement of these parts has been accounted for in life cycle stage B3.

The reference service life of the product parts in this report is based on the estimated service life, as defined in BS ISO 15686-1, which Scheldebouw provides to the client in their general guarantees and warranties schedule.

Product part	RSL
Laminated triple glazing	25 years
EPDM gaskets	30 years
Sealant	25 years
All other parts	60 years

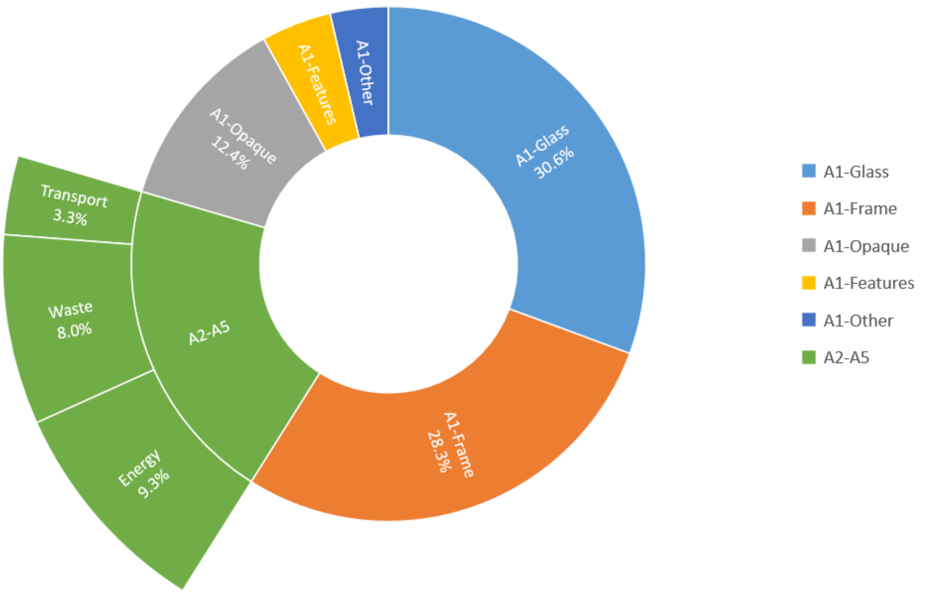
02.3.7 End-of-life and beyond the life cycle (C and D)

Modules C and D are modelled in accordance with the Dutch standardised end-of-life scenarios of the NMD (National Environmental Database). These are generic scenarios based on industry agreements as used in The Netherlands, which are deemed a good approximation of the British situation by lack of more accurate data.

02.4 Results

02.4.1 FT01A

Based on the assumptions described in the previous paragraph an LCA was executed for one façade element of type FT01A. The results for the embodied carbon in stages A1-A5 are shown in the figures below.



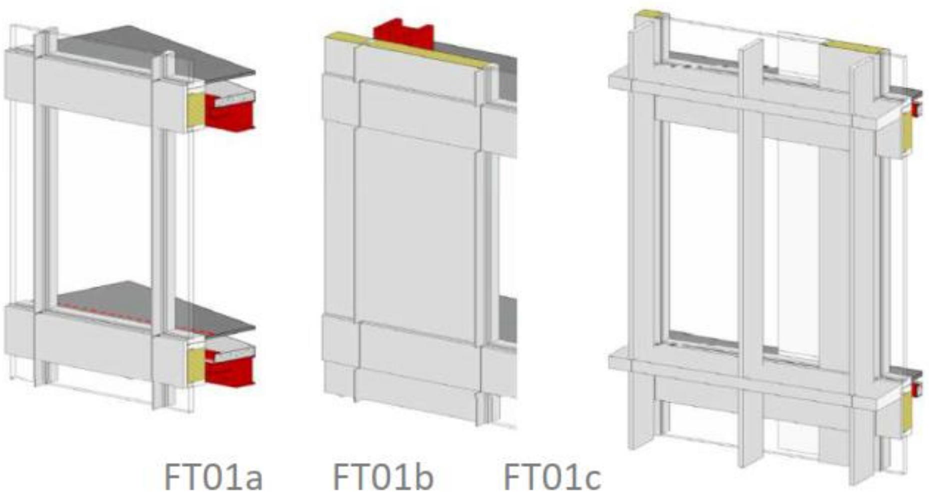
GWP-total [kgCO2e] for one element of 1.5 x 3.55 m²

Stage	kgCO2e	%
A1 - Glass	442.8	30.6%
A1 - Frame	409.2	28.3%
A1 - Opaque infills	179.1	12.4%
A1 - External Features	63.7	4.4%
A1 - Other materials	52.9	3.7%
Subtotal A1	1147.7	79.4%
Transport (A2 & A4)	47.9	3.3%
Waste (A3 & A5)	115.0	8.0%
Energy (A3 & A5)	134.4	9.3%
Total A1-A5	**1445.0**	
	271.4 kgCO2e/m2 façade	

The biggest impact (79.4%) is in stage A1, the materials that are purchased from our supply chain. Of these materials the biggest portion is taken up by the glazing (30.6%) and the aluminium frame (28.3%). The other purchased materials take up 20.5% and the remaining 20.6% is for the life cycle stages A2-A5.

02.4.2 Impact of design variations

Based on the same assumptions as for façade type FT01A, also two other façade types of the same project have been analysed.



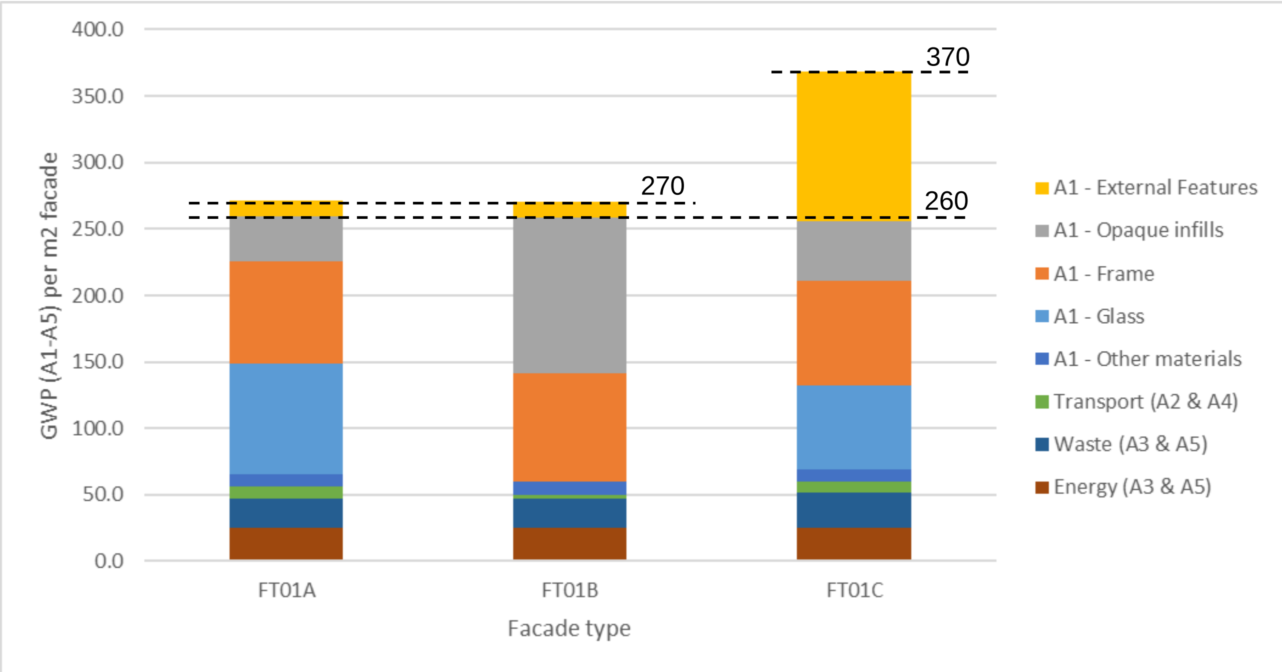
FT01B

FT01B consists of elements of the same size as FT01A (1.5 x 3.55 m2). The framing members and the materials to attach the façade panels to the main structure are all the same. The only difference is the infill. The glazing of the vision panels is replaced by an opaque panel with an aluminium sheet on the outside.

FT01C

FT01C consists of elements that are double the size of FT01A (3.0 x 3.55 m2). They are a combination of FT01A and FT01B in the sense that they are partially vision panels and that the other part has an opaque infill. In addition to that, this façade type has much bigger external features.

In the figure below the embodied carbon (A1-A5) per m^2 façade is compared for the three façade types.



The embodied carbon of both FT01A and FT01B is approx. 270 kgCO_2e / m^2. When omitting the external features the embodied carbon of all three façade types is approx. 260 kgCO_2e / m^2. Including the external features for FT01C the embodied carbon is approx. 370 kgCO_2e / m^2, so the impact of these features is that they add approx. 100 kg CO_2e / m^2 to the façade embodied carbon, when comparing FT01C to FT01A and FT01B.

02.4.3 Analysis

An easy conclusion from this analysis would be to remove the external features from the design, because they have a huge impact on the embodied carbon of the product. This is, however, a decision that Scheldebouw cannot make on its own. The architectural features are part of the client's design intent and are there for a reason. This might be aesthetics, but they might also have a specific function, like solar shading. By keeping the solar heat out of the building and thus reducing the cooling loads, they have an impact on the operational energy use of the building. These are also carbon savings, but they occur on a different location and within a different timeframe.

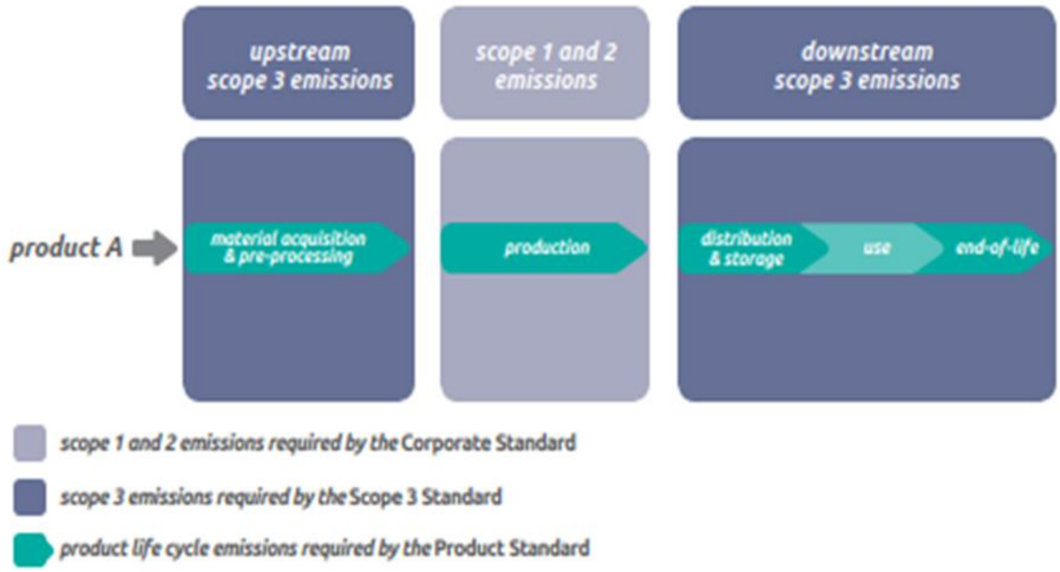
02.5 Conclusions

A pilot LCA study was conducted for the project “n2”, part of the Nova development in Victoria, London. Three façade types were analysed and the resulting calculations were sent to a third party verifier for review. The official EPD document has been published by MRPI.

Our expectation was confirmed that life cycle stage A1 mainly determines the CO_2 footprint of our product. These are the materials purchased from our supply chain and involves the specific design of a project, together with the choice of our suppliers and the further agreements with them. The other stages (A2-A5), which include transportation, waste and the activities in our own assembly facilities and on the building site, have a much lower impact.

03 Application of the product analysis in our company policy

In the figure below the relationship between the “product approach” LCA, as described in the previous chapter, and the “company approach” of the CO2 Performance Ladder and GHG Protocol are explained.



The environmental impact of all the products that are produced plus the additional emissions due to activities that are not directly related to the production process (engineering, travel and other “overhead”) together form the company’s environmental footprint.

Both approaches use different calculation methods and are based on different standards, so the results from one analysis cannot directly be applied to the other one as well. On the other hand, we think that our LCA study provides some valuable insights that are very useful to be applied in our company’s carbon reduction plan. This approach is described in the following chapter.

03.1 CO2 performance of Scheldebouw as an organisation

In the level 3 certification of the CO2 Performance Ladder a company first needs to focus on the emissions it can directly influence: its own building related energy use (Scope 1 and 2) plus travel movements (scope 3.6 & 3.7). The other Scope 3 emissions in the value chain are only included as of the level 4 certification. Please refer to the “Scheldebouw CO2 emission inventory” for more information on the calculation method and the results of Scheldebouw’s CO2 performance.

In the following table the results are shown of the CO2 emission inventory for the financial years FY22 and FY23 for the different activities included for the level 4 certification of the CO2 Performance Ladder.

	CO2 emissions FY22		CO2 emissions FY23	
	[tCO2e]	part of total	[tCO2e]	part of total
Scope 1	419	2.1%	320	1.9%
Scope 2	750	3.7%	613	3.6%
3.6 Business travel & 3.7 Employee commuting	348	1.7%	404	2.4%
Subtotal (level 3)	**1,518**	**7.5%**	**1,338**	**7.9%**

Subtotal (level 3)	**1,518**	**7.5%**	**1,338**	**7.9%**
3.1 Purchased goods and services	13,455	66.7%	12,138	71.8%
3.2 Capital goods	459	2.3%	404	2.4%
3.4 Upstream transport	4,638	23.0%	2,563	15.2%
3.5 Waste in operations	108	0.5%	472	2.8%
Total	**20,177**	**100.0%**	**16,914**	**100.0%**

This analysis shows that the activities included in the level 3 assessment account for only approx. 8% of the total CO2 emissions of our company. The biggest portion (67-72%) is taken up by the purchased goods and services (Scope 3.1), followed by transportation of goods (Scope 3.4).

03.2 Activities included in the CO2 emission inventory compared to the LCA

In the following table it is indicated for every activity in the CO2 emission inventory whether it is included in the level 3 and level 4 assessment for the CO2 Performance Ladder and if it corresponds to a certain life cycle stage in the LCA. This comparison shows how the LCA results in section 02.4 relate to the carbon footprint results in section 03.1.

Activity	Description	CO2 Performance Ladder		LCA
		Level 3	Level 4	stage
Scope 1				
Stationary combustion Mobile combustion	Gas use factory Gas use office Fuels for leased cars	x x x	x x x	A3 - -
Scope 2				
Purchased electricity	Factory Office	x x	x x	A3 -
Scope 3.6 & 3.7 Business travel & Employee commuting				
3.6 Business travel	Flights, train trips, cars & taxis	x	x	-
3.7 Employee commuting	Employee owned cars	x	x	-
Other (upstream) scope 3				
3.1 Purchased goods and services	Curtain wall materials Production + packaging materials Other purchased goods + services	- - -	x x x	A1 A3 -
3.2 Capital goods	Owned and leased assets	-	x	-
3.4 Upstream transport	Supplier – Factory Factory – Building site Other	- - -	x x x	A2 A4 -

3.5 Waste in operations	Factory waste Office waste Site waste	- - -	x x x	A3 - A5
Downstream scope 3				
3.11 Use of sold products	Operational carbon Replacement of components	- -	- -	(B6)* B3
3.12 End of life	Demolition and waste treatment	-	-	C / D

x = included - = not included * = not part of LCA standard

03.3 Embodied carbon comparison on "product" and "company" level

The "product" approach LCA only includes environmental effects that are directly related to the production process, so it excludes emissions that are "overhead", like travel and engineering. It also doesn't have a timeline and zooms in to the level of a single product, which in our case is defined as a curtain wall façade element.

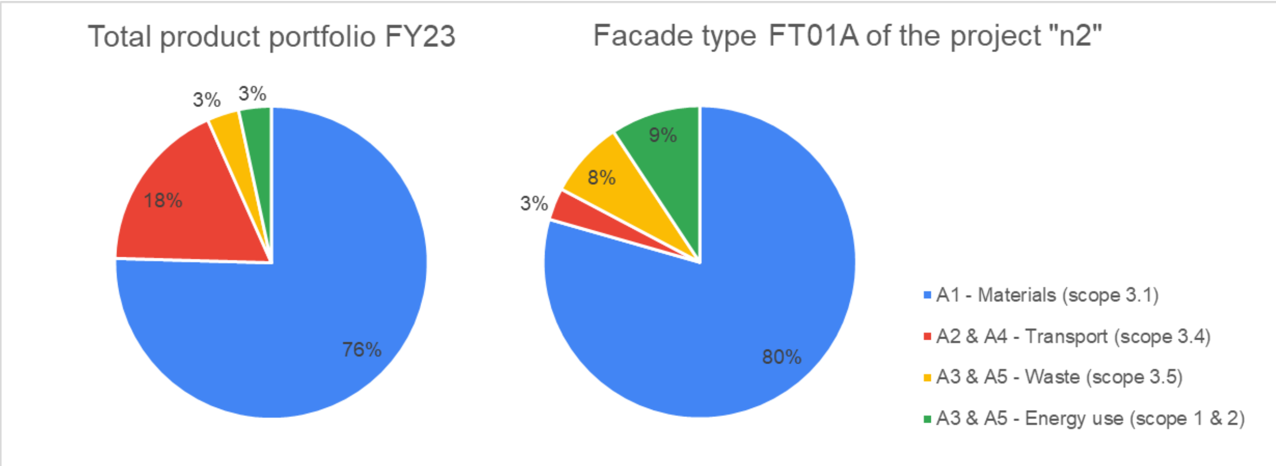
The "company" approach of the GHG protocol and the CO2 Performance Ladder includes emissions from the whole organisation and its value chain. They are reporting standards that are related to certain reporting periods (a year or shorter). In Annex 1 a further comparison between the two approaches is made.

When excluding the "overhead" from the carbon footprint data in paragraph 03.1 and only including the activities that are also in the LCA (see table in paragraph 03.2), the remaining CO2 footprint is the embodied carbon of all our company's products together. In the table below the results for financial year FY23 are corrected to exclude the overhead and represent the embodied carbon of all our products in FY23.

	CO2 emissions FY23		**CO2 emissions FY23 (excl. overhead)**	
	[tCO2e]	part of total	[tCO2e]	part of total
Scope 1	320	1.9%	63	0.4%
Scope 2	613	3.6%	421	2.9%
3.6 Business travel & 3.7 Employee commuting	404	2.4%	0	0.0%
3.1 Purchased goods and services	12,138	71.8%	10,811	75.4%
3.2 Capital goods	404	2.4%	0	0.0%
3.4 Upstream transport	2,563	15.2%	2,563	17.9%
3.5 Waste in operations	472	2.8%	472	3.3%
Total	**16,914**	**100.0%**	**14,329**	**100.0%**

The total number of produced façade units in FY23 was 4678 and the total area covered by these elements was 37,163 m^2. In the next table the results per m^2 façade elements of the whole company are compared to the results from the LCA in section 02.4.

	Embodied carbon of total product portfolio FY23		Embodied carbon of façade type FT01A of “n2”	
	[kg CO2e per m^2 façade]		[kg CO2e per m^2 façade]	
A1 - Materials (scope 3.1)	290.9	75.4%	215.5	79.4%
A2 & A4 - Transport (scope 3.4)	69.0	17.9%	9.0	3.3%
A3 & A5 - Waste (scope 3.5)	12.7	3.3%	21.6	8.0%
A3 & A5 - Energy use (scope 1 & 2)	13.0	3.4%	25.2	9.3%
Total	**385.6**	**100.0%**	**271.4**	**100.0%**



The most important finding of this comparison is the fact that the Scope 3.1 purchased materials are dominating in the results of both assessment methods (75% resp. 79%). This confirms our assumption that a carbon reduction strategy focussed on reducing these emissions would be the most impactful.

Looking closer to the results, the portion for transportation of goods (scope 3.4) is much higher on a company level (18%) than we expected from the LCA study (3%). Waste and energy use, on the other hand, make up a much smaller portion on company level (3% resp. 3%) than in the LCA study (8% resp. 9%). These differences can be explained by the fact that the calculation methods and the underlying assumptions are completely different. It will be further investigated if improvements are needed for one or both of the assessment methods.

04 Embodied carbon reduction approach on the projects

Scheldebouw's carbon reduction strategy is based on reducing the CO2 emissions that are directly influenced by the company (building energy use and travel policy) and on reducing the embodied carbon emissions during the production of our products (upstream scope 3). In the Life Cycle Analysis standard these second set of activities are categorised under the life cycle stages A1 to A5 (Production and Construction stage). Our reduction approach for these emissions is discussed further in this chapter.

The analysis in the previous chapter confirms this strategy, which is focused on providing better insight for the project related design, engineering and purchasing decisions we have to make together with our clients. By comparing the environmental impact of different design and material related alternatives, we are able to make better informed decisions. We provide embodied carbon calculations from the early design stages on, update those regularly during the project execution phase and finalise the process by going through a full third party verification to obtain official Environmental Product Declarations (EPDs) for the specific design of that project.

All of this in close collaboration with our client's project team to make sure that we meet their expectations, requirements and architectural design intent. With this approach we try to reduce the embodied carbon of our products in a holistic way instead of focussing on specific solutions.

04.1 Reduction of upstream Scope 3 activities

The design options we provide to the client usually focus on a combination of the following aspects to achieve the biggest impact:

- Optimising the design to reduce the quantities of the different materials
- Assessing the impact of using an alternative material, e.g. aluminium sheets vs. terracotta
- Looking for alternative suppliers and/or production methods, e.g. low-carbon aluminium billets

The following aspects are also part of the embodied carbon assessment of our products, but currently have a much more limited impact:

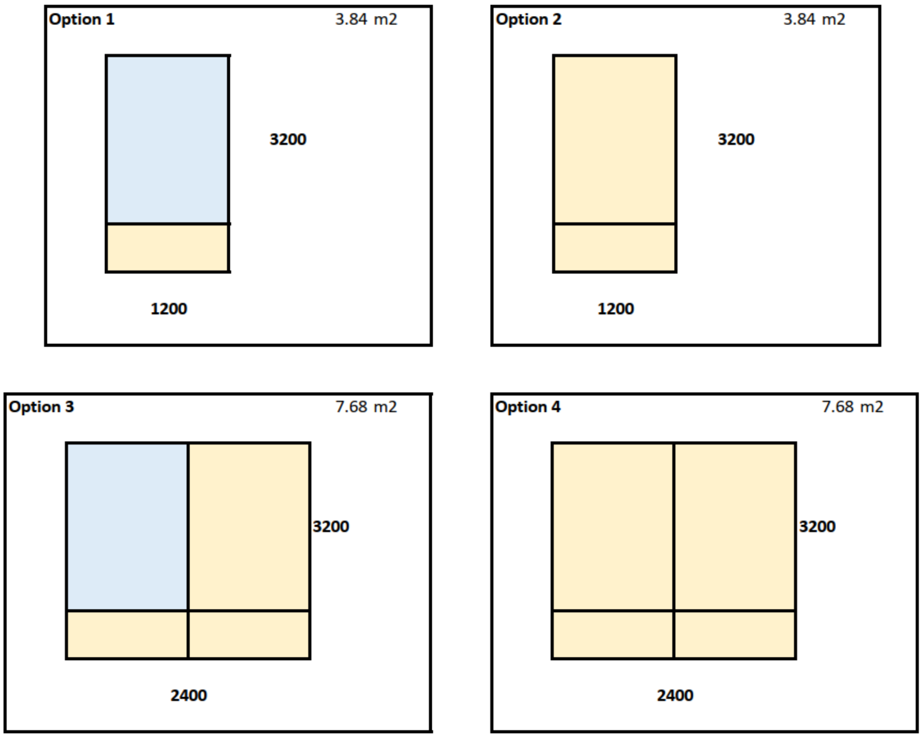
- Transportation distances
- Façade assembly activities in our own production facility
- Façade installation on the building site

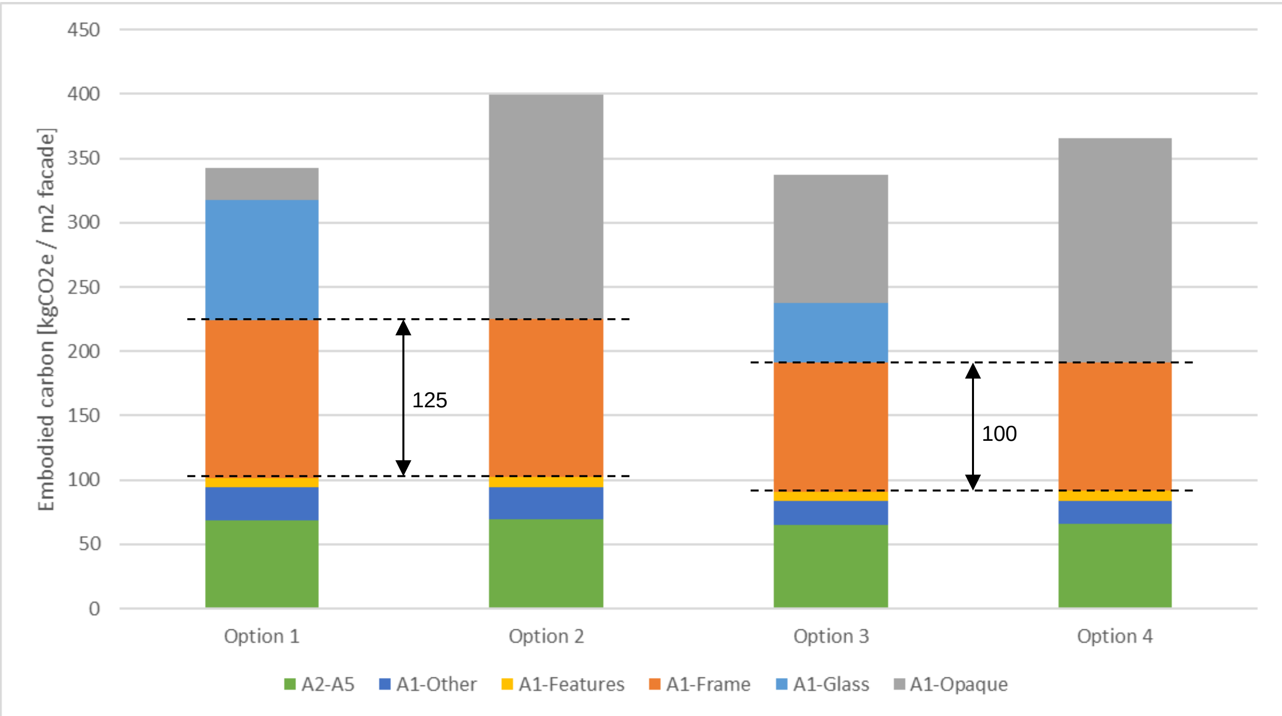
In the next paragraphs we describe two effective strategies to reduce the embodied carbon of our products in the early design stages.

04.1.1 Strategy 1: Design optimisation

The starting point of a project for Scheldebouw is an architectural design intent and a performance specification. To meet these requirements a new design is made for every project, followed by the selection of suppliers for the specific materials. In the early project stages this approach makes it possible to balance all the technical, planning and cost aspects with the environmental aspects resulting in an optimal solution for the specific project.

An example from a recent tender project is shown below. Four design options are being compared and the decision is about façade panels that are 1200 mm wide or 2400 mm wide. Option 1 and 2 are 1200 mm wide, one vision panel and one opaque panel. Option 3 and 4 are 2400 mm wide, one panel with a combination of vision and opaque, the other panel fully opaque.





For the same visual effect, Option 3 is a combination of Option 1 and Option 2, and Option 4 is a combination of two panels of Option 2. The difference is the split in the middle. When we look at the embodied carbon of the frame (in orange), it becomes apparent that combining two panels of 1200 mm wide into one panel of

2400 mm wide, saves 25 kg CO2e / m² façade just for the frame. In stages A2-A5 and in “A1-other materials” there are some additional savings, because we need to transport less weight and because we omit one joint, so we need less gaskets.

Another conclusion we can draw from this overview is that the opaque infill is more carbon intensive than the glazing infill. This is caused by the specific design of this project, which has a corrugation to the outside of the opaque panel that uses a lot of additional material.

After providing an overview like this to our clients, the conclusions are combined with the analysis of the other technical aspects of the façade and their implications for the costs and planning of the project. In this way it is possible to make an informed decision for the execution of the next project stages.

04.1.2 Strategy 2: Low-carbon material options

Like explained in the previous paragraph, the design of each project is completely tailored to the client’s wishes and needs. Also the suppliers of the materials Scheldebouw use in their facades are chosen for each project individually. This means that after the design optimisation, the next strategy that can have a lot of impact on the carbon intensity of our facades is to look for suppliers with improved production processes that have lower carbon emissions. An example are the so called “low-carbon” aluminium billets.

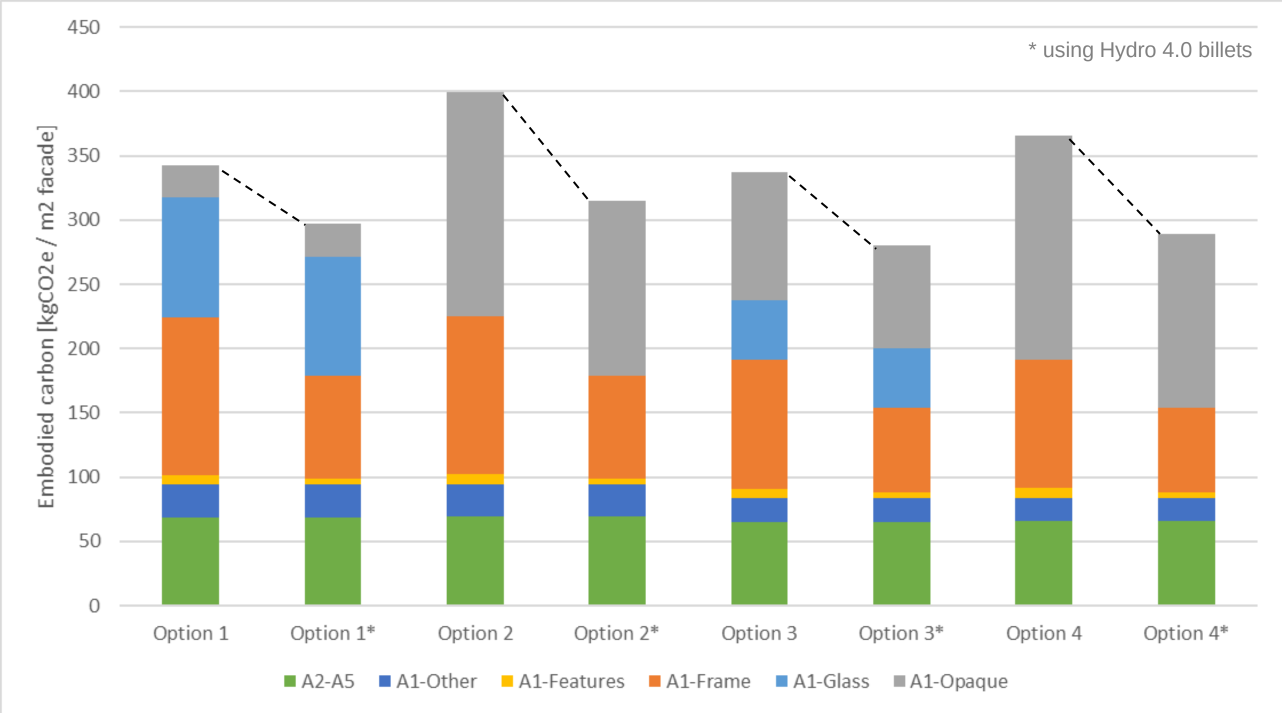
In the table below the assumptions and figures are provided that we use as an industry average of our European supply chain for the extrusion profiles.

	anodising	**powder coating**
1 kg of billets [kg CO2e]	7.17	7.17
1 kg extrusion process [kg CO2e]	0.80	0.80
0.18 m² of surface treatment [kg CO2e]	0.62	0.54
Total [kg CO2e]	**8.59**	**8.51**

The supplier Hydro now provides billets that are produced by using hydro-electric power, which have an embodied carbon of 4.0 kg CO2e / kg aluminium. Comparing that number to the table above, the carbon saving is 3.17 kg CO2e per kg of aluminium (7.17 – 4.0). The impact of this choice for the frame of the façade panels can be seen in the graph on the next page.

The supplier Hydro also provides aluminium billets with an embodied carbon of 2.3 kg CO2e / kg aluminium. These are produced by using a much higher percentage of recycled content. The consequence is that they have more impurities, which makes them not suitable at the moment to use anodisation as a surface treatment. Also the availability of these billets is limited and Hydro decided not to provide them for custom extrusions, like Scheldebouw uses on their projects. It means that in practise we cannot use these billets at the moment.

For every project we look again at the options available from our suppliers, because the developments go very quickly. Currently we are also looking at other suppliers of aluminium billets if they have low-carbon products. The next material we expect to have low-carbon options available to be used in our facades is glazing.



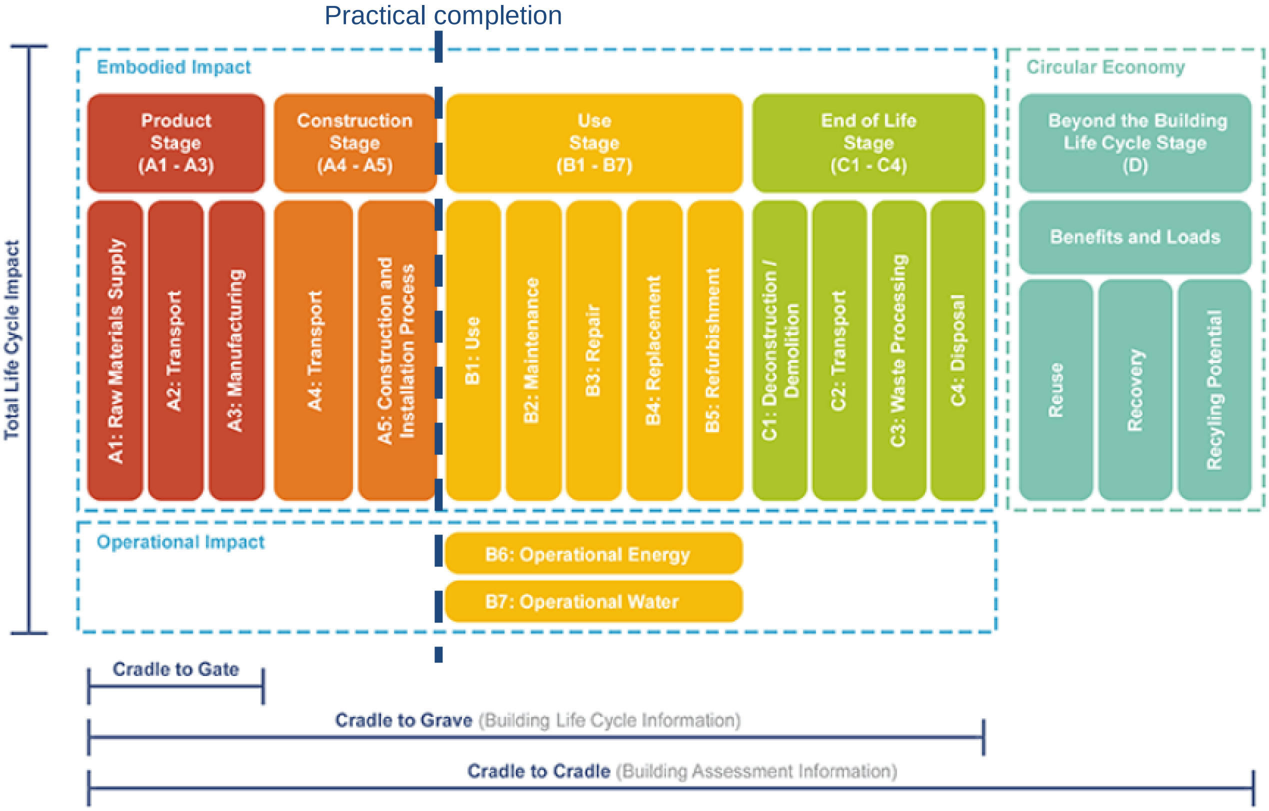
04.2 Impact of downstream Scope 3 activities

The design and material choices of our products also have a huge effect on the operational energy use of the building that our facades will be part of (scope 3.11 “use of sold products”) and on the re-use and recycling potential of the materials at the end of the service life (scope 3.12 “end-of-life treatment of sold products”). In the Life Cycle Analysis standard these downstream scope 3 activities are categorised under the stages B (use stage) and C (end-of-life).

Operational energy use

The operational energy use (B6) actually is not part of the Life Cycle Analysis standard, because it has a different assessment method. The operational energy use of a building is not purely material related, but is a characteristic of the whole building. It cannot be easily attributed to the different components of a building, so there is no easy answer to which part of the total energy use of the building is “caused by” the façade.

It is, however, clear that over the past years the development of high-performance facades has contributed significantly to reduce the operational energy use of buildings. Examples are the addition of thicker thermal insulation material to the opaque parts of the façade and the improvement of the glazing properties. Double skin façade concepts have been developed to reduce the energy consumption further and it is even possible to add solar panels to the façade to generate electricity.



Life cycle stages of a Life Cycle Analysis (LCA)

End of life potential

The end-of-life treatment of the façade components is now taken into consideration in our Life Cycle Analyses by using the generally accepted end-of-life scenarios of the Dutch NMD and by applying our standard schedule of predicted service life for the replacement of components. For a more detailed approach the information is not available, mainly because we are dealing with a lot of uncertainty about what will happen over the course of a building's service life of 50 years (or more). Also the technological developments with regards to re-use and recycling potential are going very rapidly.

Our priority is not to be able to accurately measure these emissions on short term. Instead we use our valuable resources to come into action based on the knowledge we already have, because the real aim of this initiative is reducing emissions and not only measuring them.

05 Conclusion

The CO_2 performance ladder is a Dutch initiative for companies in the construction sector that want to be pro-active and set ambitious targets to reduce their carbon footprint as a company. The initiative is chosen by Scheldebouw, because it provides a structured framework to manage our sustainability developments. It is aligned with current and expected European legislation and helps us to stay ahead of what is strictly mandatory. We are currently in the process to be audited for the CO2 Performance Ladder for the first time in September 2023. We are aiming for a level 3 certificate and will also be audited for level 4 to see how far we are to obtain this certificate as well.

05.1 Embodied carbon reduction approach

Before starting to apply for the CO2 Performance Ladder initiative the environmental analyses in our organisation focused mainly on the production process of our facades. Using the LCA (Life Cycle Analysis) method, we went through the entire life cycle of our facades and mapped out the environmental impact per phase. Our expectation was confirmed that the choice of our suppliers and the further agreements with them in particular determine the CO_2 footprint of our product. Transportation, waste and the activities in our own assembly facilities and on the building site have a much lower impact. Still they cannot be neglected, if only because they are important for the visibility and awareness of our CO2 reduction policy, both internally and externally.

The sustainability developments at Scheldebouw therefore focus on providing better insight for the project related design, engineering and purchasing decisions we have to make together with our clients. By comparing the environmental impact of different design and material related alternatives, we are able to make better informed decisions. We provide embodied carbon calculations from the early design stages on, update those regularly during the project execution phase and finalise the process by going through a full third party verification to obtain official Environmental Product Declarations (EPDs) for the specific design of that project. All of this in close collaboration with our client's project team to make sure that we meet their expectations, requirements and architectural design intent. With this approach we try to reduce the embodied carbon of our products in a holistic way instead of focussing on specific solutions.

05.2 Future developments

Scheldebouw's carbon reduction strategy first focusses on the short term effects by reducing the CO2 emissions that are directly influenced by the company (its own energy use and travel policy) and by reducing the embodied carbon emissions during the production of our products (upstream scope 3). But our facades also have a huge effect on the energy use of the buildings they are going to be part of. And they need to be maintained, repaired and will eventually be dismantled and removed. These are all downstream scope 3 activities that are even more difficult to measure. The emissions are either not directly related to the façade alone (energy use of a whole building) or have a high uncertainty because they will happen far in the future (a building's service life is 50 years or more). Our priority is not to be able to accurately measure these emissions on short term. Instead we use our valuable resources to come into action based on the knowledge we already have, because the real aim of this initiative is reducing emissions and not only measuring them.

Annex 1: Comparison of “product” and “company” methods

Environmental impact of facade manufacturing as part of Scheldebouw's organisational carbon footprint		
Level	Product: curtain wall facade	Company: Scheldebouw
Method	LCA / EPD	GHG protocol (incl. Scope 3)
Characteristics	many impact categories no timeline only direct production related	only global warming timeline including overhead
Result	environmental impact matrix with values per category per life cycle stage for one facade unit	periodical report of carbon emissions per activity type for complete company + its value chain
Carbon factors	very accurate modelling possible	← difficult to obtain accurate values, so preference to use those of LCA (if possible)
Data needed		
Purchased materials	kg in one unit from PMF	kg (or euro) total purchased from SAP
Energy use factory	use average values from →	Record
Energy use office	N/A	Record
Energy use site	use average values from →	Record
Waste	use average values from →	Record
Transport	use average values from analysis	Record or use average values
Travel + commuting	N/A	Record
Project strategy	make facade type matrix and agree number of calculations + external verifications with client	Divide organisational carbon footprint over the projects by ratio of turnover. More accurate approach to be defined.
	embodied carbon per m2 facade x facade area = total embodied carbon	