Chain Analysis Shadow pricing 2020-2025

VenhoevenCS

architecture+urbanism

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1 | Introduction

VenhoevenCS made an analysis of a GHG (Green House Gas) generating chain in the context of the CO_2 performance ladder. This document describes the chain of shadow pricing.

Note dd 18-8-2023

During the management review in April 2023 it became clear that the set goals for the Chain Analysis are not within reach. Management decided to evaluate the *Environmental Impact Tool*, our instrument for the Chain Analysis. In Appendix 2, you will find the result of thus evaluation, the conclusion, the new goals for 2023-2025 and additional chain analysis currently in progress.

About VenhoevenCS

Sustainability has been in VenhoevenCS' DNA since the foundation in 1998. Sustainability is both internally and externally an important issue. Externally, we make our clients aware of sustainable solutions, such as low-energy buildings and circular economy. Internally, we make our people aware of sustainability.

The board members of VenhoevenCS are international speakers in the field of sustainable urbanism, self-sufficient cities, low-energy buildings and circular economy. The sustainability awareness among staff members is very high because sustainability is the driving factor of our urban designs and architectural vision.

Internal sustainability focuses mainly on our own housing- mobility- and purchasing policy. In 2009 VenhoevenCS started to calculate its CO_2 footprint and set up a CO_2 reduction plan. The emissions that were unavoidable were offset by the Gold Standard. In other words: VenhoevenCS had a climate neutral operational management.

In 2013 the organization was hit by the real estate crisis, which meant that we could no longer offset emissions. As a result, CO_2 reduction disappeared from the priority list. The CO_2 performance ladder offers us tools to pick up our internal policy with regard to CO_2 reduction again. The policy that has been developed is based on sustainability, savings and compensation. Reducing CO_2 emissions is not only a top-down affair but employees are also very aware of the need to operate in a sustainable way. All measures are evaluated from a business-economic perspective.

What is a chain analysis?

A chain analysis means calculating the CO_2 emissions of the entire chain of a certain product or service. The entire chain refers to the entire life cycle of the product: from the extractions of the raw materials to the end of the life cycle.

Goal

The main purpose for conducting this chain analysis is to identify CO_2 reduction opportunities, define CO_2 reduction targets and monitor the reduction progress.

Based on the chain analysis and the insight into the scope 3 emissions, a reduction target is formulated. The energy management system implemented by the organization actively manages the reduction of the scope 3 emissions.

Providing information to partners within the chain is part of the energy management system. In addition, information will also be provided to sector colleagues who are part of a similar chain of activities. Based on this chain analysis, VenhoevenCS will take steps to involve partners within its own chain in achieving the reduction targets.

Conclusion ambition statement

VenhoevenCS considers itself a frontrunner in the field of sustainable urbanism, in which knowledge sharing and research into new sustainable possibilities are central. VenhoevenCS is the only architectural firm certified at level 5 of the CO_2 performance ladder. In addition, VenhoevenCS works closely together with chain partners and the government to ensure that this sustainable way of building can also be applied in the future.

Reading guide

In this report VenhoevenCS presents the chain analysis of shadow pricing. The structure of the report is as follows:

- Chapter 2: Identifying Scope 3
- Chapter 3: Identifying chain activities
- Chapter 4: Quantifying the emissions
- Chapter 5: Opportunities for improvement and objectives
- Chapter 6: Acknowledgement of sources
- Chapter 7: Declaration of chain analysis

2 | Identifying Scope 3

The subject of the chain analysis is determined on the basis of Product-Market-Combinations (PMC). The table below shows on which product-market-combinations VenhoevenCS has the most influence to reduce CO_2.

Selection

In accordance with the regulations of guidebook 3.1, VenhoevenCS will choose an emission source from the top two in order to set up a chain analysis. The top two concerns:

PMC's sectoren & activiteiten	Score kolom 3, tabel 2	Score kolom 4, tabel 2	Score kolom 5, tabel 2	Totaal score	Rangorde
Architectuur					
• Installaties (EPC)	10	10	10	1000	1
• Materiaal	10	10	7	700	2
• Constructie	10	10	7	700	3
Stedenbouw	10	4	10	400	4
Woon-werkverkeer	7	10	4	280	5
Aangekochte goederen en diensten	4	4	4	64	6
Consultancy	10	1	4	40	7
Papierverbruik	4	4	1	16	8

VenhoevenCS chose to make one chain analysis of a product from the category "material". Here the focus will mainly be on the main building support structure, since this component is an important component of the total CO_2 emissions. A further explanation can be found in chapter 4 of this chain analysis.

Scope

When analyzing the scope 3 emissions for VenhoevenCS, we looked at the emissions emitted in the chain. A large part of the activities takes place in the office where designs are made on computers and paper. This work causes relatively little CO_2 emissions. The largest part of the CO_2 emissions are caused by the production and implementation of these designs. For this reason, an analysis has been made of how the emissions can be reduced during execution. The focus was on offering different designs, where for each design an estimate was made of the total CO_2 emissions generated during the construction process. This allows the client to compare different options and make a choice focused on sustainability. In this way, VenhoevenCS shows the client that sustainability can play an important role in the choice that is made.

This chain analysis focuses on the shadow price of the main building support structure. In the chain analysis we looked at the designs delivered by VenhoevenCS and the CO_2 emissions associated with the production and implementation of these designs. In most

cases the designs delivered by VenhoevenCS consist of a complete project. The following products in the project emit CO_2 in their production: the main building support structure, the insulation material, the façade, window frames and the roof. The materials of the main building support structure, which mostly consists of concrete, steel and wood, causes the largest part of the total CO_2 emission. With this focus, VenhoevenCS hopes to make an informed and influential recommendation in most of the designs they submit.

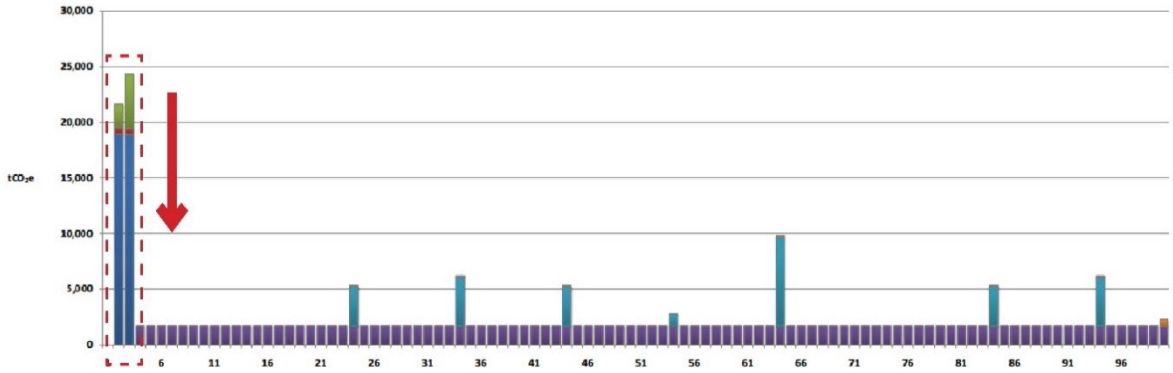
Data collection

In this chain analysis, primary data supplied by VenhoevenCS is mainly used.

	Distribution of Primary and Secondary Data
Primary data	-Experience architects -Example designs -MPG calculations
Secondary data	-NIBE database -UK Green Building Council

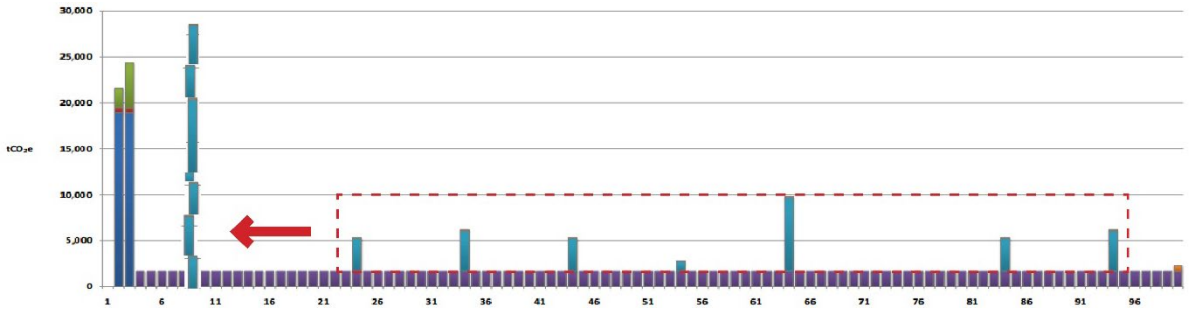
3 | Identifying chain activities

The business activities of VenhoevenCS are part of a chain of activities, where the influence is mainly at the beginning of the chain. For example, the project leader or contractor determines the final choice of building materials. In many cases the designs are used more as a guideline than as a standard. The illustration below illustrates that VenhoevenCS mainly influences the CO_2 emission at the start of a project.



1UK Green Building Council

The illustration shows the CO_2 emissions of an office building with a life span of 100 years. Most of the emissions are caused in the first two years during construction. The largest CO_2 reduction can be achieved by looking at the choice of materials and the construction process. The constant CO_2 emissions take place through the use of gas and electricity. In addition, there are a number of peak moments when a lot of CO_2 is emitted due to necessary maintenance.



2UK Green Building Council

In addition to reduction at the start of construction, it can also be very important to extend the life of the building by using sustainable materials. This spreads the total emissions over a longer period of time and reduces the need for maintenance. The illustration shows that the total amount of emissions caused during the maintenance phase is more than one year of construction.

This information shows how important it is for VenhoevenCS to prescribe the right materials during the design phase. The next paragraph describes the different chain activities.

Chain activities

Tender
The design of a new building often starts with a tender for a new project. VenhoevenCS submits a concept design and if the tender is won, this design will be further developed.

Design
VenhoevenCS has the most influence on the choice of materials for the construction and the facade, because these components are included in the concept design. If the tender is won, a preliminary design will be made in which the details are further complemented. The design will be discussed with the contractor or project developer in order to produce a final design. Finally, an implementation design will be made. After this, VenhoevenCS can only exert influence during the supervision of the building process.

Construction
During the construction of the project, raw materials are used for the various components of a building. The process of construction is responsible for most of the CO_2 emissions in the chain. In addition, the machines that are used often run on fossil fuels and therefore also cause CO_2 emissions.

Maintenance
During the lifecycle of a building, maintenance will need to be done which in some cases will cause CO_2 emissions. For example, by using machines that run on fossil fuels.

Demolition
In some cases, the building will have to be demolished to make room for a new project. It is difficult to estimate what materials and machines will be used during the demolition process, because buildings can have a life span of 100 years. It is unclear what materials and machines will be used in the future.

Possibility of influence

Research shows that concessions are often made during the implementation of designs which lead to a less sustainable choice and thus execution. The tender is often won on the basis of the sustainable aspects of the design, but the contractor often ultimately chooses a cheaper and often less sustainable option.

In this chain analysis we zoomed in on the above problem, because VenhoevenCS can achieve a marginal reduction in scope 3. However, the choice for materials is often not made by VenhoevenCS. For this reason, it is important that VenhoevenCS starts the discussion with chain partners.

VenhoevenCS starts the discussion with chain partners by offering a concept design with the best shadow price and thus the lowest CO_2 emissions. In this way VenhoevenCS hopes that contractors and project developers will base their choices more on sustainability.

The concept design contains several components that have a great influence on the total CO_2 emissions caused during the construction process. The main building support structure (which is mostly made of concrete, steel or wood) has high emissions especially in production.

Shadow pricing

The Netherlands Institute for Building Biology and Ecology (NIBE) has built up a database to make a good comparison between the environmental impact of different materials. A Life Cycle Analysis (LCA) of all these materials was made after which the effects were converted into shadow pricing. These costs include emissions, raw materials, land use and nuisance. The lower these costs are, the better the material is for the environment. VenhoevenCS already regularly uses this database in the design of sustainable projects.

Frequent use of this database has shown that the lowest shadow price at the main building support structure produce low CO_2 emissions. The greenhouse gases that include CO_2 have an average share of 61% in the total shadow price. A summary of this analysis can be found in the Appendix (1.1). This result shows that the use of this database can be seen as effective in achieving the lowest possible emissions in a design.

	Milieueffectcategorie	Equivalent eenheid	Methode	
Emissies	Klimaatsverandering – GWP 100 j.	CO_2 eq	CML2-baseline	Nationale Milieudatabase
	Aantasting ozonlaag – ODP	CFK-11 eq	CML2-baseline	
	Humane toxiciteit – http	1,4-DCB eq	CML2-baseline	
	Zoetwater aquatische ecotoxiciteit – FAETP	1,4-DCB eq	CML2-baseline	
	Terrestrische ecotoxiciteit – TETP	1,4-DCB eq	CML2-baseline	
	Fotochemische oxydantvorming – POCP	C_2H_2 eq	CML2-baseline	
	Verzuring – AP	SO_2 eq	CML2-baseline	
	Vermesting – EP	PO_4 eq	CML2-baseline	
Uitputting grondstoffen	Uitputting abiotische grondstoffen – ADP	Sb eq	CML2-baseline	
	Uitputting fossiele energiedragers	Sb eq	CML2-baseline	
	Uitputting biotische grondstoffen – BDP	mbp	TWIN	NIBE
Landgebruik	Landgebruik	PDF*m2yr	Eco-indicator '99	
Hinder	Hinder t.g.v. stank	OTV m3	CML2-baseline, inverse OTV	
	Hinder t.g.v. geluid door wegtransport	DALY	Müller-Wenk	
	Hinder t.g.v. geluid door productieprocessen	mbp	TWIN	
	Hinder t.g.v. licht	mbp	TWIN	
	Hinder t.g.v. kans op calamiteiten	mbp	TWIN	

Prevention costs to sustainability are the costs of preventive measures that would have to be taken to further reduce current emissions to a sustainable level (NIBE). These are the (theoretical/hypothetical) costs of measures that would still have to be implemented. These costs give an idea of what society would be prepared to pay for reducing the environmental burden to a sustainable level (prevention to sustainability)

Partners

The chain includes the following partners*

- Government
- Contracting authority
- Developer
- Investor
- Contractor
- Architect
- Installation consultant
- Structural consultant
- Engineer
- Building cost consultant
- Landscape architect

* Depending on the type of project or project request, the described chain may contain more or less partners.

4 | Quantifying the emissions

Functional units were used to calculate the shadow price. This means that a life span of 75 years has been considered, so that materials with a life span of 25 or 15 years can still be compared. In addition, a functional unit means that a certain area (1m2) with a certain value (strength) is compared. This choice was made because weight is not always the best unit, as for the same purpose a different amount of concrete or wood should be used. This unit is also explained per type of product in the NIBE database.

A breakdown of greenhouse effect costs and other costs was made for each product for the main building support structure (Appendix 1.1). Here it can be seen that the greenhouse effect costs (Br) have an average share of 61% of the total shadow price. The factor NIBE uses for these costs is € 0.05 / kg CO_2 eq. This allows us to look at the difference in CO_2 emissions per functional unit.

With this knowledge, the difference in CO_2 emissions between different designs can be examined. When the used products and quantities are described, it is possible to calculate the difference in emissions. In this way VenhoevenCS can demonstrate that the design based on shadow pricing is a more sustainable choice than the design based on purchase costs. The table below is based on the product groups in Appendix 1.1. Here a comparison was made between the best and worst choice in greenhouse gas costs. The cost of greenhouse gases is 45% higher in the best case scenario and 1100% higher in the worst case scenario.

Components main building support structure	Difference best vs. worst choice
28 – Main building support structure, 8 layers, office construction, template 5.4m	100%
28 – Main building support structure, 3 layers, office construction, template 5.4m	104%
28 – Main building support structure, 7 layers, apartment construction, template 5.4m	45%
16 – Pile foundations	82%
21 – External walls, facade, insulation Rc 4,5	400%
21 – Exterior cavity wall	1100%
23 - Storey, span 5.4m	191%

5 | Opportunities for improvement and goals

The application of shadow pricing in designs and recommendations to the client is used in a few cases. Through frequent use in the coming years, things will undoubtedly come up that can be improved. In addition, VenhoevenCS intends to apply the advice on a broader scale.

Broader advice

The development of designs with shadow pricing is mainly related to the components that are included in the calculation. Currently the focus is mainly on the main building support structure because this is where most CO_2 is emitted. It is expected that other components such as roofing and walls can also be included in this calculation in the future. Matters such as furnishings and installations appear to be a more difficult component. It is not yet clear whether complete projects can be delivered in a few years' time that have been designed on the basis of shadow pricing.

Increase use

In the future, VenhoevenCS wants to make these calculations more often and offer them to the client. In order to increase the impact, the goal is to eventually offer as many recommendations as possible that show the shadow price. This will enable the client to make a conscious choice with regard to sustainability.

Goal

The goal is:

By 2025, VenhoevenCS wants to add a paragraph in the design for 90% of the projects* with the shadow price of at least 3 primary building elements and an explanation of the possible reduction.**

The goal is to show clients what sustainable design versus conventional design can save in construction. By 2022, it will be applied in 50% of the projects, starting with the main building support structure.

*Only for Dutch projects for building designs (no urban designs)
* *Construction, floors, walls, roofs, foundation, installations, finishes, etc.

6 | Acknowledgement of Sources

Source	Reference
Handboek CO_2-prestatieladder 3.0, 10 juni 2015	*Stichting Klimaatvriendelijk Aanbesteden & Ondernemen*
Corporate Accounting & Reporting standard	*GHG-protocol, 2004*
Corporate Value Chain (Scope 3) Accounting and Reporting Standard	*GHG-protocol, 2010a*
Product Accounting & Reporting Standard	*GHG-protocol, 2010b*
Nederlandse norm Environmental management – Life Cycle assessment – Requirements and guidelines	*NEN-EN-ISO 14044*
www.nibe.info	NIBE database
Tackling embodied carbon in buildings	UK Green Building Council

The structure of this document is based on the Corporate Value Chain (Scope 3) Standard. In addition, the methodology of the Product Accounting & Reporting Standard was used (see table below).

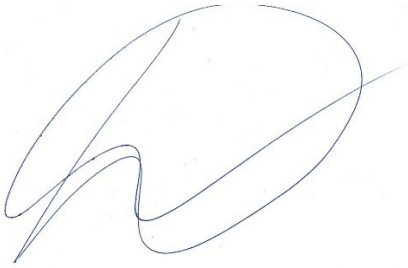
Corporate Value Chain (Scope 3) Standard	Product Accounting & Reporting Standard	Chain Analysis:
H3. Business goals & Inventory design	*H3. Business Goals*	*Chapter 1*
H4. Overview of Scope 3 emissions	*-*	*Chapter 2*
H5. Setting the Boundary	*H7. Boundary Setting*	*Chapter 3*
H6. Collecting Data	*H9. Collecting Data & Assessing Data Quality*	*Chapter 4*
H7. Allocating Emissions	*H8. Allocation*	*Chapter 2*
H8. Accounting for Supplier Emissions	*-*	*Part of the implementation*
H9. Setting a reduction target	*-*	*Chapter 5*

7 | Declaration of chain analysis

De Duurzame Adviseurs has extensive experience in drawing up chain analyses, and is therefore considered a professionally recognized knowledge institute. See also the Declaration of Expertise (included with the chain analysis or available on request separately). This decleration states which chain analyses have been drawn up by De Duurzame Adviseurs, along with the subject, the client, the date and the certifying organization that approved the chain analysis. It also describes which advisers work for De Duurzame Adviseurs, and what their level of knowledge and education is.

This chain analysis has been drawn up by Daan Meily. The chain analysis has also been checked according to the four-eyes principle by Simone Barents. Simone has not been involved in the preparation of the CO_2 reduction policy of VenhoevenCS. During this assessment it was determined that the used scope, data and calculations are correctly reflected in the current report. No deviations were found regarding completeness, independence and expertise of the analysis.

Signed for agreement:

	
28-02-2020 *Daan Meily*	**28-02-2020** Simone Barents

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Signing

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Appendix 1 *List of Material Shadow Costs*

The tables below show the materials that can be used in the main building support structure (in functional units). Next to the shadow price is a row with the total greenhouse costs calculated by NIBE. The last row shows the share of greenhouse gases in the total shadow price. A calculation of these averages indicates that greenhouse costs average 61% of the total.

28 - Hoofddraagconstructie, 8 lagen, constructie kantoor, stramien 5.4m

Product	Milieu klasse	Schaduw kosten	Br	%
Draagconstr. Staal & Houten kanaalplaatvloer	1a	22,28	€ 12,00	54%
Draagconstr. Staal & Prefab betonschil met I-profielen	1b	27,23	€ 17,00	62%
Draagconstr. Staal & Massief houtenvloer	1b	27,42	€ 14,50	53%
Draagconstr. Staal & Breedplaatvloer	1b	27,53	€ 17,50	64%
Draagconstr. Staal & Klimaatvloer	1b	27,83	€ 18,00	65%
Draagconstr. Staal & Kanaalplaatvloer incl druklaag	1b	28,39	€ 18,00	63%
Draagconstr. Beton & Breedplaatvloer	1b	28,98	€ 20,00	69%
Draagconstr. Beton & Klimaatvloer	1b	29,27	€ 20,00	68%
Draagconstr. Beton & Kanaalplaatvloer incl druklaag	1c	29,83	€ 20,50	69%
Draagconstr. Staal & Bollenplaatvloer	1c	30,22	€ 20,00	66%
Draagconstr. Beton & Bollenplaatvloer	1c	31,67	€ 22,00	69%
Draagconstr. Beton & In situ betonvloer	1c	32,11	€ 22,00	69%
Draagconstr. Beton & Airdeck	1c	33,63	€ 24,00	71%

28 - Hoofddraagconstructie, 3 lagen, constructie kantoor, stramien 5.4m

Product	Milieu klasse	Schaduw kosten	Br	
Draagconstr. Staal & Houten kanaalplaatvloer	1a	21,19	€ 11,50	54%
Draagconstr. Staal & Prefab betonschil met I-profielen	1b	25,99	€ 15,50	60%
Draagconstr. Staal & Breedplaatvloer	1b	26,3	€ 16,50	63%
Draagconstr. Staal & Massief houtenvloer	1b	26,33	€ 13,50	51%
Draagconstr. Staal & Klimaatvloer	1b	26,59	€ 17,00	64%
Draagconstr. Staal & Kanaalplaatvloer incl druklaag	1b	27,19	€ 17,50	64%
Draagconstr. Beton & Breedplaatvloer	1c	28,39	€ 19,50	69%
Draagconstr. Beton & Klimaatvloer	1c	28,69	€ 19,75	69%

Draagconstr. Staal & Bollenplaatvloer	1c	28,99	€ 19,00	66%
Draagconstr. Beton & Kanaalplaatvloer incl druklaag	1c	29,29	€ 20,00	68%
Draagconstr. Beton & Bollenplaatvloer	1c	31,08	€ 22,00	71%
Draagconstr. Beton & In situ betonvloer	1c	31,52	€ 21,50	68%
Draagconstr. Beton & Airdeck	1c	33,04	€ 23,50	71%

28 - Hoofddraagconstructie, 7 lagen, constructie appartement, stramien 5.4m

Product	Milieu klasse	Schaduw kosten	Br	
Draagconstr. Staal & Prefab betonschil met I-profielen	1a	17,69	€ 11,00	62%
Draagconstr. Staal & Breedplaatvloer	1a	17,93	€ 11,50	64%
Draagconstr. Staal & Klimaatvloer	1a	18,13	€ 11,50	63%
Draagconstr. Staal & Kanaalplaatvloer	1a	18,5	€ 11,50	62%
Draagconstr. In situ beton & Breedplaatvloer	1a	19,07	€ 13,00	68%
Draagconstr. In situ beton & Klimaatvloer	1a	19,27	€ 13,00	67%
Draagconstr. Prefab beton & Prefab betonschil met I-profielen	1b	20,26	€ 14,00	69%
Draagconstr. Prefab beton & Breedplaatvloer	1b	20,5	€ 14,50	71%
Draagconstr. Prefab beton & Klimaatvloer	1b	20,69	€ 14,50	70%
Draagconstr. Prefab beton & Kanaalplaatvloer	1b	21,06	€ 14,50	69%
Draagconstr. Staal & Appartementenvloer	1b	21,09	€ 13,00	62%
Draagconstr. In situ beton & In situ betonvloer	1b	21,16	€ 14,00	66%
Draagconstr. In situ beton & Appartementenvloer	1b	22,23	€ 15,00	67%
Draagconstr. Prefab beton & Appartementenvloer	1c	23,65	€ 16,00	68%

16 - Funderingspalen

Product	Milieu klasse	Schaduw kosten	Br	
Hout met betonopzetter; rond 230 mm; db	1a	239,7	€ 170,00	71%
Hout met betonopzetter, 180x180 mm; db	1b	265,1	€ 180,00	68%
Beton; Prefab, met EPS element, 250x250mm	1b	272,68	€ 175,00	64%
Beton, schroefpaal, 0% granulaat; rond 300 mm	1b	275,16	€ 160,00	58%
Beton; in 't werk gestort, vibropaal, rond 320mm	1b	314,25	€ 180,00	57%
Beton; Prefab, voorgespannen, 250x250 mm	1c	356,26	€ 225,00	63%
Beton; Prefab, 250x250 mm	2a	402,89	€ 250,00	62%
Hout met betonopzetter; rond 310 mm; db	2a	435,4	€ 295,00	68%

Beton, Energiepaal, 0% granulaat; 290x290 mm	2a	436,56	€ 280,00	64%
Stalen buispaal, 0% granulaat; rond 323.9 mm	2c	553,21	€ 310,00	56%

21 - Buitenwanden, buitengevel dragend, isolatie Rc 4,5

Product	Milieu klasse	Schaduw kosten	Br	
Strobalen dragend, OSB beplating, leemstuc (binnen afwerking), buitenafwerking kalkstuc	1a	4,99	€ 3,10	62%
Constructief element o.b.v. PUR en OSB - Metselwerk buitenspouwblad	1c	7,03	€ 4,00	57%
Kalkzandsteenmetselwerk - Glaswol - Baksteenmetselwerk	1c	7,71	€ 4,15	54%
HSB (Multiplex, stijlen en gipsplaat) - baksteen metselwerk	2a	8,22	€ 4,00	49%
Leemsteen- steenwol - Holle baksteen	2a	8,46	€ 3,90	46%
HSB (Multiplex, stijlen en gipsplaat) met extra isolatieplaat - baksteen metselwerk	2a	9,05	€ 4,20	46%
Cellenbeton met EPS - baksteen metselwerk	2b	10,19	€ 6,10	60%
Beton; gewapend - Glaswol - Betonsteen metselwerk	2c	12,27	€ 6,20	51%
Cellenbeton massieve bouwblokken - baksteen metselwerk	2c	12,69	€ 8,00	63%
Beton; gewapend - Schapenwol - baksteen metselwerk	5a	42,24	€ 15,50	37%

21 - Buitenspouwblad

Product	Milieu klasse	Schaduw kosten	Br	
Betonsteenmetselwerk; 200x70x50	1a	2,36	€ 1,25	53%
Baksteenmetselwerk; 150x70x30	1b	2,64	€ 1,50	57%
Kalkzandsteenmetselwerk; 210x100x50; gehydrofobeerd	1b	2,76	€ 1,70	62%
Holle baksteenmetselwerk; 250x120x60; 45% geperforeerd	1b	2,76	€ 1,55	56%
Baksteenmetselwerk; 180x85x45	1c	3,18	€ 1,75	55%
Betonsteenmetselwerk; 210x100x50	1c	3,2	€ 1,70	53%
Baksteenmetselwerk; 210x100x50	1c	3,72	€ 2,10	56%
Leemsteenmetselwerk; 295x140x90; incl. pleister afwerking	2b	4,57	€ 2,80	61%
Natuursteenmetselwerk; 210x100x50; Uit Europa	4c	16,45	€ 8,00	49%
Natuursteenmetselwerk; 210x100x50; Uit China	6a	34,84	€ 15,00	43%

23 - Verdiepingsvloer, overspanning 5.4m

Product	Milieu klasse	Schaduw kosten	Br	
Houten kanaalplaatvloer (dikte 240 mm)	1a	3,91	€ 1,75	45%
Kanaalplaatvloer excl druklaag (dikte 200 mm)	1b	4,44	€ 2,90	65%
Prefab betonschil met I-profielen (IPE 270 h.o.h. 1200 mm)	1c	5,57	€ 3,20	57%
Cellenbetonvloer	1c	6,13	€ 4,05	66%
Kanaalplaatvloer incl druklaag (dikte 200 mm)	2a	6,35	€ 4,00	63%
Massief houtenvloer (dikte 201 mm)	2a	6,89	€ 3,10	45%
In situ betonvloer (dikte 250 mm)	2a	7,14	€ 4,50	63%
Klimaatvloer (dikte 260 mm)	2a	7,32	€ 4,80	66%
Breedplaatvloer (dikte 200 mm)	2b	8,19	€ 4,90	60%
Bollenplaatvloer (dikte 230 mm)	2b	8,28	€ 5,00	60%
Cassettevloer (dikte 220 mm)	2b	8,31	€ 5,00	60%
Keramische vloer	2c	10,55	€ 5,10	48%

Appendix 2 *Evaluation 2023*

Evaluation

The QHSE manager organized several sessions to evaluate the *Environmental Impact Tool* and the goals of the chain analysis. Formal and informal meetings were held with management, with QHSE team members, with individual employees and with the whole office as part of the plenary office meetings.

A recap of the issues:

- *Environmental Impact Tool* development has taken much longer than anticipated.
- The tool currently still only functions for regular span column and beam structures (such as office buildings), and not yet sufficiently for large span structures (i.e. pools) and wall-based structures (i.e. housing) which make up a large part of the VenhoevenCS portfolio. The implementation of these additional capabilities will require a significant input from the structural engineer with whom we partnered.
- Our structural engineer partner in the development of the *Environmental Impact Tool* has decided to stop investing time and money into the project.
- The internal expert on the tool has left VenhoevenCS.
- VenhoevenCS has reached the limits of its knowledge (and core activities) regarding the development of the tool: the tool should ideally be sold to a party that can develop the software.
- The economic situation and forecast in 2023-2024 is not very bright for the field of architecture: further investment in the tool right now is therefore not opportune.
- The tool is connected to the NIBE, which is a Dutch database. The tool is therefore less useful in international projects.
- Use of the tool is not secured in the primary process.
- There is no central registration: how does QHSE team know how many projects have used the tool?
- There is no registration of outcome of the tool: was clients decision influenced by the tool?
- The tool is difficult to use, because it is linked to parametric design.
- Some employees feel the tool *can* be used, because the aim is not so much CO2 reductions in absolute numbers, but to confront ourselves, our clients and our project partners with the CO_2 emission impact of the choices we make.

Conclusion

We will stop further development of the tool, because we lack expertise (now that our structural engineer partners has dropped out) and capital at the moment. This means that part of the goal set in 2020 will not be met:

By 2025, VenhoevenCS wants to add a paragraph in the design for 90% of the projects* with the shadow price of at least **3 primary building elements** and an explanation of the possible reduction.

To compensate for the reduction of building elements from 3 to 1, we will expand the type of projects in which we will use the tool.

In short: we will use the tool in 2023, 2024 and 2025 and have set new goals for those years.

We will also have a closer look at our research projects: some of them are directly connected to CO_2 reduction, and can therefore be registered as a Chain Analysis.

There are many external development at the moment, such as the implementation of the CSRD / ESRS, the upcoming launch of Handbook 4.0 by the CO_2 performance ladder and the development of GWP (Global Warming Potential) with a standard measuring unit of kg CO_2 equivalent/ m^2. We will keep track of these developments: we will adjust, revise or completely renew the chain analysis accordingly.

New goals

To create impact awareness of the CO_2 emission impact among ourselves, our clients and our project partners, we will use the *Environmental Impact Tool* in at least

- 75% of new Dutch architecture projects in 2023
- 50% of all new architecture projects in 2024
- 75% of all architecture projects in 2025

We will use it in all architecture projects, not in consultancy, studies or urban planning.
We will use it in all category of projects, including complex sports and mixed-use buildings.

<u>2023</u>
The type of projects is the same as in 2022: newly acquired projects in The Netherlands.
These are basically Dutch tender and SO projects.
The increase of the goal is from 50% in 2022 to 75% in 2023.

We will do that by:

- Securing the tool in the Dutch primary process.
- Organise a plenary session for projectleaders of Dutch architecture projects
    - All projectleaders of Dutch architecture projects know how to use the tool
    - All projectleaders know where to save the results
    - QHSE manager is present to collect all data for central registration

2024
From 2024 we will use it not only in Dutch projects, but in international projects as well.

We will do that by:

- Securing the tool in the International primary process.
- Organise a plenary session for project leaders of all architecture projects

2025
From 2025 we will start using the tool not only in the tender phase: the tool can also be useful in later phases (all phases before building permit).

Chain Analysis in 2023-2024: Climate-neutral train stations

Bureau Spoorbouwmeester is an independent advisory body for design and design assignments within the rail sector. It is an initiative by Prorail (national railway network) and NS (train operator).
Just like everything that is built, stations and station areas will have to be built Paris-proof in the short term; that is to say with a strict CO2 budget and without compensation/settlement of, for example, energy generation or reduction of car mobility.

There is currently no set of instruments for this; a project leader at ProRail simply cannot yet steer on CO2 emissions, even if he/she wanted to.

Bureau Spoorbouwmeester has commissioned VenhoevenCS to set up, validate and test the instruments and visualize the consequences when CO2 becomes a measurable criterion within the total palette of considerations involved in station developments.

The set of instruments VenhoevenCS will develop, will significantly reduce CO2 emissions in the future. An update on specific results will be known in 2024.
[Project start up to be initiated as of yet]

Chain Analysis in 2022-2025: NEB-LAB

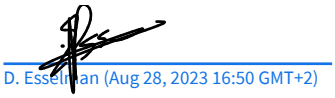
VenhoevenCS has partnered in a large and comprehensive Erasmus research ECO_2-SCHOOLS as New European Bauhaus (NEB) Labs. Other team members are

- Ellinogermaniki Agogi (Greece)
- Alliance Sens & Economie (France)
- Sigtunaskolan Humanistiska Laroverket (Sweden)
- Ciencia Viva (Portugal)
- University College Cork (Ireland)
- University of Bayreuth (Germany)
- Goodplanet (Belgium)

- Cergy Paris Universite (France)
- An Taisce – the National Trust for Ireland, and
- LernLandSchaft (Germany).

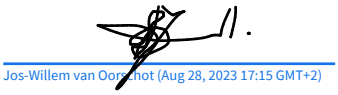
NEB-LAB will provide a Roadmap to zero-energy and energy positive educational buildings and will help lead the way to a fundamental shift from buildings as consumers of energy to buildings as producers of energy. Specific results will be known in 2025-2026.
V:\2022430 NEB-LAB research

Amsterdam 24-08-2023
Reviewed and approved by the board of VenhoevenCS*):



Danny Esselman

Cecilia Gross



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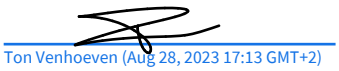
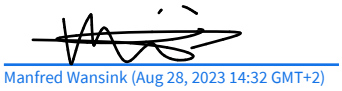


Ton Venhoeven



Manfred Wansink

**) Ton Venhoeven c.s. Architekten B.V. (a.k.a. VenhoevenCS architecture+urbanism), including all its subsidiaries VCS-FR, VCS-BE and VCS-DE.*

2023 Chain analysis VenhoevenCS 2020-2025 - UPDATE

Final Audit Report 2023-08-28

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